

Awe and wonder- science, mathematics and the outdoors

1.



2.

The image above shows the outdoor area of a Care inspectorate Wales registered childminding setting, the setting is registered to provide care for children from under one years old, up to 12 years of age, however, the setting is predominantly used by preschool children ages three to four years old. During the covid 19 pandemic of 2020 there was a push by the Welsh Government to ensure children spent more time in the outdoors to reduce the risks of transmitting covid 19 and to promote holistic wellbeing. As part of this push funding was available to improve outdoor areas in settings registered to provide the Childcare offer Wales. As a result, the setting shown received a £5000 grant and much of what is pictured was purchased with these funds.

The area has been designed to ensure children can be outdoors all year round and, in all weathers, with the polytunnel providing shelter from wind, rain and the cold, and the decked area being under sunshades which protect the children from the sun during the summer as well as rain if the children choose to shelter and keep dry.

Having access to an all-weather outdoor environment allows the children at the setting to have a fully immersive and hands on experience of the food cycle, from the planting of a seed to eating the produce and every stage in between. The curriculum for funded non maintained settings (Education Wales, 2022) states that spending time outdoors provides children with multi-sensory opportunities for purposeful learning filled with awe and wonder, where children can develop cross curricular skills in authentic environments while gaining an understanding of their impact on the world.

Below is an example of how focusing on the food cycle with one group of children spanning over 3 seasons, not only allowed the children to gain an understanding of where our food comes from, but also embraces other scientific and mathematical concepts such as the weather, seasons, hibernation, numeracy, time, measurements, and much more.

Spring

During the spring term as the weather becomes warmer the children notice small changes in the environment around them, they begin to see signs of life around them, they notice insects appearing in the polytunnel, plants sprouting where previously there was dirt and lambs in the adjoining field, we discuss what we see and how the sun is starting to feel warm on our skin. “Do we think the insects are noticing this too? What about the plants?” I ask the children. One of the children questions where the insects have been all winter, sparking a conversation about hibernation, “But what do they eat?” another child asks. We discuss the food cycle and how some animals collect food to store for winter. The discussion moves on to how different animals survive through the winter. The children decide they would like to grow food to ensure next winter all the animals can eat. During the next session the children are provided with the items needed to plant cucumbers, we discuss what seeds need to grow, “they need rain”, one child shouts while another asks “do seeds need dinner like us?”, we discuss how living things have similar basic needs, a safe place to live, some food, drink and warmth, for plants this is shelter until they are strong enough to withstand the wind and rain, the right amount of water, nutrients from soil, warmth from the sunshine just like heating our houses and also sunlight to help the plant to grow big and strong. I demonstrate to the children how to pot up a seed and they work as a team to carefully measure the compost into each pot, using sticks or fingers to make a hole for the seed. The children carefully separate the seeds counting one into each hole. Each child waters their seed and we discuss the best place to put them away from the wind and the cold. The children ultimately decide on the log table inside the poly tunnel where the sun is currently shining. Later that

afternoon one of the children announces “I checked but the seeds aren’t cucumbers yet”, sparking a conversation about time, “sometimes things happen quickly and sometimes things take a long time”, I explain that the plants might grow a little bit by the next time they visit but they need lots of looking after to get big and strong and the cucumbers won’t be ready for a very long time. During the next few sessions the children plant and care for a number of other plants and seeds giving them a sense of independence and allowing opportunities for trial and error, one child collects a bucket of water from the water butt to water their seed, however soon realises that pouring a whole bucket of water into a small pot washes the seed and the compost from the pot, I reassure the child that it is okay and they can try again, prompting them to problem solve and choose a more suitable vessel to transfer the water.

