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Awe and Wonder. Science, Maths, and the outdoors.

Part 1.

3,825

words.

The Photograph.



A Rainy Day in the Woods.

(source; Williams,2024.)

Part 2.

A rainy day in the woods can serve as the perfect opportunity to introduce early years children to the wonders of maths and science, blending the joys of outdoor play with meaningful, hands-on learning. In line with the Welsh Government's new curriculum (2020), these experiences create an atmosphere where children can explore the natural world with a sense of awe, making abstract concepts more beneficial through active engagement.

Recently, I led a group of five children, aged 3-4, on a woodland adventure. The day was drizzly and grey, with large puddles forming along the muddy trail. The sight of these puddles instantly captivated the children's attention. Their faces lit up with excitement, and I used the moment to ask, "Can you jump in the puddles? What happens when you do?" This simple question prompted them to jump in enthusiastically, leading to discussions about the water splashing up, the shape of the puddles, and even how the raindrops felt against their skin.

One of the children asked, "Are the raindrops hot or cold?" This question revealed their natural curiosity and desire to understand the world around them. According to the Welsh Government (2020), such hands-on, exploratory experiences are key to a deeper understanding of subjects like science. The splashing of puddles, the feel of the rain, and the different shapes they observed as they played laid the groundwork for discussions about the physical world—how things move and change, basic physics in action.

As we ventured deeper into the woods, the children's fascination continued to grow. I turned the walk into a counting game, encouraging them to count each step as we moved forward. Some of the children counted well beyond 20, each number marking not just a step but of quantity and sequence. The trees lining our path became the next focus, their towering presence providing a natural opportunity to introduce comparisons in size. "Which tree is taller?" I asked, sparking a discussion about height and measurement. The children used their arms to compare, wrapping them around the smaller trunks and wondering how they could not do the same with the bigger trees.

Through this activity, the children were actively engaged with mathematical concepts like size, height, and comparison—all while enjoying their time outdoors. They demonstrated divergent thinking by making decisions on their own, such as ducking under trees to avoid the rain. I pointed out the birds in the branches above us, asking, "Can you hear the birds singing?" This sparked further curiosity about wildlife, leading to one child asking, "Where do the birds live?" Such moments highlight how outdoor play allows children to think critically and make discoveries on their own terms, in line with the Welsh curriculum's emphasis on active, exploratory learning.

When we reached the riverbank, the children immediately set about collecting twigs, each one a different size, shape, and texture. We examined these twigs together, discussing their qualities—how some were smooth while others were rough, some heavy, some light. The children with larger sticks started drawing in the mud, their laughter rising with the squelching sounds, while others preferred using smaller twigs, only to quickly realize that the bigger ones worked better for drawing in the wet ground. This simple, joyful activity was filled with learning opportunities: comparing the sizes of the sticks, problem-solving, and understanding cause and effect.

These activities align with the Welsh curriculum's encouragement for children to explore early mathematical concepts through play. As they drew in the mud, they experimented with shapes and spatial reasoning without even realizing it. Their discoveries were their own, guided by natural curiosity and facilitated by the rich learning environment the outdoors provided.

As the children continued their creative exploration, some began tossing their twigs into the river to watch them float away. This led to a spontaneous science lesson: "Will it float or sink?" The children were amazed by the sight of the twigs bobbing on the water's surface. I took the opportunity to explain in simple terms why the twig floated—it was less dense than the water. This fascinated the children, who marvelled at the simplicity and wonder of the natural world. The Welsh curriculum (2020) emphasizes the importance of inquiry-based learning, and this moment allowed the children to discover scientific principles through direct observation and interaction with their environment.

As we watched the twigs float downstream, the children made another exciting discovery: a small frog hopping near the riverbank. The group gathered around in delight, careful not to scare the frog away. "I see a frog!" one of the boys said, and the conversation quickly turned to the frog's life cycle and habitat. We talked about where frogs live, what they eat, and whether we might see tadpoles in the water. This impromptu biology lesson offered the children a glimpse into the animal kingdom, helping them connect with the living world in a way that a classroom lesson might not have been able to.

