

STEM: Supporting children's learning experiences

Aistear Theme:
Exploring and Thinking

Síolta Standards

2: Environments

6: Play

STEM CPD (Birth-3 years)

*Please read **'What is STEM?'** before reading this tip sheet

Introduction

To learn about STEM, babies and toddlers need adults¹ to provide loving and secure relationships²; hands-on, open-ended, multisensory experiences as promoted in both *Aistear* (NCCA, 2009) and *Síolta* (CECDE, 2006); and to use the language of STEM in their interactions with the children. Babies are primed to investigate their surroundings and strive to understand the world. Using all of their senses, they explore and engage with their environment. They love to manipulate objects, to test their developing skills and to engage with others. As they become more mobile and more verbal, their ability to test hypotheses³, question and seek information increases.

Sensitive adults provide engaging, creative, experiences that promote curiosity and learning, and have interactions with the children that provide rich language-learning opportunities.

Talking about STEM

Supporting children's language development is fundamental to their overall development and, equally, using the language of STEM is a key role of the adult in promoting children's understanding of the world through STEM. Adults **noticing, naming** and supporting babies and toddlers to understand the language of STEM can be achieved by introducing relevant vocabulary through everyday experiences such as, for example, block play, playing with water or sand, planting seeds or construction, all of which can be maximised to introduce children to STEM education.

Babies' and toddlers' understanding of concepts is helped by becoming familiar with associated language. The challenge for adults is to be alert for, to recognise and to respond to STEM moments during interactions with the children. The following section gives some examples of such moments when the adult can respond to the child and include the language of STEM.

The activities described here are not intended to be comprehensive descriptions of the totality of possible STEM experiences but will help to identify the STEM language the adult can sensitively use in conversation with the children. Using the appropriate language regularly so that the children hear it used in different contexts (rather than expecting children to 'memorise' the words) is most helpful.

¹ Adult refers to all those who care for and educate children from birth to six in Ireland. This includes parents/guardians and other significant adults in children's lives including practitioners, and other professionals, such as therapists and social workers. (NCCA, 2009, p. 53)

² See French, G. (2019) Key Elements of Good Practice to Support the Learning and Development of Children from Birth to Three. Available [here](#).

³ A glossary of terms is available [here](#).

The children need adult support and many exposures to the words, as well as hearing them connected to their hands-on experience, for understanding to develop. Adults do not need to know all the answers to the questions and theories children pose, they just need to be open to investigating new things so that they and the children can work to find answers together. This shows that everyone is always learning, even the grown-ups!



Noticing and naming STEM

Aistear (NCCA, 2009) tells us that children learn many different things at the same time, and what they learn is connected to where, how and with whom they learn. While the adult needs to keep STEM in mind and to know about the interconnectedness of what children are learning, babies and toddlers just want to have lots of interesting opportunities to explore, solve problems and learn about the world they live in. *Aistear's* theme of **Exploring and Thinking** encompasses STEM learning and development, and it is important to remember STEM is not located in any one corner or area of the setting. Opportunities for STEM learning happen throughout the environment, and the following is intended to help adults be alert to those opportunities.

Children are naturally curious about their world and **science** in early childhood is about enabling children to discover their world. Experiences can be as simple as exploring:

- gravity; for example, a baby dropping his/her cup or a set of keys to see how many times it will be picked up
- cause and effect; for example, throwing a ball with more or less effort or in different directions and having a conversation about where and how far the ball goes each time
- hot and cold; for example, connecting cold weather with wearing hats, gloves, coats and scarves outdoors
- caring for the environment; for example, sorting material for the recycling bin
- sounds; for example, banging tins, metal spoons, plastic bottles and rustling paper; recognising sounds in the environment, for example, familiar and unfamiliar voices, birdsong, doors opening, or music playing to signify a transition
- living things; for example, watching birds outside the window; discovering spider's webs and insects in the garden; exploring grass, plants, herbs and flowers outdoors
- momentum; for example, outdoors momentum can be experienced on swings, gravity on slides and indoors this can be explored through informal activity with toys, exploring forces such as pushing and pulling
- manipulation; for example, exploring how the shape of objects such as playdough or indeed their snack can be changed by squashing, pulling or mouthing; how colours can change when mixed with others, or how paper can be torn or balled up. Exploring the properties of objects by playing and interacting with objects of different **textures, shapes, colours** etc.

