

STEM: Supporting children's learning experiences

Aistear Theme:
Exploring and Thinking

Síolta Standards

2: Environments

6: Play

STEM CPD (3-6 years)

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

Introduction

Each of the STEM areas is relevant and important for young children whose curiosity and drive to explore and understand the world is the starting point for their learning. Adults¹ can support children's engagement with STEM by providing them with opportunities to solve problems, to use their imaginations, to ask questions, to collaborate with others, to experiment, to make things and to try different ways of doing things. Like all learning and development, STEM is best supported through secure and loving relationships, through interactions and through play and playful experiences.

Talking about STEM

Observing what children are curious about and expanding on their natural enthusiasm and interests is the basis for supporting every child's engagement with STEM learning experiences.

Like a lot of children's play, playful STEM learning experiences are usually active, messy and loud. Children are talking and listening, designing and creating. When children are busy collaborating in multi-sensory, hands-on, open-ended investigations, they are open to learning about STEM. The adult can facilitate STEM learning by providing learning opportunities where the children get to predict, problem-solve and test their hypotheses² with other children. Supporting children's language development is fundamental to their overall development and adults can support STEM learning by noticing and naming the science, technology, engineering and maths they observe when they are sharing activities with the children. The adult can encourage the language of STEM by modelling open-ended questions when playing with the children, for example, 'I wonder what would happen if I try to put this block on top of all the others?', prompting children to make predictions and explain their thinking. The problems that children meet through their play, problems they want to solve so the play can go on, present opportunities to engage their thinking and inspire them to investigate.

Another context for STEM language learning, as well as a source of meaningful problem-solving, is reading favourite stories such as *The Three Billy Goats Gruff* where a bridge building project using different materials such as blocks or paper can encourage children to problem-solve and investigate possible solutions, making adjustments and testing their stability and strength.

¹Adult 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 A glossary of terms is available [here](#).



STEM learning experiences

Aistear (NCCA, 2009) tells us that children learn many different things at the same time, so it is important to be mindful that there should be an integrated approach between the STEM disciplines of science, technology, engineering and maths. You will notice as you read through the sample experiences that the same play contexts are referenced repeatedly, emphasising the multiple opportunities for the adult to notice and name the STEM happening as the children play. What children 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, children themselves just want to have lots of interesting opportunities to **explore**, **solve problems** and learn about the world they live in. The outdoors is a really important part of children's world and being outdoors sparks children's curiosity into their natural environment and promotes a love of nature. Indoors and outdoors, children need a range of **multi-sensory** experiences as they taste, touch, listen, smell and observe their environment. What follows are examples of multi-sensory, hands-on, open ended learning experiences through which adults and children can explore and learn about STEM.

Designing and making a boat for *The Gingerbread Man* to save him from the fox could lead to conversations about floating. It might also lead to a discussion about sinking, depending on the boat! Favourite stories are a good starting point, but new books can be chosen as a response to children's curiosity about the world. Listening to and observing the children's activities give insights into their thinking, and the adult can use their questions as a springboard for further investigations and for exploring possible solutions. Solutions arrived at through talk and discussion, rather than producing the right answer, are the focus of STEM activity.

Create a positive and safe learning environment for every child. Develop a space where children are comfortable making mistakes because our mistakes help us learn. Some projects will fail, so use this opportunity to model **resilience** and **perseverance**, discuss with the children what went wrong and how we can change things for the next time. As adults, we do not have all of the answers to help children learn about STEM, but by responding to a child's question with 'that is a great question, how could we find the answer?', we learn together.

Science

Children are naturally **curious** about their world and science in early childhood is about enabling children to discover their world. Adults can support children's scientific learning by providing open-ended, playful and multi-sensory experiences that enable children to explore and talk about their world. Opportunities for the adult to **notice** and **name** the science happening in play could happen in contexts such as the following examples:

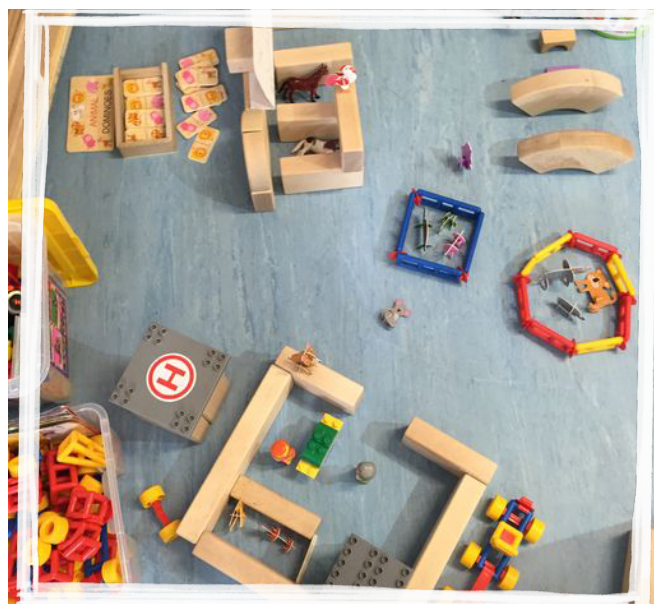
- forces can be explored through simple ramps and toy cars/balls; by using different materials on the ramps friction can be explored through, for example, the children predicting how far the car will roll and testing their prediction a number of times with different toy cars and comparing the results. Providing S- and U-bend and other tubing, small plant pots, eye-droppers, turkey basters, funnels and so on at the water table enables children to observe forces acting in water
- making bubbles gives children the opportunity to predict and observe the effect of mixing liquids like water and washing up liquid. Children may observe the different shapes and sizes of the bubbles. Making slime or playdough to experience ingredients changing from liquid and powder into a solid mass, and mixing oil and water to explore the liquids separating
- experiencing the changing states of water through, for example, what happens when we put water into the freezer. By pouring water into different containers (balloons, disposable gloves, yoghurt cartons, etc.) and freezing them children can observe the ice structures and experiment with them by, for example, leaving them out of the freezer or on a radiator
- the natural environment can be used as a focus for children to explore trees, plants, flowers, rocks, mini-beasts and so on. Having a bird table is a great way to encourage children's interest in the types of birds in their locality, and planting seeds or growing beans in wet cotton wool illustrates growth
- talking about changes in the weather and observing the effects of dry weather on puddles. Making wind chimes and listening to the effect of the wind. Having straw blowing races to explore movement of air /air pressure
- rubbing a balloon on hair to explore static electricity
- designing and making musical instruments to describe and compare the different sounds produced
- making magic potions – to explore chemical reactions and how different materials interact with each other. For example, glitter in a jar, food colouring in water, adding baking soda (to make volcano)
- children can also be introduced to scientific language and concepts through poems, rhymes and songs. For example, 'Row, row, row your boat' might open up a discussion of children's knowledge about boats and 'Polly put the kettle on' might connect into children's descriptions of boiling kettles producing steam, illustrating how a substance can change its state when heated.



Technology

Young children have daily experiences with technology and learn about its uses very quickly, be it hearing the ping of the microwave, pushing the buttons on the washing machine or swiping a parent's smart phone to look for pictures. Play offers children opportunities to explore and understand how technology can be useful in helping us to do things we want to do. Digital technologies are an important (but not dominant) part of children's lives. Supporting children's language ability so that they can explain why they want to use a particular technology is central to their development of a critical attitude to technology in everyday life. Children can be supported to explain how and why they use a wide variety of technology through, for example:

- using digital cameras, children can create a learning log and also showcase their work, especially creations that are particularly important to them. Children can use the photographs as opportunities to explain and tell the stories of how and why they, for example, built a high tower and why it fell! This allows children to analyse and reflect on their experience
- children can also take photos to document a process over a period of time, such as the growth of flowers they have planted, providing the children with opportunities to think and talk about growth and the things they can do to help it along
- role play using everyday technology, for example, 'tapping' a card in the shop; 'typing' on the computer keyboard in the surgery; 'scanning' bags in the airport to support children in identifying the reasons for using technology
- encouraging children to provide step-by-step instructions for how to complete a task such as directions to move from one place to another, instructions to make a jam sandwich, to build a sandcastle or retell a favourite story in sequence, using the language of 'first', 'next' 'then'.



