

Awe and Wonder: Science and Mathematics in the Outdoors

Part 1



(Source; Barrett, S. 2024)

Part 2

Learning opportunities for 3–4-year-olds

The outdoor environment pictured above is situated in a Cardiff state primary school. The pictured environment can provide awe, wonder and curiosity in many ways, supporting scientific and mathematical learning opportunities, additionally holistic and cross-curricular opportunities in line with the Curriculum for Wales (Wales, 2022) Progression Step 1 (PS1) and depending on the child development linking with the Curriculum for non-maintained settings.

Within this outdoor setting there is a high adult to child ratio of 1:4, with staff fostering children's curiosity and to ensure their safety as there are some natural risks, linking with the CfW Health and Wellbeing, being able to follow rules within the setting and to support understanding of things being safe or unsafe.

Feature 1

The environment, self-curiosity and den building

Learning opportunity

The minute you enter, curiosity is heightened, with large trees, shaded areas and when the weather is good, sunny areas too. Children are full of excitement when running around to explore the area, they soon notice the ground is uneven, balance is needed, and a little more care is necessary than playing on the tarmac, benefiting holistically.

The awe and wonder begins with the natural findings within the environment. These natural loose parts are scattered across the ground with larger items such as loose branches and logs, as well as smaller items like twigs, sticks, leaves, stones, conkers and fallen berries, providing the children with many imaginative ideas.



(Source: Rhubarb and Wren, 2017a)

Collecting these natural loose parts, children could create dens, build tall structures or make pictures on the ground. By adding additional items such as scissors, wool, twine, rope, masking tape, Sellotape and water, buckets, bottles and spray bottles.

Additionally, providing blankets and tarpaulins can develop independence, self-curiosity and learning opportunities. Therefore, providing children the opportunity to add to their dens, children could experiment with water and learn new skills such as latch together bundles of sticks, create a teepee. To support imaginative play some soft woodland animals could join in, the children could make them a home or a den.



(Source: Rhubarb and Wren, 2017b)

Mathematical language can be developed with children exploring the differences in natural objects by finding longer, shorter, bigger, smaller, heavier, lighter or prepositions of up and down. Also, providing counting opportunities such as how many or identifying shape and size.

There will be many opportunities to develop scientific language, children to question and show curiosity by talking and having conversations with adults or peers. Ideas will need to be described, and appropriate materials selected and explored.

Experiencing first-hand the natural world children can understand that their actions have consequences they may stand on a mini-beast and kill it or if the branch is heavy and falls it can hurt. Physically, children will be moving around without realising, carrying materials, lifting and repositioning. Problem-solving, panning and possibly teamwork. In addition, children can learn to take turns in conversations and ask or answer questions.

Conversations between peers or with adults could include;

A child could ask 'What's this?'

The adult not only replying with the name or label, but with a I wonder.

'I wonder, have you seen on before?'

'What do you think it is?'

'I wonder if you tried a stronger stick?'

‘I wonder, what could you do with this?’

‘I wonder how many sticks you will need?’

‘I wonder why that happened?’

Links to the Curriculum

Mathematical opportunities from CfW PS1 (Welsh Government, 2020a)

- Explore numbers, including cardinal, ordinal and nominal numbers, in number-rich indoor and outdoor environments
- Use mathematical language to describe quantities, and to make estimates and comparison.
- Explore, compare, and use the general language of shapes through investigative play.
- Explore movements and directions and begin to use mathematical language to describe positions.

Science opportunities from CfW PS1 (Welsh Government, 2020b)

- Explore the environment, make observations and communicate my ideas.
- Design while I make and communicate what I am making.
- Safely use simple tools, materials and equipment to construct and deconstruct.
- Explore properties of materials and choose different materials for a particular use.

For the younger three-year-olds or the children who are yet not developmentally ready for PS1, the non-maintained curriculum (Welsh Government, 2022) children could develop their mathematical language such as up and down. They may experiment with properties of materials and water. In addition, children can develop their language and communication by asking for help, using language with purpose to develop listening and understanding whilst learning that some things maybe unsafe when building and understanding how things work.