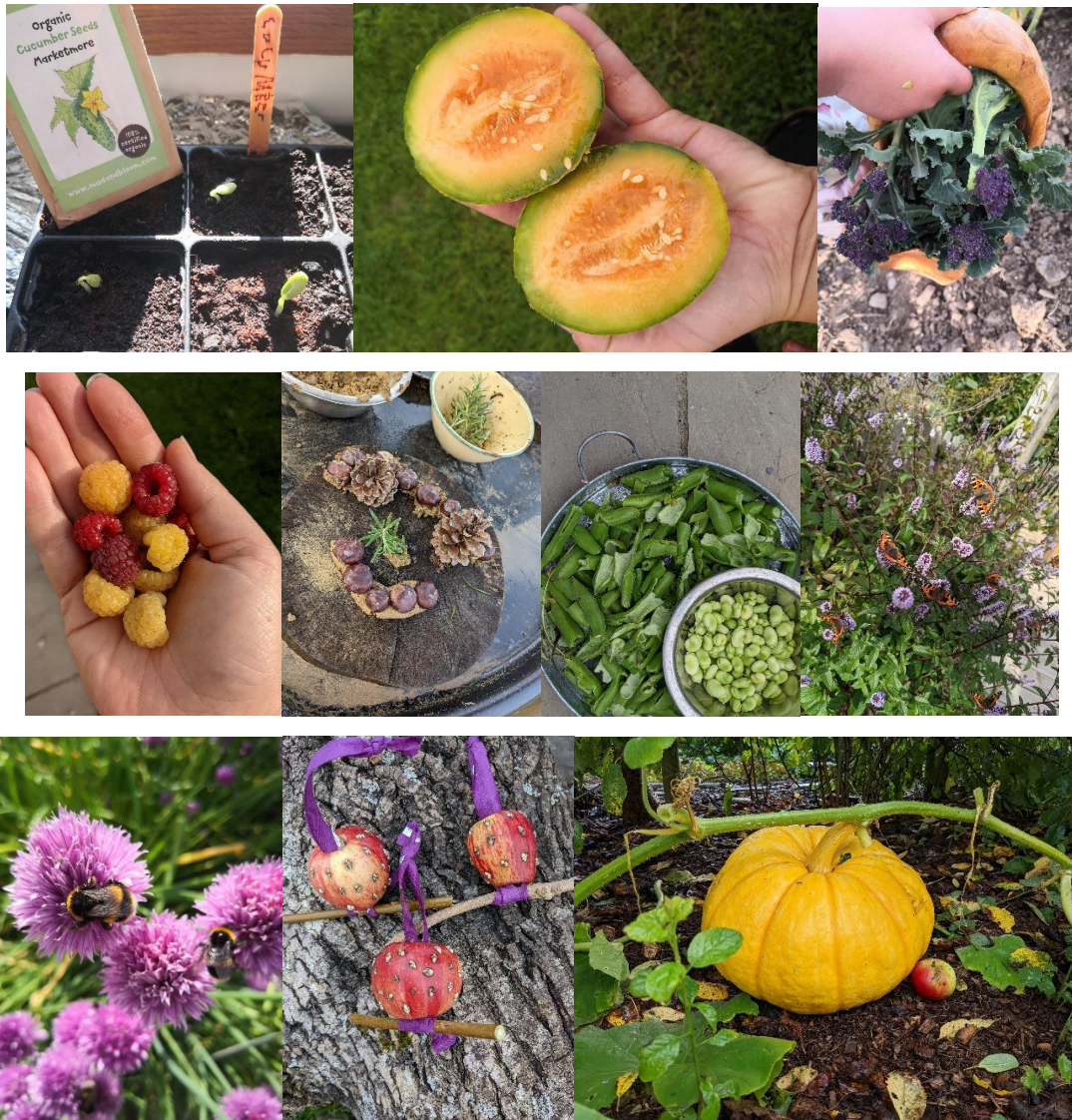
Summer

During the spring the children planted and tended to a number of seedlings, many of the plants grew, some did not. As the summer arrives, the plants we have cared for are planted out. The weather becomes warmer, and it soon becomes apparent the water butt is empty, with one child announcing, “the water has stopped working”. This provides discussion on where the water in the water butt comes from, and how, as the seasons change so does the weather, in the spring there was lots of rain but now the weather is warmer there is more sunshine and less rain. I show the children how if water is spilt on the ground, it dries quickly, this gives opportunities to practice writing names and shapes on the path with water and seeing them disappear. I explain that the heat dries up the water and this is the same in the soil, although there is less water to be had the plants will need watering more, we discuss how we can water the plants now the water butt is empty, “My daddy uses the hose pipe!”, one child shouts.

Autumn

As autumn arrives the children have had multiple experiences of picking and eating the food they have grown, including strawberries, melons, raspberries, broad beans and the cucumbers they planted in the spring. The herb garden has been used to make a wealth of perfumes, potions, and mud pies along with wood chip and crushed shells from the garden. The days begin to seem darker and the insects that fed from our plants all summer long begin to disappear. The children’s thoughts turn to Halloween with our pumpkins beginning to appear. Each day the children ask to check the pumpkins, “I want my pumpkin to be the biggest in the world”. We place an apple by the biggest pumpkin to compare the size of the pumpkin to the apple each day. One child wraps their arms around the pumpkin until one day they exclaim “it’s too big, I can’t cuddle it anymore!”.

