**RAiSE CASE STUDY: Moray Family Learning STEM Bags Pilot 2018**

**HGIOS?4 QI 2.5 Family Leaning.** Engaging Families in Learning: Creative approaches are used to engage families.

**STEM self-evaluation and improvement framework: QI 2.5 Family learning.** We consult families to better understand their needs and aspirations in relation to STEM. We are reaching out to parents with STEM jobs to involve them in our STEM planning and activities. We are exploring ways to engage with parents and families more effectively, including with community learning and development (CLD) partners.

**Background Information** - Science Capital Made Clear ([www.enterprisingscience.com](http://www.enterprisingscience.com))

Research evidence shows that the more science capital a young person has, the more likely s/he is to aspire to continue with science post-16 and to see themselves as having a science identity.

Our hope is that building science capital will have a positive effect on young people’s lives – not just in terms of encouraging more young people to continue into science, technology, engineering and mathematics (STEM) jobs, but more importantly, we hope that building science capital is a tool for social justice, to help improve people’s lives and life chances.

**Eight Key dimensions of Science Capital**:

1. Scientific Literacy – Knowledge and Understanding /confidence
2. Science-related attitudes, values and dispositions – relevance of science to real life
3. Knowledge about the transferability of science – skills
4. Science media consumption
5. Participation in out-of-school science learning contexts
6. Family science skills, knowledge and qualifications
7. Knowing people in science-related roles
8. Talking about science in everyday life

**Family Learning - STEM Bags Rationale**

STEM bags will engage parents and children in fun STEM activities that encourage discussion about STEM learning and also help to improve the children’s overall STEM enthusiasm and engagement and ultimately help to raise attainment and achievement and build Science Capital within families.

The available evidence confirms that parental involvement and engagement in children’s learning supports improved attainment and achievement. Family learning encourages family members to learn together, fostering positive attitudes to lifelong learning. We want to improve and increase the ways in which parents, carers and families can engage with teachers and partners to support their children and increase the voice of parents and carers in leading improvements within schools. (National Improvement Framework, 2017, Scot Gov)

**Family Learning - STEM Bags Pilot in Moray**

Three schools – Portessie PS, Findochty PS and St Gerardine PS took part in a STEM Bags Pilot from May 2018 to December 2018. These schools were chosen as they had Family Learning on their School Improvement Plans and were keen to help develop the programme for Moray.

Through RAiSE funding each school was given 50 STEM Bags covering 5 different STEM Experiments and a selection of STEM Home Learning Books for the school library.

The total cost of the Pilot was £885 - £295 in each school (this includes the printed STEM Moray Bags) – see Appendix 2 for breakdown of costs.

Each bag had the kit required for the experiment; a rationale explaining the STEM Bags pilot; an experiment sheet for parents with instructions, background information and links to websites with more ideas and a jotter to record pupils learning.

**Focus Groups with pupils, parents and teachers conducted in November/December 2018** – see Appendix 1 for collated responses

**Focus Group Questions:**

Where question has a scale 1-10:

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
|  | Not good at all |  |  |  | Not good or bad |  |  |  |  | Really Good |

**Pupil Questions:**

Before STEM Bags introduced:

1. How did you feel about your learning in Science/STEM Scale 1-10
2. How do you feel about Science/STEM as a future job? Scale 1-10

Process/Product:

1. What did you like about the STEM Bags?
2. Who did the experiments with you?
3. Were the experiment instructions clear?
4. What did you use the jotter for/did you use it?
5. What STEM Bag experiments would you like to see next?

Impact:

1. Did the STEM Bags help you enjoy STEM/Science more? Y/N
2. How did you feel about your learning in Science/STEM? Scale 1-10
3. How do you feel about Science/STEM as a future job? Scale 1-10

**Parent Questions:**

Before STEM Bags introduced:

1. Please describe your own experiences with Science/STEM.
2. Has your child shown an interest in Science/STEM previously?
3. Follow up: Tell me a bit more about this.
4. Have you ever taken your child to a Science Centre/museum? Y/N
5. Have you watched science programmes together (give examples) or read science books? Y/N
6. Have you ever discussed Science/STEM as a future career choice with your child? Y/N
7. Follow up: How does your child feel about Science/STEM as a future job? Scale 1-10

Process/Product:

1. What did you like about the STEM Bags?
2. Were the experiment instructions clear?
3. What did you use the jotter for/did you use it?
4. What STEM Bag experiments would you like to see next?