In relation to **technology**, it is recommended that babies and toddlers under the age of 2 do not have any access to screens, including TVs, tablets and other touch screen devices, as their use may pose health risks. However, there are other forms of technology that can be suitable for use with young children. For example, in the indoor environment light boxes can afford opportunities for exploration of colour, light or transparent material, such as dried fruit, leaves, or translucent paper. Similarly, overhead projectors allow for exploration of shadow, shape and distance and can support the development of maths concepts. Do pay attention to safety concerns and ensure that children do not look directly at lights or have access to hot bulbs. Digital cameras can be used by toddlers both indoors and outdoors to enable children to capture what is important to them.

Role-play supported by the use of technology can encourage mathematical thinking, experiences and language. Scenarios such as the shop, the library and the doctor's surgery can engage children in making lists, 'counting', scanning, dialling numbers on phones and 'typing' on the computer keyboard. Helping children to see the use of technology in context supports their understanding of technology's role in helping us to do things we want to do, rather than seeing technology as an end in itself.

Engineering is very visible as it is about **designing, making and building** things, processes that are obvious in children's play. Toddlers especially like to participate in these processes. For example, if toddlers are making 'noise makers', they can explore and discuss the objects best suited for making noise, for example; cotton balls or buttons; feathers or pasta pieces; or how to funnel these objects into narrow necks of bottles, all of which are examples of designing. Once they have made their decision, they can go ahead with the making and/or building, see the results of the process and talk about it afterwards. Having conversations like this with children gives them opportunities to practice

planning, making and improving designs, not to mention meaningful problem-solving opportunities.



Using blocks or junk materials, babies and toddlers can build simple structures in their play such as towers, roadways or enclosures. The children soon realise that how they build a tower makes a difference to its sturdiness. A narrow, unstable base will result in the tower collapsing (although sometimes this is the object of the game!). Building with stacking cups, all types of blocks and cardboard boxes helps these little engineers to see what works and what doesn't! Building small ramps, or testing **balance and equilibrium** are also explored by using wheeled vehicles either indoors or outdoors. Engineering also relates to how things **fit together** and come apart so jigsaws, tabletop, stacking toys and manipulatives are also useful.

The *STEM Education policy* (DES, 2017) acknowledges **maths** as underpinning all STEM learning experiences. Additionally, maths is viewed as being not only useful for life and as a way of thinking, but also as being beautiful in its own right (Dunphy et al, 2014). For babies and toddlers, an understanding of attributes is significant for their development in maths. For example, for babies and toddlers being able to distinguish things that are the **same** and things that are **different** helps them to sort objects into sets, an important skill that will support a child's later understanding of **more** and **less** and the concept of 'equal'. When toddlers are tidying up, for example, 'maths talk' might be about sorting and organising the tea set based on size (**small, medium, large**), colour (**red, green, blue, multi-coloured**), material (**plastic, ceramic or tin**) or function (**pot, plate, spoon**). It takes a lot of practice for young children to make these distinctions, and conversations with adults are a big part of that learning. For babies and toddlers, "Treasure baskets"⁴, and the use of a variety of textured materials (rather than wipe-able plastic alone) are needed to help children develop this skill.

While **rote counting** (saying the number words in order without understanding the quantities associated with these words) is a favourite of some children, it is important to focus on helping children to begin to understand the connection between these number words and the associated concepts. Playing games where children get to use language such as '**more than**', '**enough**', '**less**', '**full**', '**empty**' and so on helps children develop their understanding of quantity. Another simple way to do this is to support their understanding of one-to-one correspondence and cardinality. Highlighting that each child gets one plate at dinner time (one-to-one correspondence) and that the numbers increase as these are distributed with the final number being the total (cardinality). For example, "one plate for Katie; one plate for Jo, that's two plates; one plate for Niamh, that's three plates; and one plate for Faruk, that's four plates".