The children notice that something has been nibbling at the apple, “the birds are hungry.” Says a child, their thoughts turn to feeding the birds and how there is now less food for them as the days get colder, the children decide we need to begin feeding the animals and this turns to conversations of hibernation. As we collect seeds from the sunflowers we grew over summer and pierce them into the skin of fallen apples, the children talk about how they will feed the birds all winter with one child announcing, “I want to look after all the nature”.



3.

RISK BENEFIT ASSESSMENT

Location / Activity:		Garden Play area		Date:	25/09/2023
Assessor:		Hayley Severs		Review date:	Continuous
Experience exploring outdoor space in photograph	How will young people benefit from this activity?	Hazards and associated risks	Who is at risk?	PRECAUTIONS in place to reduce the risk of injury	Overall risk after precautions RATING: L/M/H
Planting seeds	Gardening with children provides opportunities for gross and fine motor development. When children are included in the whole process gardening allows opportunities for a greater understanding of mathematical and scientific concepts and gives children a sense of responsibility both individually and as part of a team. Gardening can have a positive impact on wellbeing as well as allowing children to understand where their food comes from and support healthy eating habits.	Water – Practitioners should be mindful that any body of water holds a drowning risk. During summer months water left standing in hose pipes carries the risk of scolds. Standing water has an increased risk of water borne pathogens and disease. Animal excrement – Animal excrement carries the risk of parasites, infection, and disease. Tools- Cuts and injury from sharp edges or damaged tools. Ingestion – Some seeds and compost may be treated with pesticides which are toxic. Ingesting seeds and compost may also carry a choking risk, risk of disease and illness or plant toxicity.	Early years practitioners, children, visiting personnel	Water butts – Water butts should be always kept covered to ensure no person or animal can fall into them or become trapped or drown. During hot summer months water butts should be monitored and fully emptied weekly to ensure risks of water borne diseases are reduced. Water butts should not be used for drinking water. Everyone should be encouraged to wash their hands with warm tap water after using any form of standing water. Hose pipes. Hose pipes should be fully emptied after use and stored out of direct sunlight to ensure any remaining water cannot cause scolds. To avoid accidental scolding the hose pipe should not be left attached to the tap. Adults should carefully set up the hose ensuring the water is running cold before children are free to use it. Animal excrement All areas where animals have access should be checked for excrement before use and any excrement as well as soil etc which has had direct contact should be removed, where	low

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				possible high-risk areas such as long grass and sand or loose chippings should be fenced off so animals cannot gain access. Hands should be thoroughly washed using warm tap water and an appropriate soap after handling high risk substrates. Tools Tools should be regularly checked and maintained to ensure they are safe to use. Where tools have sharp edges or moving parts, everyone using them should be taught how to use them safely with children being supervised at all times. Ingestion. Small children often explore using their mouths. Where possible children under the age of two should use taste safe options. However, as this is not always possible practitioners should ensure constant supervision. Organic options will ensure no toxic substances have been added. Children should be made aware that the items should not be consumed, and hand washing should be encouraged after the activity is complete.	
Being outdoors in all seasons	Being outdoors in all weathers gives children immersive and holistic cross curricular experiences. Children experience the opportunity to move freely with the option of a much greater range of moving than can be achieved indoors including climbing, running, jumping, swinging, and sliding.	Sun – Practitioners and children should be aware of the risks of sun exposure, these include sunburn, dehydration, and heat exhaustion / sunstroke.	Early years practitioners, children, visiting personnel	Appropriate clothing Practitioners should ensure that everyone is dressed appropriately for the weather. This includes wearing sunhats thin long sleeved clothing during the summer and multiple thin layers and warm hats during colder months. All staff and children should wear	Low

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	The outdoors provides endless opportunities for experimenting with cause and effect allowing children to take risks and learn to manage risk independently. Being outdoors gives children a greater understanding of the natural world and the environment, encouraging respect and a desire to protect the world around them.	Wind - During high winds there are risks of flying debris which may cause injury or damage to property. Children and practitioners may have difficulties in maintaining balance thus increasing the risk of injury. Rain – Rain can make surfaces slippery, increasing the risk of slips trips and falls. Where clothes become soaked there is a risk of being unable to maintain body temperature. Cold – During cold spells surfaces may become icy. Ice may make some surfaces slippery increasing the risk of slips, trips, and falls. Touching icy surfaces can cause ice burns. During cold spells there is a risk of hypothermia due to body temperature dropping.		appropriate wind and waterproof clothing such as all in one suits or coats and waterproof trousers as well as wellington boots during the cold and wet months. Suncream and shelter Suncream should be applied regularly during the day in all seasons. Practitioners must ensure permission is sought to apply suncream. During summer months shade should be sought between the hours of 11am and 2pm. Hydration Drinking water should be always available, practitioners should encourage children to drink regularly especially during hot weather. Wind Where the forecast mentions gusts of wind of 35mph or higher the practitioner should take the decision to move activities indoors to ensure everyone's safety. When wind speeds are above 20mph practitioners should dynamically risk assess taking into consideration other factors such as air temperature and rain as to whether it is safe and beneficial for the children to be outside. Warm drinks should be offered during prolonged periods outside during cold and wet weather. Slippery/ Frozen surfaces Practitioners should ensure surfaces are well maintained and safe. The decked area and	