Impact:

1. Has your child shown an increased interest in Science/STEM since using the STEM Bags?
2. Follow up: Tell me a bit more about this.
3. Have the STEM Bags helped you talk to your child about their learning? Scale 1-10

**Teacher Questions:**

Before STEM Bags introduced:

1. Describe your pupil’s attitudes towards Science/STEM prior to the STEM Bags Pilot.
2. How many of your pupils showed an interest in Science/STEM jobs?
3. Please describe the parental engagement/involvement interventions within your school.

Process/Product:

1. What did you like about the STEM bags?
2. How did you find the process of loaning out the bags to pupils?
3. Follow up: What could be done to make this process easier?
4. What improvements would you suggest to the STEM Bags as a learning tool?

Impact:

1. Please describe the impact of the STEM Bags Pilot on pupils in terms of their interest/enthusiasm for Science/STEM? Scale 1-10
2. Please describe the impact of the STEM Bags Pilot on Parental Engagement/involvement in your school? Scale 1-10
3. Will you continue to use the STEM bags with your pupils?
4. Follow up: What would make you want to continue to use them?

**Evaluation of Results from Focus Group Questions**

**Focus Group Questions: Pupils**

Prior to the STEM Bags Pilot; pupils were generally positive about their STEM learning though this varied on the scale form 4-10 and depended on the particular Science context. Although some had thought about STEM as a job this did seem to depend on who they knew and in particular having a family member in a STEM career was a positive influence (as discussed by Archer et al in the Aspires Report).

When it came to the STEM Bags pupils were very enthusiastic describing their favourite experiment and all enjoyed the hands on practical element with one comment that it’s “like being a scientist in training”. The majority of pupils did the experiments with their mum though there was evidence that dad was sometimes involved if they had the bag over a weekend. Pupils with younger children particularly commented on enjoying leading them with the experiments. All pupils used the jotter to record findings; some adding pictures to show their learning.

All pupils said that the STEM Bags had impacted positivity on their feelings about STEM learning with the majority giving a high score of 10. It had not influenced their career choices; however so perhaps adding in links to careers would be helpful to help them explore this further.

**Focus Group Questions: Parents – Please note – only two parents took part in the focus groups.**

Parental experience varied - both had taken science at school with one in a STEM job now. Both parents said their children had shown some interest in STEM previously and in particular mentioned STEM Weeks in school. They had watched science programmes but not been to a Science Museum – closest one is in Aberdeen. Neither parent had discussed STEM as a career choice with their child but after this pilot had realised the importance of doing so.

When it came to the STEM Bags parents liked that all the materials were in the bag, that they came with instructions and that pupils were encouraged to record their experiments in a jotter. This gave them opportunity to discuss their learning including spelling, following instructions carefully and evaluating results.

Post pilot; one parent commented that their child was “more interested when they see it (Science) on TV/will comment and discuss more”. Parents suggested leaving the STEM Bags home over a weekend to give longer for whole family to try out.

**Focus Group Questions: Teachers**

Prior to the STEM Bags Pilot; teachers noted that pupils were positive about STEM and in particular enjoy STEM Week but also that STEM was becoming an important part of their curriculum. They had not discussed STEM as a career choice with pupils and did not know how many of them wanted to pursue a career in a STEM field. There were many different methods of parental engagement discussed including open afternoons/shared learning; packs and booklets for literacy/numeracy and reporting. There was also mention of making use of family talents in music and sport as well as family competitions.

When it came to the STEM Bags teachers also liked that all the materials were in the bag, that they came with instructions and that pupils were encouraged to record their experiments in a jotter. Pupils could speak about their STEM Bag experiments and were “happy to share their learning and were enthusiastic/motivated by STEM Bags”. Some issues emerged around protocols for lending the bags and it was clear that schools needed to give clear guidelines on loan time, returns and checking contents and suggestions about targeting specific pupils as a PEF intervention. In addition adding a strategy/letter about How to encourage your children with STEM Learning would be welcomed. Both schools said they would keep using the format as it worked well and suggested a teacher CLPL on Science Capital and the STEM Bags as a small part of this would also be welcomed.

**Conclusion**

Overall findings from the Family Learning - STEM Bags Pilot showed that this made a positive impact on the pupils enthusiasm for practical/experiential STEM learning and provided an opportunity for parents and pupils to discuss their learning in a focused manner.