Counting and pattern books are a great source of maths concepts and music exposes children to

pattern, rhythm and repetition. Sand and water play, baking or making playdough can help children learn measure concepts and the words associated with this (**full, empty, too much, too little, overflowing**). Using trikes, navigating obstacles or climbing outdoors can support a child's developing spatial awareness, including where their body is in relation to others (**beside, near, far**). Talking about the daily routine around snacks, meals, nap time and other regular events, as well as turn taking, will help with the children's understanding of time (**first, then, next, before, after**) whilst building with blocks, junk or stacking cones can support a basic recognition of 2-D (**circle, triangle, rectangle, square**) and 3-D (**cube, pyramid, cylinder**) shapes. Having conversations about pictures in favourite books helps with developing understanding of data.

Other examples, mainly associated with maths but relevant to the other areas too are:

- measurement - 'big', 'small', 'little', 'short/tall', 'tiny', 'huge', 'less/more', 'long/short'
- position - 'in, on, beside', 'over', 'under', 'behind'
- pattern - 'next', 'same', 'different'
- shape - 2-D and 3-D ('cube', 'pyramid', 'cylinder')
- spatial features - 'curved', 'flat', 'straight', 'edge', 'side', 'line', 'corner'

Documenting and assessing

As with everything children do, it is important to document and assess what and how children are learning and developing through day-to-day interactions and observations. These observations could help with effective preparation for future learning based on the children's emerging interests. Use these too to help children connect new learning with past experiences as well as planning for future learning. Take photos of the structures children build before they have to put things away. Make notes about what children are talking about as they build. Observe which blocks are used the most and what props are rarely used. Children can use technology to do the recording themselves!

⁴ For more on Treasure Baskets see <https://www.aistearsiolta.ie/en/cpd/birth-3-years/treasure-basket-6-18-months-1.pdf>

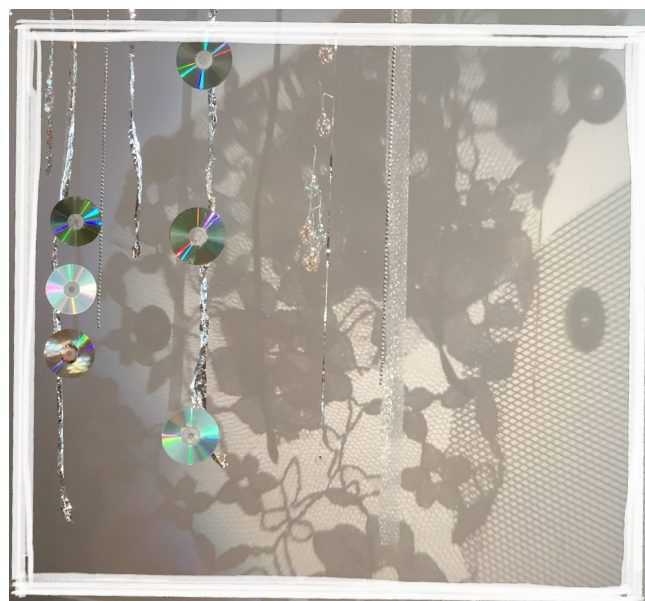
Creating a STEM rich learning environment

Supporting STEM does not require special equipment or dedicated areas in the room. Instead, consider the materials in your room in a new way by using a 'STEM lens' (see section on Noticing and naming STEM). Many of the resources you have already will support STEM:

Indoors

- treasure basket or heuristic play bags are a great place to start to explore properties of materials and notice similarities and differences. Over time, children will naturally begin to categorise and order
- junk and open-ended, natural materials allow children to explore shape, size and how things can fit together, balance, and come apart
- blocks of all sorts – wooden, cardboard and plastic in all shapes and sizes. Offer a variety from empty shoe boxes to more complex Duplo and octagons for older toddlers. Having small world figures near the construction area is a good idea as making homes for small world people and animals will involve lots of trial and error
- books with STEM concepts such as the *'Kevin and Kate's Food Adventures'* series by Olivia Goodwillie, or *'Balancing Act'* and *'Mouse Paint'* by Ellen Stoll Walsh
- provide sand and water trays with ever-evolving contents – measuring jugs, containers of various sizes (plastic bottles, plastic piping, s-bends, funnels), items that float and sink (stones, shells, cork), small world toys
- overhead projectors and light boxes with a variety of open-ended materials (paper, card, voile and net fabrics, doilies)
- digital cameras can be introduced to toddler groups slowly, one child at a time. Ensure that devices are robust, intuitive and suitable for little hands. Allow the children to explore taking and reviewing images and videos and discuss what the children have captured
- baskets of natural loose parts (pinecones, acorns, stones). They can be moved to different areas – from the construction to the water/sand area to the outdoors

- have paper, chunky crayons, rulers, measuring tapes available for toddlers
- let the children make home-made playdough of different colours and place a basket of things that can be added like herbs, lavender, pasta, glitter etc.
- provide a variety of open-ended materials
- small world play props – little people, vehicles, animals
- variety of balls, stacking toys, large threading beads, ride on and push along toys, push up and pop up toys
- tunnels, tents, large cardboard boxes
- variety of physical features – slopes, steps, grass
- chalk, large brushes, paint (non-toxic);
- household items – pots, pans, wooden spoons, empty containers with lids, tea sets.



Outdoors

- challenging environments inside and outside that allow babies and toddlers to explore are vital – different natural surfaces; grass, mulch, sand, ramps as well as those found more typically in settings such as soft surfaces or paving. These allow the children to test how stable/secure the surfaces are, how they are likely to react to a ball rolling or bouncing, how easy or hard it is to move a tricycle
- space to crawl, walk, run, jump
- open-ended materials outdoors allow children to build dens or hideaways – large cardboard boxes, pegs, blankets and masking tape can create simple spaces and allow children to be involved in (or at least observe) the design and creation of spaces

- space to move around freely and explore the environment helps children to explore space, distance and speed and practice new-found skills or crawling, walking, running or scooting. Babies and children should be outdoors every day, regardless of weather, to experience the changes in the environment caused by heat, rain, cold. Appropriate clothing (waterproofs in wet weather, sun hats in summer and wool hats and scarves in chilly weather) makes this much easier to achieve
- large paint brushes and water to paint dry walls
- mud kitchens enable children to mix mud, water and leaves and to see how solids and liquids transform when mixed. The addition of pots, pans, buckets and bottles enable children to test capacity, size and other fundamental maths concepts
- adding a bug hotel and/or bird feeders to the garden encourages wildlife into the area
- small vegetable plots, herb gardens or flower beds with child-friendly plants, allow children to see the life cycle of plants happen before their eyes, and encourages care of living things. A space just for children to dig when they feel like it is also important.



Conclusion

Support for STEM can be achieved by providing hands-on, open-ended, multisensory experiences for babies and toddlers. Everyday practice provides plenty of opportunities for children to be involved in STEM learning with adults who notice and name the science, technology, engineering and maths going on. Thinking about STEM when you are planning for the children's experiences is a good opportunity to identify the kind of language you will be using in your loving interactions with the children.

Link to *Aistear Síolta* Practice Guide STEM resources!

Developed in collaboration with Sandra O'Neill, DCU.

References:

Dunphy, E., Dooley, T., Shiel, G. (2014) *Mathematics in Early Childhood and Primary Education (3–8 years) Definitions, Theories, Development and Progression*. Available at: https://ncca.ie/media/1495/maths_in_ecp_education_theories_progression_researchreport_17.pdf

Websites

<https://www.zerotothree.org/resources/series/let-s-talk-about-stem-video-series>

<https://www.naeyc.org/resources/blog/making-tinkering-and-toy-store-project>

<https://maths4all.ie/>

<https://bayareadiscoverymuseum.org/roots-stem-success>