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				other wooden surfaces should be treated with preservative annually to decrease risk of algae build up. Where the ground becomes muddy, practitioners should ensure everyone is aware that there is a risk of slipping and where possible provide a secondary route for those who may need a sturdy surface. Icy surfaces should be treated with care or avoided if when walking the risk of falling becomes high. Metal surfaces such as poles should be covered during frosty periods to avoid ice burns. Warm waterproof gloves should be worn during colder months when handling snow and ice for prolonged periods.	

3.

Vygotsky believed that children have the ability to learn from the adults who guide them, however, Vygotsky also theorises that play or self-education is fundamental to a child's learning and development, this play allows children to emotionally regulate and form their own boundaries as well as following the rules of others (Macblain, 2022), furthermore, Education Wales (2022) recognises that adults are an integral part of supporting children's innate desire to learn, ensuring that natural learning opportunities are approached in a playful way, igniting children's sense of awe and wonder. This is reflected in the Reggio Emilio approach, which puts the child at the centre of their development, with the adult providing the child with agency over their learning style and considers the 100 languages of the child, to support long term learning opportunities which follow the child's interests (Senent, Kelley and Abo-Zena, 2021). In addition, Maria Montessori placed an emphasis on the role of the adult preparing the environment for purposeful learning, stressing that being immersed in nature and having freedom to explore and experiment with realistic

boundaries is the only way a child can develop (Montessori Family, 2021). Jean Piaget's theory on assimilation and accommodation reflects this by placing an emphasis on the impact the environment has on a child's learning, noting that when children are able to manipulate their environments, learning is promoted (Macblain, 2022). Thus, it is imperative that adults realise the significance of their role in providing rich outdoor environments that promote exciting opportunities for cross curricular learning (Education Wales, 2022).

Bruner believed that children should be scaffolded. This places an emphasis on adults working with children to support their learning, Bruner believed this process should be flexible and child centred where the adults provide environments loaded with purposeful opportunities to learn through exploration (Macblain, 2022). Moreover, Robertson (2017), explains that the role of the adult is to look at the outdoors through a different lens, considering everything in the environment as a possibility for mathematical development, furthermore, Brunelle (2016) states that every child is a natural scientist, learning and experimenting through play and exploration, but this can only be achieved when adults provide the environment and opportunities to do so.

Patet (2016) states that through adding new and interesting materials into environments, children can be encouraged to build on mathematical concepts or consider new mathematical ideas. A study by Spencer *et al.* (2019) found that introducing loose parts to outdoor areas benefitted children in multiple ways, including sparking curiosity, promoting independence, and encouraging children to take risks. These findings are reflected by Daly and Beloglovsky (2015), who describe loose parts as a tool to unlocking awe and wonder within children, allowing them to problem solve and think imaginatively without prescriptive ideas or targets. McLennan (2017) describes the outdoors as being a treasure trove of natural materials, such as leaves, feathers, pebbles and sticks, providing endless opportunities for mathematical and scientific learning as a natural part of outdoor play. Additionally, Cree and Robb (2021) describe forest school areas as having an abundance of natural loose parts which can be used as the imagination desires, spanning all areas of the curriculum. Loose parts are described as being beautiful and tactile objects that can be reimagined by children and used endlessly in many different scenarios, children can manipulate them and transport them in many ways with no specific defined purpose or outcomes (Daly and Beloglovsky, 2015). Spencer *et al.* (2021) report practitioners finding challenges with sourcing and storing loose parts, noting that practitioners question the sustainability and longevity of using these resources. However, Play Wales (2017) explain that through careful consideration and a little imagination many barriers to sourcing and storing loose parts can be overcome. Parents

often comment on spending large sums of money on the must have toy for their child and all the child played with was the packaging, often children prefer to play with items that stimulate their sense of awe and wonder, where the item can become whatever they desire (Daly and Beloglovsky, 2015). Through the use of loose parts, curriculum aims happen naturally, with trained playworkers stepping back and allowing children to experiment, discover and push their limits (Play Wales, 2017). However, Spencer *et al.* (2019) note that many adults struggle to change their mindsets, often reverting to being risk adverse or being prescriptive with how children engage with materials or their environment. Being risk adverse and controlling a child's play is an indisputable way to extinguish a child's natural curiosity, explain Robb and Cree (2021). Instead, Robb and Cree suggest, practitioners should be armed with an understanding of the importance of child directed play and perform risk benefit analysis to reinforce awareness of the importance of risky play.