**Key messages for trying this out:**

* Having kit/instructions are helpful. Added links to other sites might be better on a school website (see Appendix 5)
* Keep it practical and give a jotter to record findings with ideas of how to go about this inside the jotter
* Have a cover letter to help parents understand the importance of STEM and how to discuss it with their children prior to the STEM Bags being handed out and in addition to the Rationale in the Bag
* Teacher CLPL on Science Capital Teaching Approaches would be helpful
* Have a clear protocol for lending and give weekend time to encourage whole family to take part
* Maintaining the kit requires time and needs to be part of pupil classroom jobs

**Ideas for other Bags (selected from those by pupils):**

* Volcano set
* Rockets – pump for air rockets
* Fingerprints
* Building/Fixing Challenges – Tinkering
* Engineering Challenges

**References/Further Reading**

* Aspires: Young people’s science and career aspirations, age 10 –14 The ASPIRES research team is: Professor Louise Archer (Director), Professor Jonathan Osborne (Co-investigator), Dr. Jennifer DeWitt (ASPIRES Research Fellow), Professor Justin Dillon (ASPIRES Intervention), Dr. Billy Wong (ASPIRES studentship) and Mrs Beatrice Willis (ASPIRES Administrative Officer).
* Louise Archer, Emily Dawson, Jennifer DeWitt, Amy Seakins, and Billy Wong (2015) ‘‘Science Capital’’:A Conceptual, Methodological, and Empirical Argument for Extending Bourdieusian Notions of Capital Beyond the Arts - Journal of Research in Science Teaching VOL. 52, NO. 7, PP. 922–948
* Professor Louise Archer ‘Science is not for me’: understanding young people’s non-participation in STEM Presentation to ASDC Annual Conference, 24th September 2014
* King’s College London team: Louise Archer, Emily Dawson, Jennifer DeWitt, Spela Godec, Heather King, Ada Mau, Effrosyni Nomikou and Amy Seakins. Science capital made clear [www.enterprisingscience.com](http://www.enterprisingscience.com)
* Godec, S., King, H. & Archer, L. (2017) The Science Capital Teaching Approach: engaging students with science, promoting social justice. London: University College London.
* <https://education.gov.scot/parentzone/Documents/IamaScientistMar16.pdf> Let’s explore science together! Has a number of science ideas for children & parents to try out at home.
* <https://education.gov.scot/parentzone/Documents/IAmAMathematician270417.pdf> is a Maths resource for families to learn together

**Appendix 1: Collated responses to Focus Groups Conducted in November/December 2018**

**Focus Group Questions: Pupils** *St Gs – P5 - 10 pupils Portessie – Group 1 – 4 P4, Group 2 – 4 P5*

**Before STEM Bags introduced:**

1. How did you feel about your learning in Science/STEM Scale 1-10

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
|  | Not good at all |  |  |  | Not good or bad |  |  |  |  | Really Good |
|  |  |  |  | 2 | 1 | 1 | 2 | 4 | 3 | 5 |

Comments:

* Depends on what we are doing – I like Electricity in particular
* Some comments that they did not feel that they did much Science
1. How do you feel about Science/STEM as a future job? Scale 1-10

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
|  | Not good at all |  |  |  | Not good or bad |  |  |  |  | Really Good |
|  | 1 | 3 | 2 |  | 1 | 1 | 3 | 1 | 3 | 1 |

Comments:

* One really did not know!
* Future jobs – footballer (2), Orthopaedic surgeon (one in family), Surgeon, Sport, Swimmer/Marine Biologist, Shop owner/design clothes, medicine
* One pupil said her Auntie is a scientist and she would like to be too.
* Younger pupils (P4) had not really thought about this

Process/Product:

|  |  |
| --- | --- |
| 3. What did you like about the STEM Bags? | * Fun/Good – a fun homework, exiting to do something new. Improved confidence at trying things
* Liked the experiments – in particular the film canister one
* Experiments were different and not all worked as expected
* All the stuff you needed was in bag
* Really liked the cloud in a jar – parents did too as they did not expect it.
* Good for kids to find out what it is like being a scientist – like being a scientist in training
 |
| 4. Who did the experiments with you? | * On Own – 1
* Mum – 11
* Dad - 6
* One said both mum/dad
* Granny
* Brothers and Sisters – they liked leading the learning with the feely bags for younger siblings
* Friends
 |
| 5. Were the experiment instructions clear? | * Yes with one noting that mum read them
* Did not use links
 |
| 6. What did you use the jotter for/did you use it? | * Explained how experiment worked – what happened/how it looked
* Said if they enjoyed it
* Drew picture of experiment
* Yes – asked to write what they liked and take pictures/draw experiments
 |
| 7. What STEM Bag experiments would you like to see next? | * Slime
* Coke/Mentos
* Volcano set
* Rockets – pump for air rockets
* Anything that changes colour
* Fingerprints
* Building/Fixing Challenges – Tinkering
* Make rocket shoes
 |

