



# Engaging younger children with STEM

A practitioner guide for engaging children under  
the age of 7 with science, technology,  
engineering and maths

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# Introduction

This guide is aimed at practitioners considering or planning activities to engage children with STEM activities, to support the inclusion of children younger than seven.

Children under the age of five are underserved in informal Science, Technology, Engineering and Maths (STEM) learning provision<sup>1</sup>. (Informal learning is that which takes place outside of formal education settings, and doesn't necessarily involve conscious or deliberate learning<sup>2,3</sup>). Even in schools, extra-curricular STEM provision, for example that delivered by external institutions such as universities, tends to focus on secondary or older primary school students.



Perceptions of science which conjure up images of laboratories and stereotypical 'scientists'<sup>4</sup> can lead to adults to believe that younger children cannot engage

with STEM activities<sup>5</sup>. However, children aged 7 and under (e.g. in the English [Early Years Foundation Stage](#) and [National Curriculum](#) Key Stage 1, or Welsh [Foundation Phase Framework](#)) are constantly engaging with STEM concepts as they learn about the world around them.

Both parents/carers and children can benefit from participating in STEM activities for younger children<sup>6</sup>. The 'science' involved isn't complicated equipment or laboratory-style demonstrations – it's about exploring, questioning, experimenting and developing ideas.

This is the basis of scientific thinking<sup>5</sup> and can begin at a very early age through sensory play<sup>7</sup> (play which stimulates senses such as sight, hearing, taste, smell or touch).

## 'Understanding the World'

In the [Early Years Foundation Stage](#) (the framework for pre-school learning in England), science-based learning falls within 'Understanding the World'. This is also an underpinning concept of scientific literacy<sup>8</sup>, and can be explored through activities such as:

- Asking how things work
- Investigating using senses
- Exploring environments and living things
- Using materials

## Play-based learning

Play is key in early childhood learning<sup>9</sup>. It is also a great way to engage children with STEM, by integrating STEM concepts and skills into their everyday activities.

Play allows for exploration and experimentation, and for children to satisfy curiosity rather than searching for the 'right answer' (this a constructivist approach to learning, in which children develop their own knowledge rather than passively receiving it)<sup>5</sup>.

Being a familiar activity for both children and their parents/carers,



play can be an easier concept to engage with than 'science'.

# The importance of parents and carers

Getting parents and carers involved in children's learning at pre-school age leads to better results when they get to school; this is even more effective when families are engaged in developing specific knowledge and skills<sup>10</sup>. Parental involvement from an early age, and how adults view their children's abilities, has a significant impact on their future progress in STEM subjects<sup>11,12,13</sup>.

Parents/carers are also the people who decide which activities their children take part in. Are activities suitable? Will their children enjoy them? Can they get to the activities? If the answer to any of these questions is no, it is unlikely that parents/carers will facilitate their children's participation.

## Practicalities

### Location and venue

Accessibility of both locations and venues is important. If families can't reach the place where activities take place, they can't take part in them. Aspects to consider are:

- Can the location be easily reached, including by public transport?
- Is the venue accessible?
- Does it have toilets and baby-changing facilities?
- Is there suitable floor space for play?
- Is there a space where messy activities can take place?
- Is there an activity area placed away from exits that children could access the street through?
- Is the venue somewhere that families with young children will feel comfortable?

## Timing

Think about timing for families with both younger and older children, for example:

- Does your session clash with school run times for older children?
- Does your session coincide with mealtimes, and if so, is it possible for families to eat and feed their children?
- Are you running a set session or a drop-in? What happens if someone is late to a set session – timing around young children can be unpredictable!
- How long is your session? Is there time to do everything? Are families likely to remain engaged for the duration of set sessions?

## Provision

There can be **large differences in levels of development and desires** in very young children – think about whether your provided activities offer engagement for a variety of abilities and requirements.

Depending on your activities, there are various other factors to consider:

- Activities for a **defined age range** only – make sure this is clear in advertising.
- Activities **suitable for babies and toddlers** – ensure that this is clear; some families may assume that these children are too young to participate.
- Sessions that **older children may be present** at (generally, outside of school hours, although some children are home educated) – consider whether they can be engaged too in some way.
- **Certain skills** (e.g. being able to pick up small items) required to participate - ensure that this is clear beforehand.
- **Messy** activities - parents/carers may appreciate a warning to wear old clothes! It's a good idea to have washing facilities available too.

## Engaging parents/carers

**Make your activities relevant** by thinking about what parents/carers might be looking for. Will they see a **benefit** to bringing their children? Will they feel that your activities are **'for them'**?

Once they are through the door, there is **benefit for children in actively engaging parents/carers** with the activities themselves<sup>10</sup>, thereby also **engaging them with their children and their children's learning**<sup>6</sup>.

