UNIVERSITY OF CANBERRA

EARLY CHILDHOOD

STEM HABITS OF MIND

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GUIDE TO THE
EARLY CHILDHOOD STEM HABITS OF MIND

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Early childhood is the natural starting point for STEM learning, as young children are curious and want to explore their environments. Children are very capable STEM learners, and their knowledge and skills are often greatly underestimated by educators and parents. Children can develop complex understandings about the world around them with the right guidance from adults. Early STEM experiences can set children up for later formal STEM learning. As educators and parents, we want children to be confident and involved learners. We need to support children to feel that they can 'do STEM'[1], as well as understand and speak the language of STEM.

The Early Childhood STEM Habits of Mind were developed in response to an identified need for a model and common language for educators, parents and children, regarding STEM education in the early years. For the past 30 years in Australia and internationally, there has been a strong movement to foster children's early literacy skills. There is an abundance of information on how parents can do so by engaging their children in reading books, singing songs and nursery rhymes, playing word games and noticing print. Comparable resources supporting early STEM learning are largely non-existent in Australia. Similarly, the importance of STEM learning has not been widely promoted to parents.

The Early Childhood STEM Habits of Mind were developed to:

- to raise awareness of STEM and its importance in the early years;
- (b) to provide a shared way of thinking and talking about STEM learning experiences by focussing on habits of mind and learning dispositions; and
- (c) to serve as an integrating device for planning STEM education in early childhood settings. The Habits of Mind move beyond the individual disciplines or silo approach to STEM.

The habits include those that are used routinely by professionals in STEM-related fields. It positions young children as inquirers, observers, describers, encoders, decoders, engineers, pattern sniffers, experimenters, measurers and predictors. The Early Childhood STEM Habits of Mind align with the Australian Early Years Learning Framework (EYLF)[2]. Specifically, the habits align with:

Outcome 4 Children are confident and involved learners, when learning about the world through active hands-on explorations and investigations and

Outcome 5 5 Children are effective communicators, when expressing themselves, connecting with others and extending their learning.

As per the principles and practices of the EYLF, a focus on developing habits of mind assumes that "children are capable and confident learners, who actively construct their own learning, and have capacities and rights to initiate and lead learning"[3].

While children, educators and parents regularly engage in STEM, often it is unrecognised as such and opportunities for learning are missed. The Early Childhood STEM Habits of Mind can help educators and parents make STEM in the early years more explicit. Just by labelling what children are doing can make them and the adults around them more aware of STEM. For example, when children build in the block area, we can tell them that they are being engineers and when children mix materials together to see what happens, we can say they are experimenters.

Confidence in STEM language can help children believe that they can "do STEM"[4]. We know from research that language matters. Only children who have had certain types of language socialisation are likely to choose to study or learn science in later life[5]. Children need parents and educators to model STEM language that children can imitate. The Early Childhood STEM Habits of Mind give children, educators and parents a shared language for talking about STEM. Imagine if all children could talk about themselves as inquirers, observers or decoders.

The Early Childhood STEM Habits of Mind cater to all educators and parents regardless of their knowledge and confidence in teaching STEM. For those beginning to learn about STEM, the Habits of Mind can be used in everyday activities and conversations. There is no need for educators to implement a new program or set up science special experiments. However, for those educators who are looking to program STEM experiences, the Early Childhood STEM Habits of Mind offer multiple and interesting starting points for planning. Educators may ask: *How do I design learning experiences that also allow children to be describers, encoders, measurers, pattern sniffers or engineers?* The habits may also support planning of deeper learning experiences for children focusing on problem-based scenarios or design challenges. Educators may ask: *How do I design team-based engineering challenges for children?*

The following pages give examples of what the habits might look like, what you might hear from the children and how to keep conversations going with question starters.