Feature 2

Logs, bricks - Identification/naming minibeasts, potential life cycle.

Learning opportunity

Children whilst walking around and there seems to be logs in the way, some are easy to push over, some are too heavy.

“I wonder, how to get past?”

The possibilities could be to walk around them, step over or jump off them, children may do this by recruiting peers to support, for some children asking an adult for help, or a child may attempt independently therefore, developing resilience and perseverance.

Children from upturning a log and discovering minibeasts, they would tend to scarpers showing children these animals are living things, which grows children’s curiosity and providing children questions. Knowledge and understanding of why worms would try to go back down into the soil. A question that could be asked “If worms stay on the soil, what could eat them?”

Depending on the weather the ground under logs may be wetter than the ground, showing differences of colour, texture.

In this learning opportunity, adding magnifying glasses, can support children’s curiosity by enabling them to take a better look. Adding clipboards with paper and mark making resources or a device to take photos, enables children to recreate or capture what caught their interest at that moment. Could add rulers or old kitchen scales, children may want to see how long a worm is, or how heavy it is, possibly comparing weights and sizes.



Could use language such as “I wonder many worms can you see?” supporting cardinal and nominal number. Additionally, could ask “Which log did you move first? Supporting ordinal numbers. Could introduce the Welsh language and British Sign Language (BSL) by naming the minibeasts.

((Source: Bicanski, 2016)

The child could group minibeasts found, into worms, woodlice, slugs, etc. With the paper or iPad, be able to record their data, by taking a photo and editing by writing a number on the image or a simple table or pictogram or bar graph.

When turning over a log, there could be white little balls, providing curiosity and opportunities to discuss what they could be. This could develop into life cycles of minibeasts as well as supporting language, literacy and communication skills. Some children caught by their curiosity could ask questions, where as another child may use their knowledge and answer questions to clarify understanding. Some children may use this time to develop their turn taking within a conversation, where the adult can demonstrate my turn your turn.



(Source: Seedman, 2012)

However, for some children finding worms and mini beasts disgusting, showing and expressing their opinion. Adding gloves or encouraging sticks may help the children to explore.

Links to the Curriculum

Mathematical opportunities from CfW PS1 (ref)

- Explore numbers, including cardinal, ordinal and nominal numbers, in number-rich indoor and outdoor environments
- Use mathematical language to describe quantities, and to make estimates and comparison. More than, less than
- Explore, compare, and use general language of shapes through investigative play.
- Make estimates and comparisons with measure, 'shorter than', 'heavier than'.
- Use a variety of objects to measure (ruler, stick, etc.)
- Collect and record data found in the environment.
- I can group into sets or categories and begin to communicate the rule I have used.

Science opportunities from CfW PS1 (ref)

- Explore the environment, make observations and communicate my ideas.
- Recognise that plants and animals are living things that grow.
- Experiment with and identify uses of a range of computing technology.

For the younger three-year-olds or the children who are yet not developmentally ready for PS1, the non-maintained curriculum (Welsh Government, 2022) children could develop the understanding of living and non-living when exploring with the minibeasts and flowers, notice similarities between the minibeasts. Additionally, extending their attention and show likes and dislikes, especially when they see a worm for the first time or hold one.

Part 3 - Risk-benefit Assessment

Location/Activity	The 'Secret Garden' (onsite)	Date:	12 th September 2024
Assessor:	Stephanie Barrett	Review date:	September 2025

Overall risk rating – Low, Medium, or High – based on judgement about whether the BENEFITS of the activity or opportunity outweigh the RISKS.

Experience exploring (in photograph)	How will young people BENEFIT from this activity?	Possible hazards and associated risks	Who is at risk?	Risk Rating	PRECAUTIONS in place to reduce the risk of injury	Risk Rating
				L M H		L M H
Preparation of clothing	Appropriate clothing will allow children to have more of a positive and enjoyable experience. Learn to be prepared and safe for the weather or activity. Practice independent dressing and changing shoes Encourage responsibility for own belongings.	Inappropriate clothing causes restrictions, not waterproof or warm enough. Natural area there are brambles and nettles - appropriate clothing and footwear could prevent injury Slippery when wet, ice, morning dew.	Children/ staff		Request prior to the session that parents provide long trousers and long-sleeved top, as well as boots or wellies. Additionally in wet weather, waterproof clothing.	