Engineering

Engineering is very visible in young children's activities as it is about **designing, making and building things**, creative processes that can be observed in children's play. Children can learn about engineering through open-ended play experiences such as:

- exploring construction materials such as blocks of various sizes and shapes, shoe boxes and other stackable items where children can experience balance and stability
- making plans, choices and decisions about what to build and make from blocks, boxes (big and small), junk materials, Lego, straws, lollypop sticks and playdough; sticking materials together with tape, string and glue; decorating with paint, markers, feathers and glitter
- designing, making and building projects that integrate STEM learning such as creating a sailboat (that can float) using materials such as tin foil, fabric, wood and clay; building a den or shelter to protect themselves (or their toys) from wind and rain; making a warm, airy bug hotel where insects can hide and store food
- planning their constructions and investigations gives children opportunities to explore art and design. Working together to develop the 'blueprint' for their design will help them to identify possible problems and work out how to solve them.

Maths

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). Children's mathematical development can be supported through, for example:

- construction play and junk art activity in which children can explore geometry through 2-D (circle, triangle, rectangle, square) and 3-D shape (cube, pyramid, cylinder, prism, cuboid, sphere). These provide opportunities for 'maths talk' about, for example, shapes that roll and those that stack; shapes that have edges, sides and corners and those that don't; shapes that fit together (tessellate) and those that don't. Children can begin to understand symmetry through, for example, looking at leaves or mini-beasts through magnifying glasses when they are outdoors
- physical activity, such as using trikes, navigating obstacles or climbing outdoors, where children move around and small world play where the children position people and objects in relation to each other can support children's spatial awareness (above, below, under, behind, in front, beside, near, far)
- the different aspects of measurement, such as ordering things by height, weight and length can be explored through a wide variety of play activities:
 - » sand and water play, baking or making playdough provide children with opportunities to explore and compare the capacity of different containers using terms such as full, empty, less, more, the same, different, enough, too much, too little, overflowing
 - » through role play in the 'shop', children can use the weighing scales and explore the language of weight such as heavy, heaviest, heavier, light, lighter, lightest, more, less. Many play activities, such as construction with blocks, baking using measuring cups and spoons, or playing with playdough offer opportunities for sorting by weight and using the appropriate language. Real measuring containers can be included in the sand, water and role play areas to allow children to begin to connect with the formal language of weight such as gram and kilogram
- » talking about the daily routine around snacks, break-times, 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). For older children, visual guides to the daily routine can support independent daily planning and the language of the clock can be explored through association with daily events such as lunch.
- emergent algebra may be explored through patterns found in sounds, actions and movements such as sound sequences with noise makers, clapping sequences, jumping/hopping sequences, building patterns with 2-D and 3-D shapes, making patterns with small-world items like cars or animals and giving children opportunities to talk about what comes next
- as children independently care for their environment through tidying-up, authentic opportunities arise for sorting and categorising. As the children tidy away after themselves, 'maths talk' might be about attributes such as relative size (smaller, larger, longer, shorter), colour, material (wooden, plastic, fabric) or texture (rough, smooth, grooved). As children progress, sorting according to two or more attributes can be introduced, for example, big blue cars, small red cars. It takes a lot of practice for young children to make these distinctions, and conversations with adults are a big part of that learning
- meal and snack times offer an opportunity for exploring number concepts such as ordinal number, for example, '*The first plate is for Katie, the second for Jo, the third for Niamh and the fourth for Faruk, that's four plates for four people*', and this can be explored outdoors when the children take turns on bikes and swings. Being outdoors offers opportunities for counting of leaves, stones, birds and so on, and working out if there is a stone or leaf for each child (one-to-one correspondence). Songs and rhymes provide opportunities for counting, and noticing, and naming numbers in favourite stories is a good game.

Conclusion

Children have an immense capacity to engage in STEM learning because of their curiosity and capacity for wonder at the world. Research suggests introducing STEM learning experiences to children in early childhood supports later learning in numeracy and literacy. Adults can promote children's learning in STEM by providing children with opportunities to exercise their curiosity, to predict and experiment with an idea through multi-sensory, hands-on and open-ended play experiences. The adult can extend the children's explorations by noticing and naming the STEM as they play and explore with the children. It's never too early (or too late) to start!

Developed in collaboration with Bridget Flanagan, PhD candidate, Mary Immaculate College.



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_eccp_education_theories_progression_researchreport_17.pdf

Websites

<https://regentsctr.uni.edu/regents-center/stem-experiences-classrooms>

<https://stemfromthestart.org/>

<http://www.peepandthebigwideworld.com/en/iolta> Practice Guide STEM resources