Cree and Robb (2021) state that a practitioner must observe everything, including the unwanted and unexpected, only when every sense is used can the practitioner gain a full understanding of what is going on. Likewise, Bruner placed an emphasis on the adults knowing what the child was already capable of and using this as a base to promoting learning. (Macblain, 2022). Patet (2016) notes, that through observation and understanding of what children are drawn to and their current mathematical understanding, environments can be updated and adapted to meet the child's individual needs. Furthermore, through a flexible approach and being ready to follow the child's lead a practitioner is able to develop the child's learning through prompts, resources and activities which promote independent learning (Robertson, 2017). It is the practitioner's role to facilitate this extension of learning through providing opportunities to challenge and engage the child appropriately (Brodie, 2018),

One study by Tricket *et al.* (2022) suggested that adult directed mathematical activities for preschool children had a similar impact on overall numeracy outcomes as child-led mathematics, however, a study compiled by Maynard, Watter and Clements (2013) showed that although practitioners stated being outdoors required more organisation and planning than being indoors, the overall occurrence of child led activity was substantially higher while being outdoors, moreover, the majority of practitioners found the child led learning in an outdoor environment was of benefit to the child, providing them with experiences for deeper exploration with more freedom and opportunities to learn.

Although the benefits of outdoor learning are becoming well known there are multiple factors which impact practitioners' ability to get outdoors with a large group of children (Marte and Waite, 2022). Maynard, Watter, and Clements (2013) state that many practitioners find the facilitation of an outdoors provision to be challenging with time constraints, weather and inappropriate clothing all causing barriers to accessing the outdoors, with many claiming to access their outdoor areas less than once a week. Moreover, Marte and Wate (2022) state that many practitioners find their curriculums to be too prescriptive to allow for the freedom outdoors brings and others find concerns over safety to be a major barrier. Robertson (2017) suggests that many barriers can be overcome through planning and routine, when being outdoors becomes part of routine it no longer feels like a challenge and obstacles such as meeting curriculum expectations can be overcome by viewing maths and science from the learner's perspective.

When children play it is not uncommon for an adult's presence or interference to diminish the play cycle, to avoid this and allow an adult to be part of the play process a child may need to view the adult as an equal part in their play (Keith, 2018). Keith explains that through sustained shared thinking the adult can become part of the child's peer group, thus giving them opportunities to enrich their mathematical learning through prompts and questions, such as "what if...?" Davies *et al.* (2014) defines sustained shared thinking as one of the key components in pedagogical excellence, furthermore, Purdon (2016) explains that sustained shared thinking is considered an important factor in improving child outcomes. Sustained shared thinking builds on many of the topics discussed previously, with Purdon (2016) explaining that sustained shared thinking allows adults to scaffold a child's learning while the adult also makes their own learning visible. Purdon notes that it is important for the adult to admit that sometimes the child will have a greater understanding of a scientific or mathematical concept than the adult, but the practitioner must use that knowledge as well as knowledge from their observations to plan opportunities to expand on the child's learning. Moreover, it is also believed that sustained shared thinking is pivotal in encouraging critical thinking in the early years allowing, children to make sense of mathematical and scientific concepts (Davies, *et al.* 2014) However, Boyd (2014) describes the challenges faced by practitioners, especially those in school settings who are so overwhelmed with meeting the needs of the curriculum, that finding time to implement sustained shared thinking is increasingly difficult, however Boyd notes that when teachers use transportable identity, such as taking on the role of a class mate and asking the child to teach the adult, these barriers are eased.

In conclusion, there are many ways in which the practitioner can support and encourage a child to engage with mathematical and scientific concepts in the early years, however, it is apparent that the practitioner's input is pivotal in promoting positive outcomes. Through sustained shared thinking the practitioner can gain an insight into the needs and interests of the child and promote a truly child led learning experience where the child's innate desire to explore and develop is nurtured through creating an environment rich in opportunities for awe and wonder. This can be achieved through the careful addition of items such as loose parts to the prepared environment and looking at maths and science in the outdoor from a new perspective. Although practitioners may face barriers in accessing and implementing these approaches, with a little imagination and some additional planning, providing enriching mathematical and scientific learning opportunities in the outdoors can become a natural part of an early years settings day.

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