Walking under or near trees	Provide shade	Child may try and climb or hang off low hanging branches	Children/ staff			Ensure these are cut back to above head height.			
Explore flora and fauna	Experience natural habitats and observing flowers/berries	If rotten, unsteady, may snap and fall.				Check for loose branches after adverse weather.			
Climbing of low branches.	Physical development and wellbeing, gross motor skills encouraged								
	Self-confidence and								
	Communication skills developed,								
	Increase safety awareness								
Contact with animal faeces	Becoming aware of dangers, Ensuring keeping self and others safe.	Contact with animal faeces Toxocariasis	Contact children/ staff			Site to be inspected and cleaned up on day prior to use of area. Gloves, bag, and a cone kept in area if any is found – be removed and cone placed in area to prevent contact. - Report to caretaker.			

Exploring nature in different about seasons and weathers.	Learn seasons and weathers Learn to take care of self and others. Be prepared. Learn when to keep self-safe and why and how.	Sunburn, sunstroke Slips or falls in icy conditions Falls, branches fall from high winds	Children/ staff		Letters home to advise if sunny suncream, applied or provided to nursery Walk slowly and take extra care and appropriate footwear worn. If high winds or blizzards, area is not to be used.			
Walking, or running on uneven natural ground	Develops: Confidence Physical skills, spatial awareness Self-awareness Keep self-safe. Listening skills, following rules	Slippery mud when running. Trip over logs, branches Uneven surfaces	Children/ staff		Remind children - of possible slippery areas - not to throw bark - careful around log circle - First aid kit			
Contact with soil	Beneficial bacteria – building immune system Childhood experience	Ingesting soil Ingesting/absorbing contaminated soil	Children/ staff		Provide washing provisions during and after play. Establish hand washing routines			

Observing hedgerows Stinging Nettles and Brambles and possibly fungi	Curiosity, awe, and wonder Knowledge and understanding of the natural world Trial and error	Scratches, cuts from brambles Stinging rash and uncomfortable from the nettles.	Children/ staff			Suitable clothing Show and remind regularly children the plants, dangers, and consequences of touching them. If touched, adult uses first aid kit, gloves and sterile wipe and tweezers to remove or soothe. Use of a dock leaf for stinging nettles.			
Fruits, berries, other findings	Curiosity Exploration Communication Knowledge and understand of the world	Not edible - poisonous Cause itchy skin or reaches	Children/ staff			Remind children of golden rule Do not pick, do not lick, and nothing goes in the mouth! Especially if red – nature's way to warn.			
Swing – Out of reach			Children			For younger children, put it out of reach, as 1:1 ratio required for age.			

Log Circle	To be a part of a group Sense of belonging Listening skills, Keeping self-safe Self-awareness	Uneven surfaces Trips falls	Children/ staff		Remind children to walk on the outside of the circle and step over logs. Do not walk through the circle.			
Wooden Mud Kitchen	Develops; Imagination, Curiosity Exploration Communication, Teamwork Physical skills	Splinters	Children/ staff		Sandpaper to remove rough edges If broken or damaged, corner off and report.			
Climbing of logs	Improves; Self-esteem and Confidence Teamwork Physical development	Wet and uneven surfaces Falls, cuts, bruises Broken limbs Head injuries	Children		Ensure children are aware of possible risk. Remind children to consider others Take extra care when wet weather. Children closely supervised			