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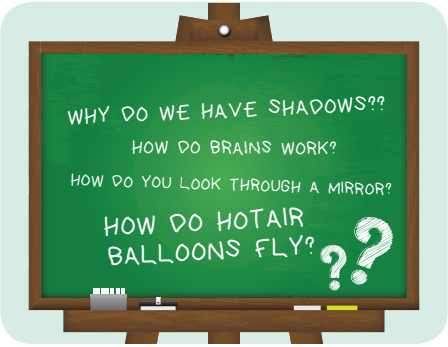
[1] Early Childhood STEM Working Group. (2017). Early STEM matters: Providing high-quality STEM experiences for all young learners. Chicago: University of Chicago STEM Education/Erikson Institute
[2] Australian Government Department of Education, Employment and Workplace Relations. (2009). Belonging, being and becoming: The early years learning framework for Australia. Canberra: Australian Government.
[3] Australian Government Department of Education, Employment and Workplace Relations. p. 14
[4] Early Childhood STEM Working Group
[5] Heath, S. B., & Brown, M. (2007). Diverse learning and learner diversity in "informal" science learning environments. Commissioned paper prepared for the National Research Council Committee on Science Education for Learning Science in Informal Environments. Retrieved from http://sites.nationalacademies.org/cs/groups/dbassesite/documents/webpage/dbasse_080081.pdf

Inquirers

Children are inquirers

When they wonder why things happen and how things work



Children's questions

Wondering about rainbows

Examples of what it might look like	Examples of what you might hear	Questions you could ask to keep the conversation going
• Children wondering about the world • Children asking questions • Children trying to find an answer to a question	• I wonder... • Why... • Why does...	• What do you think? • Where could we find out? • Who could we ask?

Other habits of mind that are closely linked to this habit of mind

Experimenters – to test out their ideas of how things work

Describers – to explain what they know

Observers

Children are observers

when they watch closely things in nature and the world around them

Looking through a magnifying glass

Looking at things in the water

Examples of what it might look like	Examples of what you might hear	Questions you could ask to keep the conversation going
• Children using magnifying glasses to look closely at something • Children looking for some time at something or something happening	• Look at... • What is this? • What's happening?	• What can you see? • What do you think this is? • What is happening here? • What did you notice?

Other habits of mind that are closely linked to this habit of mind

Describers- to explain what they know

Predictors – what will happen next

Describers

Children are describers when they describe what they see and do so using precise language

Describing characteristics of animals

Describing attributes of socks

Examples of what it might look like	Examples of what you might hear	Questions you could ask to keep the conversation going
• Children describing attributes of objects • Children describing what they built and how they did so • Children explaining what they did when experimenting	• The blue block is longer and wider than the red block • The beetle has six legs, with a black body and a horn like a rhinoceros at the front • We put some seeds in dry soil and some in damp soil and the seeds in the damp soil grew faster	• Can you describe? • How could you describe...? • What's the word we use to describe...? • What happened when?

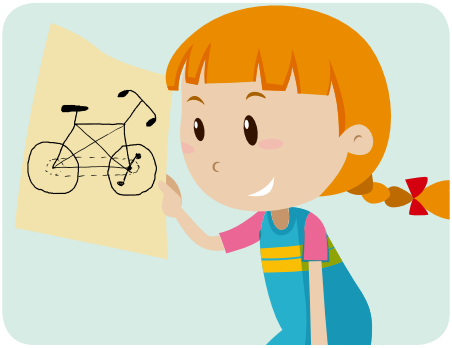
Other habits of mind that are closely linked to this habit of mind

Experimenters –
to test out their ideas of how things work

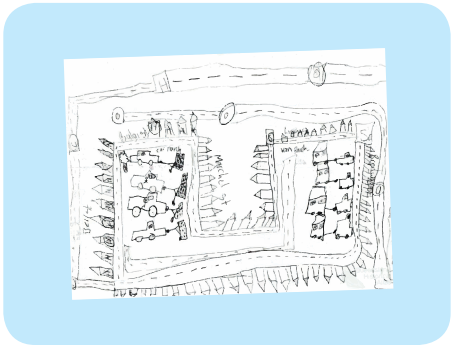
Encoders

Children are encoders

when they represent what they see and do with drawings or symbols



Drawing a bicycle



Drawing a map

Examples of what it might look like	Examples of what you might hear	Questions you could ask to keep the conversation going
• Children drawing objects • Children making symbols for their dance moves • Children creating plans and blueprints of things they want to build • Children making maps	• This is a... • This is my... • I was imagining...	• Can you tell me more about...? • What might your drawing look like from above?