The Welsh curriculum advocates for children learning through experimentation and play, and the rest of our day embodied this perfectly. After observing the frog, some of the children expressed interest in walking into the shallow part of the river. With guidance and safety in mind, we stepped into the cool water, feeling the texture of the riverbed beneath our feet. This immersive sensory experience engaged all their senses—the cool splash of water on their skin, the soft squish of mud underfoot, and the gentle plop of raindrops hitting the river's surface.

The children were particularly fascinated by the ripples forming from both the rain and their movements in the water. One of them asked, "What makes the ripples?" which gave me the chance to explain how energy moves through water, creating those circular patterns. It was another example of how the natural world presents constant opportunities for scientific inquiry, allowing children to learn through their senses and direct engagement.

Despite the rain growing heavier, the children remained eager and excited. As we listened to the sounds of the rain falling on leaves and water, one child commented on how quiet it was compared to their usual surroundings, saying, "There are no cars or lorries here." This remark revealed their growing awareness of their environment, a reminder of how important it is to provide young children with time in nature, away from the constant hum of urban life.

Before heading back, I encouraged the children to cross the river by stepping on the stones that jutted out from the shallow water. This required them to assess the stability of each rock, testing their balance and spatial awareness. It was more than just a fun activity—it was a chance for them to develop important life skills like decision-making and problem-solving, while also building confidence in their ability to navigate challenges. The Welsh curriculum emphasizes the value of taking calculated risks, and this moment provided just that—an opportunity for the children to test their limits in a safe and supportive setting.

As our woodland adventure ended, I reflected on the many learning opportunities that the day had provided. From jumping in puddles to counting trees, discovering wildlife, and exploring how raindrops create ripples, the children had engaged in deep, meaningful learning without even realizing it. This approach—allowing children to lead their learning through play and exploration—ensures that their experiences are not only educational but also memorable and fun.

The day offered four key natural learning opportunities:

Jumping in puddles – A fun introduction to the basic principles of physics, like motion and splashing.

Counting and comparing tree sizes – A hands-on exploration of early mathematical concepts, such as measurement and comparison.

Observing a frog's habitat – A direct interaction with biology, fostering an understanding of life cycles and ecosystems.

Watching raindrops create ripples – An engaging way to introduce scientific principles like cause and effect and energy transfer.

By allowing the children to explore at their own pace and follow their curiosity, the day became a powerful example of how the natural world can serve as the ideal classroom. As the Welsh curriculum advocates, this child-led approach ensures that learning is rooted in their natural sense of wonder, making it more meaningful.

Part 3. Risk assessment.

<u>Activity</u>	<u>Risk benefits?</u>	<u>Hazard (potentially dangerous activity or physical item</u>	<u>Risk (innocent/a ccident that may happen)</u>	<u>Likelihood and severity</u>	<u>Action to remove or reduce risk</u>	<u>Who?</u>	<u>When?</u>	<u>Risk level (when actions observed.)</u>
River crossing		Potential slippery floor, chilly water, and rocks.	Slips and falls may occur. Falls into water. Slipping on wet or unstable stones. Cuts or scrapes from large rocks.	Likelihood-possible Severity-minor- (may involve first aid)	Assess the stability of stones before allowing children to step on them. Ensure the water depth is shallow and slow-moving. Advise children to wear waterproof, sturdy footwear. Have an adult positioned on either side of the	Children and adults.	Before and during the activity.	Medium.

					river to assist if necessary. Brief children on the importance of moving slowly and carefully across the stones. Ensure children stay within sight and arm's reach of supervising adults. Provide first-aid kit for minor injuries, such as cuts or scrapes.			
Jumping in the puddles.	Jumping in puddles can be an exciting outdoor experience for	Potential slippery floor and chilly water.	Slipping and falling on wet ground. Hypothermia from	Minor-may involve first aid	Ensure children wear waterproof clothing and boots.	Children and adults.	Before and during the activity.	Low.