Lifting or moving logs	Improves; Self-esteem and Confidence Teamwork, Physical development Knowledge and understanding of the world – mini beasts etc	Logs could be heavy – strain the body Heavy log, jam, pinch or lay on limb or fingers or feet.	Children/ staff		Ensure children ask for help if too heavy. Remind children to look after their fingers and feet as well as others. Under supervision		
Carrying sticks	Physical development	Heavy, awkward, pointy/sharp Can cause injury to face/body/eyes			Show children how to carry and possibly lash bundles together. Under supervision		
Den Building	Develop confidence and self-esteem Provides cultural and artistic experiences	Collecting materials from ground Sharp objects Animal faeces Cuts, bruises Illness from faeces Use of string	Children		Remind children about potential litter or sharp objects. Do not touch, tell an adult Remove or corner off area Wash hand/antibacterial gel Under supervision		

Cutting Tools Scissors, secateurs	Increases fine motor skills Hand eye coordination Awareness of personal safety Confidence Self-esteem	Cuts, scratches, or injuries	Children/ staff			Show how to use and care for the equipment Correct handling First aid kit Remind to walk when carrying these items. When using secateurs wear a glove on the holding item hand. Under supervision			
Wash hands at the end of the outdoor experience.	Personal care and hygiene		Children/ staff			Ensure all children and staff wash hands after session, using soap and water			

Part 4

The outdoor environment can provide children with freedom to explore natural materials, offering open-ended and engaging learning opportunities (Ryder Richardson, 2014). Duglan (2015) suggests the outdoors and natural materials enhance mathematical and scientific learning, aligning with Nicholson's (1971) loose parts theory and Froebel's theory of 'gifts'. The Welsh Curriculum (2022) emphasises the role of supportive adults in outdoor environment, drawing from Froebel's theory and Montessori's approach which advocate for children's growth in stimulating and rich environments, that promote holistic development.

Play for children is a fundamental need and right identified by the United Nations Convention on the Rights of the Child (UNCRC, 1989, UNICEF, 2019). Gray and McBlain (2014) states play is an important factor in children's development. Furthermore, Ryder Richardson (2014) states children outdoors require space to move around, encouraging physical activity as well as freedom to be boisterous and make noise, whilst having the connection with the natural world. White (2014) agrees, adding the outdoor environment can offer children opportunities to be loud, physical, and busy, whilst still able to maintain their need and want for curiosity within the natural environment.

Movement supports improving children's cognitive development and brain function, and by providing authentic resources (loose parts), adults can help children connect concepts within their environment, fostering a love for learning, through curiosity (Leisman, Moustafa and Shafir 2016). Furthermore, Ouvry and Furtado (2021) and White (2016) agree, stating providing children opportunities for movement and to be active outdoors enhances concentration by boosting blood flow to the brain, which helps strengthen neural connections, making them function more efficiently. Furthermore, Boulton and Thomas (2022) identify children use their senses to explore, enabling children's brains organise information, developing spatial awareness.

The Curriculum for Funded non-maintained nursery settings (CfW, Wales, 2022) highlights the importance of the outdoors and providing opportunities for awe and wonder, therefore benefitting the holistic development of children- physically, socially, emotionally, spiritually, and overall wellbeing, increasing their confidence through exploring, practise and developing skills as well as providing the children with a sense of 'Cynefin' (belonging) within the environment and the adults in it. White (2016) agrees and argues play in the outdoors offers space and freedom of movement, which is paramount for children's development, additionally providing children with awareness of self.

However, Bento and Dias (2017) and Dillon (2014) identify, time spent outside has decreased, influenced by adults' views on the risks of outdoor play and possible accidents, which in turn affects childhood experiences, relationship, and behaviour towards the natural world. Moreover, in accordance with Maslow's Hierarchy of Needs (1943, Aubrey and Riley, 2016) the role of an adult is to ensure a child is safe, in addition to other factors. It is a natural role, adults wanting and needing to protect children, however, it is beneficial for children to learn how to manage minor risks, therefore increasing their confidence (Lucchetti, 2023). Moreover, White (2014) and Ball-King (2022) suggests managing and identifying risks, by a benefit-risk assessment, to advocate for minor risks (as seen in part 3). Furthermore, CfW (Wales, 2022) and Gill (2010) recognise all children are unique and seek awe and wonder therefore, ensuring the role of the adult is to provide authentic and engaging experiences and offering opportunities to take risks and finding solutions, supporting children to grow to be healthy, confident and competent.