Impact:

1. Did the STEM Bags help you enjoy STEM/Science more?

|  |  |
| --- | --- |
| Yes | No |
| 18 | 2 – one said they only like Space part of Science and other said they enjoyed as much as they had before |

1. How did you feel about your learning in Science/STEM? Scale 1-10

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
|  | Not good at all |  |  |  | Not good or bad |  |  |  |  | Really Good |
|  |  |  |  |  |  |  | 1 | 1 | 4 | 11 |

Comments:

1. How do you feel about Science/STEM as a future job? Scale 1-10

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
|  | Not good at all |  |  |  | Not good or bad |  |  |  |  | Really Good |
|  |  |  |  |  |  |  |  |  |  |  |

Comments: Generally sticking to same jobs/same as before

**Focus Group Questions: Parents – 1 parent plus letters**

Before STEM Bags introduced:

1. Please describe your own experiences with Science/STEM.

|  |  |  |
| --- | --- | --- |
| School? | Work? | Interest? |
| In school – dropped PhysicsDid BSc (Hons) TextilesDid it in High School | Scientific Support Officer in Police – stopped when she had children. Now finding through STEM bags that discussing this role more.Not in STEM job | Have not visited a science museum in a long time but would consider . |

1. Has your child shown an interest in Science/STEM previously?

|  |  |
| --- | --- |
| Yes | No |
| Both parents said that their children had shown and interest previously  |  |

1. Follow up: Tell me a bit more about this. Science week a big favourite at school. Child very excited about STEM Bags

Had Science Kits to play with at home

1. Have you ever taken your child to a Science Centre/museum? Y/N

|  |  |
| --- | --- |
| Yes | No |
| Science Fair at Moray College UHI | Other was no |

1. Have you watched science programmes together (give examples) or read science books? Y/N

|  |  |
| --- | --- |
| Yes | No |
| Both Yes – Planet Earth etc; Carol Vorderman Science Book and anything about Space |  |

1. Have you ever discussed Science/STEM as a future career choice with your child? Y/N

|  |  |
| --- | --- |
| Yes | No |
|  | Not previously but thinking about this nowNot yet |

1. Follow up: How does your child feel about Science/STEM as a future job? Scale 1-10

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
|  | Not good at all |  |  |  | Not good or bad |  |  |  |  | Really Good |
|  |  |  |  |  | I |  |  |  |  |  |

Comments: Does not really speak about this with P5 child who experienced STEM Bags, P7 child wants to be a teacher or farmer

Does not really speak about this although Grandfather is an engineer and may have spoken with child about this.

Process/Product:

|  |  |
| --- | --- |
| 8. What did you like about the STEM Bags? | * All materials in bag for experiment
* Seemed more interesting that regular homework
* Like the practical element
* Messier but better for kids
 |
| 9. Were the experiment instructions clear? | * Yes – they could do things themselves without much help
* Did not use links but suggested having them electronically on school website may be easier
 |
| 10. What did you use the jotter for/did you use it? | Wrote down results/took pictures  |
| 11. What STEM Bag experiments would you like to see next? | * Using recyclables
* Something to do with the environment
 |

Impact:

1. Has your child shown an increased interest in Science/STEM since using the STEM Bags?

|  |  |
| --- | --- |
| Yes | No |
| Other said yes | Does not tend to communicate this with mum! |

1. Follow up: Tell me a bit more about this.
* More interested when they see it on TV/will comment and discuss more
* Interested in clouds and weather after cloud in a jar experiment
1. Have the STEM Bags helped you talk to your child about their learning? Scale 1-10

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
|  | Not at all |  |  |  | No more than usual |  |  |  |  | Definitely  |
|  |  |  |  |  |  |  |  |  |  | 2 |

Comments:

* Discussed - Following instructions and Evaluation Process. Suggested adding in pointers for evaluating experiments to inside of jotter.
* Maybe having some tick box versions for those that don’t like to write much
* Helped with spelling
* Good to see what he is capable of in terms of practical work

General Comments:

We love getting the STEM bags home! Robyn thinks they are amazing.  She gets dead excited about organising everything.  She loves to involve her wee brother as she then gets to be the proper scientist.  It’s really encouraged her to ask questions and be more interested

Maybe leave the bags with pupils for two weeks (over a weekend) to make it easier to get whole family involved.