Counting and comparing tree sizes.	children, enhancing their sensory development, motor skills, and enjoyment of the natural environment This activity involves children exploring a wooded area to measure, count, and compare tree sizes. It encourages physical movement	Uneven grounds, unvisable stumps on the ground, dangerous objects on the ground, bee, or wasp nests.	getting wet and cold. Tripping on uneven terrain Tripping over roots or uneven ground Striking branches at eye level Bee or wasp	Minor- may involve minor first aid.	Inspect the area for any hidden obstacles or deep puddles. Encourage children to jump in designated areas with even surfaces. Keep an eye on weather conditions and ensure children dry off or change into warm clothes if needed. Walk the area beforehand to identify any hidden roots or branches that could pose a risk.	Children.	Before and during the activity.	Low.
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	and cognitive skills, as children learn about nature, biodiversity , and mathematics.		stings near tree bark		Instruct children to be mindful of their surroundings, and not run between trees. Ensure children avoid disturbing wildlife, such as bees or wasps, near the trees.			
Observing the Life Cycle of a Frog	This hands-on activity involves children observing frogs and tadpoles in shallow ponds or streams, enhancing their understand	Shallow running water,	Falling into the pond or muddy areas Risk of drowning (if near deep water) Bacterial contamination from water	May involve first aid.	Clearly mark boundaries around the pond and ensure children stay within the safe zone. Keep a close eye on	Children and adults	Before and during activity	Medium.

	ing of life cycles, ecosystem s, and aquatic habitats.				children, especially near water, and maintain a low student-to-adult ratio. Encourage handwashi ng or sanitizing after the activity to prevent bacterial exposure.			
<u>Walk to and from the woods.</u>	Walking to and from the woods is an essential part of outdoor learning, providing children with the opportunity to explore nature, exercise, and	Traffic Hazards (Crossing Roads and Walking Alongside Roads). Uneven Ground	Slips, Trips, and Falls.	Medium (may involve first aid)		Children and adults.	High Visibility Clothing Close Supervision Pre-Walk Briefing Buddy System Route Inspection	Medium.

	develop awareness of their surroundings. However, walking in a group, especially with children, presents certain risks that need careful consideration. This risk assessment outlines the potential hazards and provides strategies to mitigate them, ensuring a safe and enjoyable experience for							
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	everyone involved.							
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*Emergency procedures

Ensure a fully stocked first-aid kit is on-site.

Have a designated meeting point in case of emergency.

Keep mobile phones charged and accessible for emergency calls.

Inform children of safety rules before starting each activity.

Ensure supervising adults are familiar with basic first aid and emergency response procedures.

Part 4.

Outdoor learning offers substantial benefits for both early years and primary-aged children, helping them develop holistically through hands-on experiences. As Waite (2017) suggests, outdoor environments provide a unique learning opportunity that goes beyond the traditional classroom's constraints, contributing to children's cognitive, emotional, and physical growth. Practitioners play a pivotal role in this process by applying critical thinking and reflective practice to enhance outdoor learning opportunities. This demands not only awareness of how different spaces support varied learning experiences but also a willingness to adapt and respond to children's individual needs. Hodgman (2012) emphasizes the importance of adults in creating enabling environments outdoors, which encourages children to engage in a broad spectrum of learning, particularly in subjects like mathematics and science. These environments should be thoughtfully designed to invite exploration, promote inquiry, and allow for risk-taking, all of which are essential for fostering independence and problem-solving in young children.

Outdoor learning offers children the flexibility to explore creatively, take ownership of their learning, and develop new skills within dynamic, engaging environments. Hodgman (2012) argues that this sense of agency is fundamental for children's self-confidence and ability to approach problems with innovative solutions. By allowing children the space and freedom to make decisions about their activities, practitioners can support deeper learning outcomes that reflect the natural integration of physical, social, and intellectual development. Moreover, by incorporating natural elements, children can apply their understanding of mathematical and scientific principles in real-world contexts, thus fostering learning through discovery.