Other habits of mind that are closely linked to this habit of mind

Inventors-
when they build and make things

Describers-
when they explain their representations

Decoders

Children are decoders when they make meaning from representations or symbols

Using a map

Following instructions to make something

Examples of what it might look like	Examples of what you might hear	Questions you could ask to keep the conversation going
• Children following plans to build things • Children reading symbols • Children following a map to find things • Children performing a dance using the dance symbols • Children following pictorial instructions	• I wonder what this means? • I think that this is...	• What do you think this means? • Can you describe what that is to me?

Other habits of mind that are closely linked to this habit of mind

Encoders- being able to represent what they see

Describers- to explain what they are seeing

Engineers

Children are engineers when they build and construct things

Building with blocks

Making structures

Examples of what it might look like	Examples of what you might hear	Questions you could ask to keep the conversation going
• Children building things with blocks • Children making things with loose parts • Children making things with boxes	• It's a ... • Where's the sticky tape? • How can we make this stay up? • Look how high this is	• What did you do? • Could you do it a different way? • What would you do next time? • Who could we ask...?

Other habits of mind that are closely linked to this habit of mind

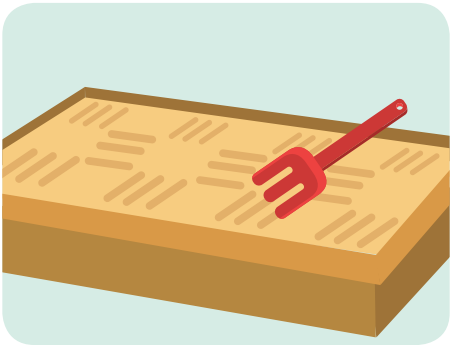
Experimenters – to test out their ideas of how things can stay together

Describers- to explain what they have done or how they made it

Pattern sniffers

Children are pattern sniffers

when they search and find patterns in words, numbers and their world



Making patterns in the sand

Making mandalas

Examples of what it might look like	Examples of what you might hear	Questions you could ask to keep the conversation going
• Children make patterns with objects • Children notice patterns in sounds (rhyme and alliteration) • Children notice patterns in music • Children sort things according to attributes	• Look at the pattern I made • Look they are the same • It is repeated • It keeps going over and over again	• What comes next? • What is missing? • Is it the same?

Other habits of mind that are closely linked to this habit of mind

Describers-
to describe the pattern they made or see

Experimenters

Children are experimenters

when they try and test things to learn how things work or what will happen

Making potions

Mixing colours

Examples of what it might look like	Examples of what you might hear	Questions you could ask to keep the conversation going
• Children testing materials • Children mixing materials • Children pulling things apart • Children making ramps	• Look what happens when I... • I think I will try...	• What did you do? • What happened when you...? • What else could you do? • What actually happened compared to what you thought might happen?

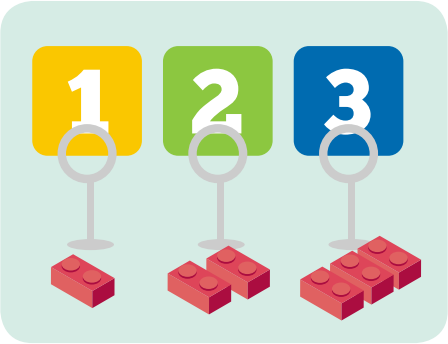
Other habits of mind that are closely linked to this habit of mind

Describers-
to explain what they know

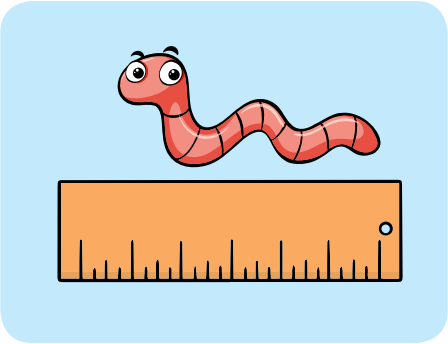
Predictors-
to think about what will happen when they test things

Measurers

Children are measurers when they measure and count things



One to one correspondence



Measuring the length of a worm

Examples of what it might look like	Examples of what you might hear	Questions you could ask to keep the conversation going
• Children counting things • Children measuring things with informal units (e.g. shoes, unit blocks) • Children hefting things • Children comparing things	• This one has more/ less • This is bigger/ longer/wider • It is as tall/big/long as...	• What do you think...? • Where could we find out...? • Who could we ask...?