**Focus Group Questions: Teachers – In both schools the Head Teacher took charge of the STEM Bags**

Before STEM Bags introduced:

1. Describe your pupil’s attitudes towards Science/STEM prior to the STEM Bags Pilot.

Generally very positive

Do lots of Science/STEM in school – important part of curriculum and also have STEM Week and STEM Clubs

Pupils find it exciting – quite often done as part of vertical learning groups

1. How many of your pupils showed an interest in Science/STEM jobs?

Not really asked about this; however they do have a careers morning and RAF STEM in the Workplace event for P6

Related it to jobs as pupils are interested

1. Please describe the parental engagement/involvement interventions within your school.
* Shared learning – mainly P1 and nursery where parents can come into lessons
* Open afternoons - whole school
* Parents invited in over a week – focus on skills this year
* Booklet re maths strategies and Number Notion packs go to all parents and all classes run workshops on these
* Nursery packs for Literacy
* Reporting – weekly logs of what class have been doing and 1 comment per curricular area each time
* Some parents are Ambassadors for Careers
* Make use of parental talents in music and sport in school
* Family Competition – Doric Poetry
* Parents welcomed in to special events – St Andrews Day, Church services etc

Process/Product:

1. What did you like about the STEM bags?
* Everything in them
* Attractive for the children
* Explanation of what to do was helpful
* Jotters meant that we could see what the children had done with each STEM Bag
* Pupils could speak about it as they had experienced practical themselves
* Pupils were happy to share their learning and were enthusiastic/motivated by STEM Bags
1. How did you find the process of loaning out the bags to pupils?

|  |  |  |
| --- | --- | --- |
| Good | OK | Tricky |
|  | Other OK but issues on returning on time | Bit time consuming but this is due to the way I handed them out. |

1. Follow up: What could be done to make this process easier?
* Do class at a time rather than whole year group
* Give all children one rather than an ad hoc choice to take one
* Checking contents – do this with pupils using kit list. Have a hand over time. Biggest future issue – checking contents and replacing materials
* Some things heavy – vinegar/salt. May need to consider packaging of these
1. What improvements would you suggest to the STEM Bags as a learning tool?
* Set clear guidelines about bringing them back
* Have a cover letter in the jotter – How to encourage your children with STEM Learning
* Format works well – the senses one maybe a touch too easy

Impact:

1. Please describe the impact of the STEM Bags Pilot on pupils in terms of their interest/enthusiasm for Science/STEM? Scale 1-10

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
|  | Negative Impact |  |  |  | No impact |  |  |  |  | Positive Impact  |
|  |  |  |  |  |  |  |  | 2 |  |  |

Comments:

Interested pupils enjoyed them as part of their overall STEM learning

Some were already interested and some now want to find out more – overall positive

1. Please describe the impact of the STEM Bags Pilot on Parental Engagement/involvement in your school? Scale 1-10

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
|  | Negative Impact |  |  |  | No impact |  |  |  |  | Positive Impact  |
|  |  |  |  |  | 1 |  |  | 1 |  |  |

Comments:

One school felt that the impact was variable – as they were not handed out to all pupils, it was noted that children whose parents don’t engage did not take one. They need to be directed to those children in future.

Other school felt it was a good way to engage families that work and cannot come In to experience lessons

1. Will you continue to use the STEM bags with your pupils?

|  |  |
| --- | --- |
| Yes | No |
| Both said yes |  |

1. Follow up: What would make you want to continue to use them?
* List of where to get replacement stock would be helpful
* Teacher CPD – to help class teachers understand the programme