Boulton and Thomas (2022) identify the outdoors as a space where children's schematic development can be nurtured, as movements are greater, and creativity is deeper. Furthermore, Piaget's (1972) schema theory, children learn through hands on experience, make sense of their world around them, using repeating behaviours that support development and lead on to new schemas (Athey, 2007, cited Birth to Three Matters). Schemas are usually explored one at a time, the most common schema

according to Ouvry and Furtado (2019) is the 'Trajectory' schema where children are interested in straight lines, such as, dropping items, climbing, building high and jumping. The role of the adult in supporting schemas, is observing play patterns, understanding schemas, following children's lines of direction and adding loose parts to support children's curiosity and extend learning (Boulton and Thomas, 2022).

The role of adults providing children time and space in the outdoors, enabling the children to take the opportunities to explore, and experiment, promoting a child's holistic development, enabling the child to think creatively and to be able to cooperate, as well as to learn about themselves and the world around them from an early age (Bento and Dias, 2017; Ouvry and Furtado, 2019; Tinney, 2022). Additionally, Vygotsky (1978), acknowledges play is being important for children's intellectual development as it builds on their existing knowledge. He emphasised that adults should scaffold a child's potential, using language that meets the child's need, while also challenging and expanding their thinking, helping children reach the limits of their potential (Aubrey and Riley, 2016). However, Malaguzzi (1963) believed adults and children can work together, within the environment that provides the children with a third teacher, deepening understanding and igniting children's curiosity to encourage children to think and ask questions (Biermeier, 2015).

However, MacDonald (2022) emphasises, there is a fine balance of the adults role of enhancing children's play and to overtaking it and making it adult-led. Montessori (1919) highlighted the importance of the adult to observe, by stepping back, therefore enabling the adult to respond to the child individually (Aubrey and Riley, 2016). Similarly, Froebel's (1840) theory identifies the role of an adult to guide children and provide freedom, opening possibilities by enabling children to freely play at their own pace to explore, move, and be creative (Tovey, 2020). Rekers and McCree (2022) agree adults should step back, and actively observe children's play, being available to respond, without interrupting their play, as adult involvement, can unintentionally remove the curiosity and the feeling of play, making it feel more adult- led work. Furthermore, Tinney (2022), adds the benefit of observing is to gain insight in how to support the

children's curiosity further. Additionally, according to Leisman, Moustafa and Shafir, (2016) the adult role in observing is to support early mathematical and scientific learning, therefore enabling adults to create activities that spark curiosity. Piaget's theory (1976) argues that adults should observe children, which supports planning and developing activities that encourage exploration through a child centred and focused approach (Boulton and Thomas (2023).

Dewey (1910) emphasised that curiosity is vital for learning science, and adults should encourage and nurture these traits in children and should learn to recognise them but concentrating on fostering curiosity and wonder instead of only assessing knowledge, enhancing children's engagement in learning (Ye and Shih, 2021). Grigg and Lewis (2016) suggest children asking questions is a way children express their sense of wonder. Furthermore, Dale Tunnicliffe (2017) states for adults to support scientific learning, they need to observe the children, to understand their actions, use language then to scaffold learning with appropriate questions.

Moreover, to support children's independence, Ouvry and Furtado (2019) state the role of the adult is to provide the children with stimulating resources and suggests adding items such as guttering or planks of wood to enhance children's knowledge and curiosity of gradients, supporting building and construction, thereby enhancing mathematical and scientific knowledge. However, Keith (2018) suggests adults should plan for possible learning outcomes, and not just an activity. For example, wheeled resources, the learning outcomes that could be developed are the language of direction, change of speed, estimating.

In part 2 of this assignment, the adult could add materials such as a tarpaulin, ropes etc, then children could make dens. According to Keith (2018) mathematical learning such as, positional language, developing spatial awareness can be enhanced outdoors.