Other habits of mind that are closely linked to this habit of mind

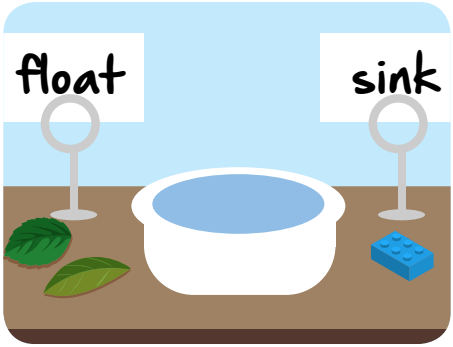
Describers- using precise language to describe attributes

Predictors- making predictions about different attributes

P Predictors

Children are predictors when they predict what will happen next

Predicting how far the ball will travel



Predicting what will float and sink

Examples of what it might look like	Examples of what you might hear	Questions you could ask to keep the conversation going
• Children making predictions about what will happen • Children justifying their predictions • Children trying to find out about a question	• I think... • It will ... • Last time it... • Next time I think it will...	• What would happen if we...? • What could we do differently? • What do you think might happen? • Did what you though would happen actually happen?

Other habits of mind that are closely linked to this habit of mind

Experimenters – to test out their ideas of how things work

Describers- using precise language to predict what will happen next

Questioning

the key to effective STEM learning

Thoughtful questions can

- Open up Conversations
- Extend Learning
- Foster Interest and Curiosity

Children are naturally curious, but it's not enough for them to develop their STEM skills and knowledge. Children need adults to build on their interest in the world around them. When children notice things or do things, we can make these experiences rich learning opportunities by asking questions.

Asking questions affords children opportunities to describe and explain things and for adults to elaborate, extend and/or model new vocabulary. These exchanges are key to developing children's language as well as their interest in STEM.

Asking questions that focus on 'WHAT' children can see or do, rather than 'WHY' allow children to confidently answer and experience success. 'What is happening to the bubbles? is much easier to respond to than 'Why do the bubbles stick together?' and promotes further discussion between children and adults.

Many of our children have English as a second or third language, while others have language delays. Some children are not used to being asked content type questions. 'What' questions allow all children to experience success at answering questions and can lead to sustained shared conversations[1].

Many adults cannot answer science type questions, for example why magnets stick together, so it is unlikely that a young child will be able to answer the question. This is not to say 'why' questions do not have a place. They do, but only when the child has the language and confidence to answer them.

Blank's levels of Questioning[2] are a helpful way to scaffold questions, moving from the concrete to the abstract. 'What questions can be seen in the first level while 'why' questions are found in the fourth level.

LEVEL 1 Focus on salient features

- What is it?
- What are you doing?
- What can you see?

LEVEL 2 Focus on the details and less salient features

- Can you describe it?
- What size/shape/colour is it?
- How many ... does it have?
- What does it taste/smell/feel/sound like?
- Where is it?

LEVEL 3 Generalisation and explanations

- What do you think it means?
- What did you try?
- What will happen next?
- How can we tell?
- What comes next?
- What is missing?
- Is it the same/different?

LEVEL 4 Predict, reason and problem solve

- What will happen if ...
- What else could it be?
- What could you use instead?
- Where could we find out...?
- Who could we ask?
- Could you do it a different way?
- What would you do next time?

[1] Sylva, K., Melhuish, E., Sammons, P., Siraj-Blatchford, I., & Taggart, B. (2004). The Effective Provision of Pre-School Education (EPPE) Project: Findings from Pre-school to end of Key Stage1.

[2] Blank's levels of Questioning used with permission by Dr. Marion Blank, PhD, ReadingKingdom.com

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