**Appendix 2: Break down of Costs for STEM Bag Pilot**

|  |
| --- |
| STEM Bags KIT LIST Calculator |
|
| Notes: Most consumables bought in ASDA - other supermarkets available! Film Canisters acquired from contact at LifeScan, however they are available from EBay/Amazon or Photography Clubs |
| Number of Bags - 10 of each type | TOTAL = 50 bags |   |
| Item Name | Quantity Required | Pack Size | Packs Required | Code | Price (per pack) | Item Total\*\* |
| Salt | 10 | 1 | 10 |   |  £ 0.27  |  £ 2.70  |
| Vinegar | 20 | 1 | 20 |   |  £ 0.39  |  £ 7.80  |
| Bicarbonate of Soda | 10 | 1 | 10 |   |  £ 0.69  |  £ 6.90  |
| Rubber Gloves | 20 | 100 | 1 |   |  £ 2.00  |  £ 2.00  |
| Shaving Foam (NOT GEL) | 10 | 1 | 10 |   |  £ 1.25  |  £ 12.50  |
| Gel Food Colouring | 20 | 1 | 20 |   |  £ 0.90  |  £ 18.00  |
| Effervescent Vitamin C | 10 | 1 | 10 |   |  £ 1.00  |  £ 10.00  |
| Blu-Tac | 10 | 1 | 10 |   |  £ 1.00  |  £ 10.00  |
| Flim Canisters | 20 | 100 | 1 |   |   |  £ -  |
| Jotters | 30 | 100 | 1 | Findel HE11411493 |  £ 10.31  |  £ 10.31  |
| Pipette Droppers | 20 | 10 | 2 | Findel HE1002843 |  £ 1.49  |  £ 2.98  |
| Spoon | 10 | 20 | 1 |   |  £ 1.25  |  £ 1.25  |
| Ball | 10 | 100 | 1 |   |  £ 6.00  |  £ 6.00  |
| Sponge | 10 | 3 | 4 |   |  £ 1.00  |  £ 4.00  |
| Block/letters | 10 | 23 | 1 |   |  £ 5.00  |  £ 5.00  |
| Crayon | 10 | 30 | 1 |   |  £ 3.00  |  £ 3.00  |
| Safety Goggles | 10 | 10 | 1 | Findel HE 1522516 |  £ 27.99  |  £ 27.99  |
|   |   |   |   |   |   |  £ 130.43  |
| Bicarbonate of Soda 500g (alternative) | 10 | 1 | 10 | Findel B8F79579 |  £ 2.50  |  £ 25.00  |
|   |   |   |   |   |   |   |
| Drawstring Bags - Purple with STEM logo | 30 | 250 | 1 |   |  £ 300.00  |  £ 300.00  |
|   |   |   |   |   |   |   |
|   |   |   |   |   |   |   |
| Suggested Books (for School library) |   |   |   |   |   |   |
| Home Lab | 1 | 1 | 1 | ISBN: 9780241228449    |  £ 7.79  |  £ 7.79  |
| Do you know about Science? | 1 | 1 | 1 | ISBN: 9780241318690      |  £ 7.79  |  £ 7.79  |
| How to be a scientist | 1 | 1 | 1 | ISBN: 9780241283080      |  £ 7.79  |  £ 7.79  |
| Science Squad | 1 | 1 | 1 | ISBN:  9780241301852     |  £ 6.59  |  £ 6.59  |
| Until I met Dudley | 1 | 1 | 1 | ISBN: 9781847803504     |  £ 4.79  |  £ 4.79  |
|   |   |   |   |   |   |  £ 34.75  |
|   |   |   |   |   |   |   |
| Total Cost of Pilot (3 schools)  |   |   |   |   |   |  £ 884.59  |

**Appendix 3: STEM Bags Kit List**

**Bright as a new penny: First Level**

* Salt
* White vinegar
* Rubber gloves

**Cloud in a Jar: Early to First**

* Large Plastic Jar
* Shaving Cream
* Pipettes
* Gel Food Colouring

**Erupting Apple: Early to First**

* Bicarbonate of Soda
* White Vinegar

**Senses: Early Years**

* Items to fill the feely bag: cup, spoon, ball, block, fruit, sponge, rock, a small bell, cotton ball, pine cone, feather, wood letters or numbers

**Film Canister Rockets: 2nd Level**

* Effervescent Vitamin C
* Blu-Tac
* Film Canisters

**Each bag would also have:**

* Laminated Experiment Sheet
* Laminated Leaflet/Letter
* Jotter to record experiences/feedback
* Label/Number

**Appendix 4: Experiment Sheets**

**Chemistry Cleans Pennies Experiment**

**Supplies Needed:**

* Shallow Container
* A few pennies – the older/dirtier the better
* Table salt
* White Vinegar
* Rubber gloves

**Setting up the Experiment:**

1. Place the pennies in the container.
2. Cover the pennies with salt
3. Pour white vinegar over the pennies
4. Rub the salt and vinegar mix over both sides of the pennies (you might want to wear gloves for this)
5. Take the pennies out and wash off the mixture.

What do you see?

**An additional Experiment:**

What happens if you don’t wash the pennies once you’ve taken them out the salt and vinegar mixture?

1. Leave one penny in the mixture for about an hour
2. Take the penny out and wash off the mixture.

What do you see?