This can be as simple as involving them in **helping their children to take part in activities**. Parents/carers may lack confidence in their own knowledge in educating their children, and should be supported<sup>14</sup>. Acknowledging that they are the first educators of their children<sup>15</sup> by making them the leaders of their children's play-based science learning and facilitating them to communicate scientific concepts can **improve their confidence in engaging with their child's science learning**<sup>6,16</sup>.

Adults over the age of 19 are also **underserved** for informal science learning<sup>1</sup>, as well as under-fives; involving parents/carers in activities for their young children can address the lack of provision for both groups.

If parents/carers are not actively involved in your session, make sure there is somewhere **comfortable** for them to sit!

The 'science' within this does not have to be the focus of the session or activities, particularly as some adults may be put off by other **perceptions of 'science'**. It can be delivered as embedded learning within the provision. There are many **everyday activities** that can involve science-based learning<sup>17</sup>.

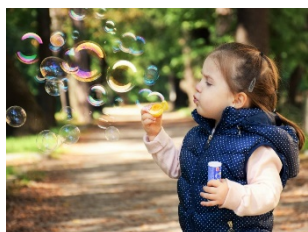
Activities are more likely to both attract and engage participants if they are relevant to both parents/carers and children. Whether or not you aim to actively engage parents/carers in your activities, they are the people who will ultimately decide whether or not their child/ren have the opportunity to participate, so activities should appeal to them (see the box 'Engaging parents/carers').

There are many different approaches and various scientific fields which can be used to engage children in activities; it's not feasible to list them all here. However, there are some general points that are applicable across the wide range of potential content and styles of delivery:

- Sensory activities can be accessed by all ages and by people with varying needs (see the section 'Sensory play').
- Food can be useful as a relevant topic to support engagement, as it is relevant to everyone (but take care to assess risks, e.g. of presence of allergens).
- Nature and the environment are also broadly relevant, as everyone experiences them, as is the human body.
- Using a theme that is currently popular with children – for example, a current children's film – can help to attract them to activities
- Adapting activities for older children to allow younger children to engage can increase participation levels for both younger children and families with older and younger children.

## Sensory play

While by all means not the only way to engage young children with STEM concepts, sensory play offers many opportunities to do so and is a great place to start. Such activities are also likely to be familiar to parents/carers and can therefore be a vehicle for communicating the STEM principles that underpin their everyday activities.



Children will engage differently with sensory experiences at different stages of

development. For example, babies may watch bubbles float and burst, toddlers might chase them and observe how they move, and pre-schoolers might experiment with how they blow the bubbles. This often correlates with the mobility and motor skills the child has, and the level of adult input that they require.

Other ideas for sensory activities include:

- Playing with fabrics and papers of different textures (exploring how they feel and sound when manipulated)
- Playing with light and shadows
- Making or playing with different types of play dough (which can have different textures, malleability, colours and scents, for example)
- Experimenting with types of sound and different volume levels, and ways to create these
- Sensory bottles<sup>18</sup> are an option for allowing young children to explore items they could not otherwise safely handle.

There are many further suggestions and examples of sensory play activities which can be found online.

## Accessibility

As well as accessibility of the location and venue, it's important to consider potential barriers to attendees participating in your activities. For example:

- Have you fully assessed risks that may arise? E.g., children may put materials in their mouths.
- Is it clear what families are supposed to do?
- If activities take place on the floor, can you make provision for attendees for whom this is not suitable?
- Have you considered allergies when selecting your materials and consumables?
- How are you communicating the scientific concepts? Will they be easily understood by non-scientists? Are they inclusive and appealing to non-scientists?
- If you have written or audiovisual materials, are they accessibly formatted?
- Have you considered potential sensory difficulties, e.g. with certain textures, noise levels or lighting?
- Do you want families to replicate activities at home? If so, are the materials readily available and affordable?

## Working with Early Years professionals

When working with Early Years practitioners, many of the same considerations apply as when delivering activities for family-based engagement.

They will need access to suitable facilities and the activities and materials within the provision, and may also need facilitation in order to engage children with science specifically. They should therefore be supported to do so, as with parents/family carers.

# Evaluation

Plan your evaluation before you begin – don't add it as an afterthought or you risk not gaining sufficient or appropriate information for your needs.



It's really important that any evaluation is suitable for your audience<sup>19</sup>. Make sure that however you collect your data, it doesn't detract from your participants' experience and enjoyment of your activity.

- Think about what you want to achieve by running the activity, and how you can find out whether you have done so.
- Will you use one method or mixed methods? Will you need quantitative data, qualitative data, or both? A mixed approach can work well for many activities, but each project will have specific needs.
- Your evaluation might highlight some unexpected outcomes; will you have space to record these?
- Will you collect information from adults, children, or both?
- Can you integrate evaluation data collection into your activities? If not, can you make your data collection fun and creative, particularly if children will be contributing?
- Can you use non-intrusive observations? For example, could you use or adapt a scale of wellbeing to assess enjoyment, or look for Generic Learning Outcomes<sup>20</sup>?
- How extensive does your data collection need to be? Will parents/carers be able and willing to contribute whilst supervising young children?