To maximize learning potential in mathematics and science, practitioners must adapt outdoor spaces to meet children's developmental needs. Kirvanta et al. (2023) suggest that extending learning beyond the traditional classroom fosters holistic engagement, allowing children to explore complex concepts through play, exploration, and movement. Outdoor environments allow for an embodied learning experience where children use their bodies and senses to interact with natural elements, thereby deepening their understanding of abstract ideas. Research consistently shows that hands-on experiences enable children to solve problems organically, supporting deeper learning and critical thinking. This type of

learning aligns with the Welsh Government's (2022) emphasis on experiential learning in the new Welsh curriculum, which identifies outdoor exploration as vital for developing mathematical and scientific understanding in early years of education.

Mathematical and scientific concepts emerge naturally in outdoor play. For example, children might explore ideas of quantity and measurement by collecting leaves, stones, or other natural objects. In doing so, they engage in sorting, counting, comparing, and categorizing—skills central to mathematical thinking. Simultaneously, observing the natural world fosters scientific inquiry. Children may question why certain plants grow in specific areas, investigate the behaviour of insects, or hypothesize about changes in the environment. These explorations connect learning with the world around them, demonstrating that outdoor environments are uniquely positioned to support the development of both scientific and mathematical thinking through active engagement.

The Role of Loose Parts Play in Outdoor Learning

A particularly effective approach to enriching children's outdoor learning experiences is through the inclusion of loose parts play. Flannigan and Dietze (2017) observed that when children engage with loose parts—open-ended, flexible materials—they demonstrate a variety of positive behaviours, including problem-solving, collaboration, and risk-taking, all of which are essential for cognitive and emotional development. Loose parts play provides children with materials that can be manipulated, moved, and transformed, offering endless possibilities for exploration and creativity. By encouraging children to think critically about how to use these objects, practitioners support the development of executive function skills, including planning, decision-making, and persistence.

Loose parts are especially beneficial in promoting mathematical and scientific thinking. Pacey (2019), drawing from Nicholson's (1971) concept of loose parts, explains that such materials ignite curiosity by allowing children to explore ordinary objects in new and innovative ways. For instance, children might use sticks and stones to create patterns, build structures, or experiment with balance and gravity. By manipulating loose parts, children engage in hands-on exploration that promotes incidental learning in mathematics and science. This aligns with Piaget's theory of active learning, as children learn best through direct interaction with their environment (Cohen & Waite-Stupiansky, 2022).

Moreover, Han Qi Zeng and Siew Chin Ng (2024) argue that loose parts play encourages the use of open-ended questions in children, particularly in science-based learning experiences. In their study of five-year-olds, over 180 open-ended questions emerged during loose parts play, demonstrating how uninterrupted periods of playtime foster deep inquiry and critical thinking. These findings highlight the need for practitioners to carefully curate environments that

stimulate curiosity, especially in promoting scientific exploration. Loose parts act as catalysts for inquiry, prompting children to ask "why" and "how," thus fostering an investigative mindset essential for both scientific and mathematical learning.

The role of adults in creating high-affordance environments for early years learning is important for providing valuable opportunities for exploration, particularly in subjects like mathematics and science. Boulton and Thomas (2022) highlight that outdoor resources can help nurture a child's schemas—cognitive frameworks, as described by Piaget, that children use to organize and make sense of their knowledge. These schemas are continually developing, and by providing varied and open-ended materials, practitioners can support their expansion. For instance, a child exploring water flow in a stream might develop an understanding of cause and effect, volume, and spatial relationships, all of which are foundational mathematical and scientific concepts.

Additionally, outdoor play supports emotional well-being, something that is often overlooked in traditional learning environments. Ouvry and Furtado (2019) echo the importance of outdoor play, noting that a lack of fresh air and physical movement can negatively affect a child's wellbeing and development. They argue that practitioners often focus too much on preparing children for the next stage of education, rather than supporting their current developmental needs. This misalignment can detract from the benefits of outdoor play, which promotes not only physical health but also resilience and emotional regulation. By embracing daily changes, such as varying weather conditions and seasonal shifts, practitioners can harness nature's free resources to foster learning and well-being.