**Key Word(s):** chemical reaction, compound (two or more elements chemically joined make a compound e.g. copper and oxygen make copper oxide)

**How it Works:**

Pennies have a copper coating. Pennies get dull and dirty because the copper in the pennies reacts with oxygen in the air to form copper oxide, a compound.

When you put your pennies in a vinegar and salt mix, the vinegar and salt react together and remove the copper oxide.

If you don't wash the salt and vinegar mix off, a blue-green layer forms on the pennies. The salt and vinegar mix speeds up the reaction between copper and oxygen in the air, forming copper oxide - which is a blue-green colour. Have you seen any building roofs or statues with a blue-green colour? These must be made of copper!

**CfE Links:** Investigative & Inquiry Skills and SCN 2-19a

**Rain Cloud in a Jar Experiment**



**Supplies Needed:**

* A large jar (I used a plastic one like this)
* Shaving cream (not a gel version)
* Gel Food colouring or washable watercolours
* Pipettes or droppers

**Setting Up the Experiment:**

1 .In a small cup, mix the food colouring with some water.

2. Fill the large jar with water until it is about 3/4 full.

3. Place the jar and the cups of coloured water on the table. Place a pipette in each cup of coloured water.

4. Right before your child is ready to do the experiment, spray shaving cream in the large water-filled jar until it sits just above the top of the jar.

5. Pick up some coloured water with a pipette and squirt it on top of the shaving cream cloud. Repeat this step one or two more times, but pay close attention to what is happening below the cloud! The coloured water will begin to seep down through the shaving cream and into the water below. Just like rain!

  

**Key Word(s):** Water Cycle, Condenses/Condensation (water vapour condenses to form liquid water)

**How it Works:**

The shaving cream represents the clouds and the water represents the air. The coloured water represents rain.

As the coloured water saturates the “cloud”, it gets heavy and eventually is so heavy that it can no longer hold the water. It “rains” down into the jar through the “air” in the same way that real rain falls through the air.

In real clouds water vapour condenses as it cools until drops form that are heavy enough to fall as rain.

**CfE Links:** Investigative & Inquiry Skills and SCN1-05a/2-05a

**Erupting Apple Experiment**



**Supplies Needed:**

* apple
* baking soda
* vinegar
* container to catch the fizz
* knife to carve out hole *(for adults to do!)*

**Setting Up the Experiment:**

1. Take the core out of the apple (Adults)
2. Fill the apple with baking soda.
3. Place apple in the middle of a container.
4. Pour the vinegar straight into the apple
5. Observe what happens!
6. Have a chat about what is happening…for example…

The fizzy bubbling action is actually a chemical reaction from the two materials (baking soda and vinegar) mixing.

You can explain that a gas is released called carbon dioxide.

**Key Word(s):** chemical reaction, reactants (what is reacting in the chemical reaction), products (what is made in the chemical reaction)

**How it works:**

Baking soda is the common name for sodium bicarbonate. It is a weak base which means when added to water it will create an alkali solution. Sodium bicarbonate contains the elements sodium, hydrogen, carbon and oxygen.

Vinegar contains ethanoic acid (also known as acetic acid). Ethanoic acid contains the elements carbon, hydrogen and oxygen.

When you add these together a chemical reaction occurs and water, a salt (sodium acetate) and carbon dioxide gas is formed.

It is the release of this carbon dioxide gas through the liquid that causes the fizzing bubbling action!

**CfE Links:** Investigative & Inquiry Skills and SCN 2-19a

**Senses Experiment: Brain Box- Exploring the Sense of TOUCH**

**Supplies needed:**

A pillowcase (or use the STEM Bag)

One long sock

Items to fill the pillowcase (for example, cup, spoon, ball, block, fruit, sponge, rock, a small bell, cotton ball, pine cone, feather, wood letters or numbers)

**Setting up the Experiment:**

1. Put all objects in the case.
2. Ask your child to reach into the pillowcase and try to identify objects.
3. Now try with a sock on their hand – is this harder? Why?
4. See how many items your child can identify with the sock on their hand.
5. Now… Let them see what was inside the box. See how easy it is now when all senses are restored! Is it easier to guess if you can TOUCH and SMELL? Are using all the senses together better than just using one?

**Key Word(s):** five senses (touch, smell, taste, hearing, seeing), nerves (carry information from your sense organs e.g. nose to the brain)

**How it works:**

Touch combined with sight, hearing, and smell is much more effective. It's even tougher to identify objects if you don't have your full sense of touch, like if you have a sock or glove on your hand.

**What is the Sense of Touch?**

Your sense of touch, unlike your other senses is not restricted to any particular part of your body. The sense of touch originates at the bottom-most layer of your skin called the dermis.