## Planning checklist

- Are the location and venue easily physically accessible?
- Are the location and venue suitable for families with young children?
- Are the timing and duration of your activities accessible?
- Do the layout and activities provided facilitate interaction and engagement?
- If the aim is to involve parents/carers, do the activities actively involve them?
- Have you considered potential accessibility issues with your activities?
- Are evaluation strategies appropriate?

## Useful resources

Brunton, P. and Thornton, L., 2009. [Science in the Early Years: Building Firm Foundations from Birth to Five](#). Sage Publishing.

Hobbs, L., 2016. [What to do with under 5s this British Science Week?](#) British Science Association.

Hobbs, L., 2016. [Mud, sieves and ice cube trays – messy muddy play for toddlers](#). Geological Society of London.

Science from the Start [Under 5s informal science learning directory](#). List of UK provision.

Science from the Start [sample activities](#) for younger children. Available for non-commercial use.

STEM Learning. [STEM Directory](#). Can be filtered for age 4-5 years.

# References

- <sup>1</sup>Falk et al., 2012. [Analysing the UK Science Education Community: the contribution of informal providers](#). London, UK: Wellcome Trust.
- <sup>2</sup>Lloyd et al., 2012. [Review of Informal Science Learning](#). London, UK: Wellcome Trust.
- <sup>3</sup>Hofstein, A., & Rosenfeld, S. (1996). [Bridging the gap between formal and informal science learning](#). *Studies in Science Education*, 28, 87-112.
- <sup>4</sup>Castell, S., Charlton, A., Clemence, M., Pettigrew, N., Pope, S., Quigley, A., et al., 2014. [Public Attitudes to Science 2014: Main report](#). London, England: Department for Business, Innovation and Skills and IPSOS MORI Social Research Institute.
- <sup>5</sup>Wilson, R., 2008. [Promoting the Development of Scientific Thinking](#). *Early Childhood News*, online.
- <sup>6</sup>Hobbs, L.K., 2015. [Play-Based Science Learning Activities: Engaging Adults and Children With Informal Science Learning for Preschoolers](#). *Science Communication*, 37(3), 405-414.
- <sup>7</sup>Goodstart, 2016. [Exploring the benefits of sensory play](#). Goodstart Early Learning, online.
- <sup>8</sup>DeBoer, G.E., 2000. [Scientific literacy: Another look at its historical and contemporary meanings and its relationship to science education reform](#). *Journal of Research in Science Teaching*, 37 (6), 582-601.
- <sup>9</sup>Broadhead, P., Howard, J. and Wood, E., 2010. [Play and Learning in the Early Years: From Research to Practice](#). London, UK: Sage.
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- <sup>11</sup>Ruby, M., Kenner, C., Jessel, J., Gregory, E. <sup>7</sup> & Arju, T., 2008. [Gardening with grandparents: an early engagement with the science curriculum](#). *Early Years*, 27(2), 131-144.
- <sup>12</sup>Archer L., DeWitt, J. and Willis, B., 2014. [Adolescent Boys' Science Aspirations: Masculinity, Capital, and Power](#). *Journal of Research in Science Teaching*, 51, 1-30.
- <sup>13</sup>Bleeker, M.M. and Jacobs, J.E., 2004. [Achievement in Math and Science: Do Mothers' Beliefs Matter 12 Years Later?](#) *Journal of Educational Psychology*, 96(1), 97-109.
- <sup>14</sup>Ball, C., 1994. [Start right: The importance of early learning](#). London, England: Royal Society for the Encouragement of Arts, Manufactures, and Commerce.
- <sup>15</sup>Vartuli, S. and Winter, M., 1989. [Parents as First Teachers](#). In Fine, M.J. (Ed.). *The Second Handbook on Parent Education: Contemporary Perspectives* (99-117). San Diego, USA: Academic Press.
- <sup>16</sup>Lloyd, E., Edmonds, C., Downs, C., Crutchley, R. and Paffard, F., 2017. Talking everyday science to very young children: a study involving parents and practitioners within an early childhood centre. *Early Child Development and Care*, 187(2), 244-260.
- <sup>17</sup>3M and British Science Association, 2019. [Explore, Experiment and Enjoy! Everyday activities to engage your family with science](#). London, UK: British Science Association.
- <sup>18</sup>Hobbs, L., 2014. [Sensory, bottles, tins and bags](#). Science from the Start, online.
- <sup>19</sup>University of Manchester (2012). [Evaluating your engagement activities](#). University of Manchester, online.
- <sup>20</sup>Arts Council, 2019. [Generic Learning Outcomes](#). Arts Council UK, online.