Puntambekar (2021) aligns this approach with Vygotsky's concept of the zone of proximal development (ZPD), which emphasizes the importance of social interaction in learning. Outdoor environments naturally facilitate collaboration and peer interactions, encouraging children to learn from one another. Practitioners can scaffold this learning by offering guidance and support as children explore, helping to deepen their understanding and confidence while maintaining the child-led nature of outdoor discovery. For example, while observing a group of children building a structure with branches, a practitioner might ask guiding questions that prompt the children to think about balance and stability, thus enhancing the learning experience without taking control of the activity.

Moreover, the Welsh Government (2022) acknowledges the role of practitioners as play partners, accompanying children along their learning journey. In line with the new Welsh curriculum, the role of the adult is not to direct learning but to

facilitate it by supporting and responding to the child's interests. This approach ensures that the learning environment fosters curiosity, creativity, and exploration, encouraging practitioners to engage with children meaningfully while allowing them the freedom to lead their learning experiences. The balance between offering guidance and allowing autonomy is critical; practitioners must be skilled at recognizing when to step back and when to intervene to maximize learning opportunities.

Kleppe (2018) suggests that outdoor environments should be versatile and flexible, providing children with the freedom to explore and engage on their terms. Ryder Richardson (2013) adds that practitioners need to have a solid understanding of outdoor learning and be enthusiastic about encouraging risk-taking where appropriate. While some might argue that outdoor play introduces risks, it is through calculated risk-taking that children develop important life skills, such as assessing danger and making informed decisions. Risk, when managed carefully, can be a powerful tool in building resilience and confidence. Practitioners who foster safe yet challenging environments empower children to push their limits, both physically and cognitively.

Tovey (2016) suggests that practitioners adopt a Froebelian approach to the outdoor environment—one that is spontaneous, creative, and open-ended. This method emphasizes a balance of materials and relies heavily on building trust and fostering warm, responsive relationships between adults and children. In contrast, Bilton (2010) highlights the importance of careful planning and management in designing outdoor spaces. While spontaneity is essential, Bilton argues that outdoor spaces must be thoughtfully structured to ensure safety, accessibility, and engagement. Additionally, Bilton (2010) stresses the need for a seamless flow between indoor and outdoor areas, suggesting that if outdoor play is not integrated into the daily routine, children may perceive it as less important than indoor activities.

Practical Applications of Outdoor Learning

Skinner and Stevens (2012) state that children naturally explore a variety of mathematical and scientific concepts when engaging in outdoor activities. Practitioners can support this learning by encouraging children to use their senses, such as counting and sorting natural materials like leaves, stones, or sticks. Additionally, activities such as surveying trees, comparing shadows, or identifying wildlife can foster a scientific understanding of the natural world. By encouraging these explorations, practitioners help children develop key skills in observation, prediction, and experimentation, which are foundational for future scientific inquiry.

Wilson (2018) explains that while children are naturally born with a keen sense of wonder for the outdoors, they still need adults to provide and encourage opportunities for exploration. Practitioners should create an environment where children feel free to investigate on their terms. However, Wilson emphasizes that practitioners must allow ample time for uninterrupted play, engaging positively with children but allowing nature to serve as the primary teacher. This approach enables children to learn directly from their environment with minimal adult interference, promoting independence, curiosity, and deep engagement.

Shoval et al. (2015) also determines that allowing children the opportunity to play outside encourages movement and motor activity, which supports coordination and spatial awareness. For example, using large loose parts like tires and planks of wood can enhance balance control and potentially ignite conversations about gravity and the space around us. By incorporating such elements into outdoor play, practitioners can create rich learning environments that foster both physical development and scientific inquiry.

Conclusion

In conclusion, outdoor learning is a powerful tool in early years and primary education, offering children valuable opportunities to engage with their environment in meaningful ways. From promoting mathematical and scientific thinking through hands-on exploration to fostering independence and emotional resilience, outdoor play supports holistic child development. However, the success of outdoor learning is heavily reliant on the role of practitioners, who must thoughtfully create enabling environments that balance freedom with structure, risk with safety, and curiosity with guidance. By embracing the natural world as a rich and dynamic learning space, practitioners can provide children with the tools they need to thrive academically, socially, and emotionally, as they navigate their learning journey.

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