Your dermis has millions of tiny nerve endings which relay information about the objects, textures and temperatures that come into contact with your body. It relays this information to your brain in the form of small electrical impulses sent via the spinal cord that tells you whether something is hot, cold, rough, smooth or sticky.

**There are mainly four common receptors sending information to your brain:**

1. Heat 2. Cold 3. Pain 4. Pleasure

Each of these nerve endings are responsible for telling your brain when it is exposed to a particular type of stimulus. Certain parts of your body like the fingertips, lips and face have more nerve endings than the rest of the body, which is why they are more sensitive to touch.

Some parts of body contain more of one type of receptor than the rest. Like your tongue, this has more taste receptors and fewer heat and cold receptors.

**CfE Links:** Investigative & Inquiry Skills and SCN 0-12a/1-12b/2-12b

**Film Canister Rockets Experiment**

(Adapted from SSERC instructions)

**Supplies Needed:**

* Film canister
* Effervescent Vitamin C Tablet
* Blu-tac
* Eye protection

**Setting up the Experiment:** *This experiment should be done outside!*

1. Put on the safety eyewear (even plastic sunglasses would do!)
2. Break a vitamin C tablet into quarters and blu-tac one quarter to the inside of the lid.
3. Fill the film canister about one-third full of water.
4. Attach the lid.
5. Quickly invert the canister and place on a flat surface/the ground and WAIT

**\*\*SAFETY**: Step back at least one metre.\*\*

What happens?

*If it does not work for you*: The tub and lid are the main things to check. Make sure water or gas isn't seeping out. You'll see bubbles on the outside if the lid isn't a good enough seal. Try a different kind of canister if it does leak.

**An additional Experiment:**

You can investigate any change in performance of the rocket (time to lift off or height attained) using smaller or larger bits of vitamin C tablet or by varying the volume or temperature of the water

**Key Word(s):** chemical reaction, force, pressure

**How it Works:**

Rockets, jets and propellers all work by pushing something away in one direction (usually backwards). Doing that gives the craft itself a push in the opposite direction (that'll be forwards).

Here, when the pressure inside the tub is enough to push the lid off, the force of the gas escaping downwards gives the tub a mighty shove upwards.

What generates the pressure? The main ingredients of effervescent vitamin C tablets are citric acid, sodium bicarbonate and calcium carbonate. As the tablets dissolve, the sodium bicarbonate splits apart to form sodium and bicarbonate ions. The bicarbonate ions react with hydrogen ions from the citric acid to form carbon dioxide gas (and water). The carbon dioxide mixes with the air contained in the tub. With more and more gas building up - in a volume that can't increase - the pressure inside the plastic tub rises until…

**CfE Links:** Investigative & Inquiry Skills and SCN 2-19a/2-07a

**Appendix 5: Suggested Links for School Websites or Further Ideas/Information**

* <https://education.gov.scot/parentzone/Documents/IamaScientistMar16.pdf> Let’s explore science together! Has a number of science ideas for children & parents to try out at home.
* <https://education.gov.scot/parentzone/Documents/IAmAMathematician270417.pdf> is a Maths resource for families to learn together
* The Royal Institution ExpeRimental (<http://www.rigb.org/families/experimental/about>) has lots of science videos to help you bring science home with simple and inexpensive experiments.
* The Dad Lab on YouTube (<https://www.youtube.com/channel/UCc_-hy0u9-oKlNdMKHBudcQ>) also has lots of simple experiments to try at home with videos showing you how to do them.
* <https://www.britishscienceweek.org/> has activity packs and citizen science projects with new ones each year for the annual British Science week in March.
* The Five Senses | The Dr. Binocs Show | Educational Videos for Kids can be found on YouTube (<https://www.youtube.com/watch?v=q1xNuU7gaAQ>)
* <https://handsonaswegrow.com/48-sensory-bags-roundup/> has lots of examples of sensory bags that pupils could make for younger children to explore.
* <https://www.natgeokids.com/uk/discover/geography/physical-geography/volcano-facts/> has lots of facts about real volcanos.
* <https://littlebinsforlittlehands.com/chemistry-activities-experiments-kids/> has more chemistry experiments you can try at home.
* <https://www.metoffice.gov.uk/learning/weather-for-kids/clouds> gives you lots of information about clouds - the different types/how they form.
* <https://www.scientificamerican.com/article/shine-bright-like-a-penny/> This article takes the Bright as a New Penny experiment one step further!