Montessori, believed the environment and materials should provide children with freedom to choose, whilst encouraging the use of 'real life' hands on resources (Aubrey and Riley, 2016) Similarly, Froebel (1840) advocated learning materials, he referred to as 'gifts' being three dimensional and believed children were naturally creative and play enables children to express their creativity (Aubrey & Riley, 2017). Moreover, Whinnett (2020) simplifies Froebel's open-ended 'gifts' to how they are interpreted today, as block play, developing mathematical skills for example, geometry – shape, distance, angles, measuring, symmetry, reflections, matching, and problem solving.

Furthermore, Tinney (2022) suggests adding loose parts can enhance a child's learning further, particularly mathematically and scientifically. Loose parts can be natural objects, i.e. fir cones, sticks that children can carry, move, and have no direction for use, keeping the use open-ended for children to explore creatively (Sisson and Martha 2017). Additionally, Flaxbeard (2019) identifies the scientific benefits of investigating and building with loose parts, such as developing the understanding of the concepts of gravity, motion, force, weight and more. Whereas noting the mathematical benefits of loose parts, for example, noticing patterns, matching, sorting, sequencing, separating, and measuring. Casey and Robertson (2019) list many natural resources to support Nicolson's loose parts theory such as mud, sticks, pinecones, water as well as planks of wood, hammer and nails. These opportunities are offered by being outdoors or with natural materials (loose parts). Therefore, children gain the affordance of an object which is unique to each individual, for example in the photograph in part 1, a child may find a stick and use it as a walking stick, another could use it as a precious poker, to keep themselves safe but explore the environment around them. (Gibson, 1979, cited Casey and Roberston, 2019).

Conclusion

Play is a fundamental need and right of a child (UNICEF, 2019). Through play children can explore at their own pace, when provided with time and freedom, children are able to make sense of their world around them, and their experiences are greater developing them holistically (White, 2014; Bento and Dias, 2017; Tovey, 2020; CfW, Wales, 2022; Canning and Rekers, 2022). Additionally, CfW (Wales, 2022) emphasises the importance of developing the sense of belonging 'Cynefin' from the environment and adults within it. Reinforcing Malaguzzi's (1963) belief that the environment provides the children with a third teacher and enables the adult and child to work together (Biermeier, 2015). Tinney (2022) adds, the outdoors in particular can provide many opportunities for children to develop mathematical and scientific knowledge especially through adding loose parts. Additionally, Boulton and Thomas (2022) state, children playing and exploring the outdoors heightens the uses of children's senses as well as enabling children to use the outdoor environment and natural resources (loose parts).

Enhancing the environment with loose parts can offer children endless opportunities to explore, sparking their curiosity and offer opportunities for them to experience awe and wonder and igniting curiosity (MacDonald, 2022; CfW, Wales, 2022). Boulton and Thomas (2022) emphasises loose parts providing children with affordance, bringing individuals the opportunity to perceive them to be anything. However, the outdoors provides children with risks, which supports holistic development and relationship to the natural world (Bento and Dias, 2017).

MacDonald (2022) emphasises the important role of an adult providing a fine balance of standing back and intervening in the play and changing the outcome to adult-led. Whilst supporting children's curiosity and exploration through play, adults should step back and observe and waiting for the child to invite the adult into their play (Montessori, 1919, cited Aubrey and Riley, 2016; Casey and Richardson, 2019).

However, when adults observe children, their learning can be enhanced, in particular with scientific learning, responding to questions and using language to enhances

children's knowledge, by asking the child appropriate questions (Dale Tunnicliffe, 2017). Additionally, observing enables adults to support children's development, in particular, schemas, Piaget's theory (1972) where children are making sense of the world, through hands on experiences (Athey, 2007 cited Birth to Three Matters).

Additionally, adults through observing can assess risky play in the outdoor environment supporting children's natural urge for curiosity and by managing and identifying risks prior through a benefit-risk assessment, supports children's natural desire for curiosity and safety (White, 2014; Ball-King, 2022).

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AI

I confirm that I have not used any AI tools in the research and creation of this assignment. I confirm that I have not presented any AI generated materials as my own work. I confirm I have copies of my drafts, notes and other resources I used, which I may be asked to provide in evidence.