

Awe and Wonder- Science, Mathematics and the outdoors**Part 1- Original Photograph**

Figure 1: Kenfig Nature Reserve (Author's own, 2026)

Part 2- Learning journey

I chose this photograph of the nature reserve because the natural environment provides a range of opportunities for children to explore mathematical and scientific concepts through first-hand experiences. The photograph includes a large tree, open grounds, vegetation, water and a wind turbine in the distance, creating a range of possibilities for children to investigate areas such as measurement, comparison, forces, movement and the natural world. The varied environment also provides opportunities for children's own interests and curiosity to influence the direction of their learning.

9:00AM

A small group of children aged three to four from an early years setting arrived at Kenfig Nature Reserve with their practitioners and were given some time to explore their surroundings and become comfortable within the outdoor environment. Rather than immediately starting the activities, I observed as the children explored the open space and began identifying features that interested them. This highlights the Curriculum for Wales Enabling Learning guidance, which focuses on effective outdoor environments which provide authentic experiences and allows children to follow their interests, explore and develop curiosity (Welsh Government, 2023).

During exploring time, Child A stopped by the large tree and said, "Look how big this tree is!" Child A's use of the word 'big' suggested a growing understanding of size and comparative differences. Rather than immediately explaining to child A how to measure, I asked, "I wonder how we could find out how big the tree really is?" This question was aimed to extend Child A's initial observations while letting the child consider how the idea could be explored. Child A then tried to measure by wrapping their arms around the tree trunk but quickly realised that their hands wouldn't meet. The other children joined in and continued this by comparing the big tree with the smaller trees nearby.

I then introduced mathematical language such as narrower, wider and around, while encouraging the children to share and explain their observations. This child-led experience created an opportunity for the children to explore size, comparison and early measurement through direct experience rather than a planned mathematical task. This can be linked specifically to Mathematics and Numeracy at Progression Step 1, where children develop early understanding of measurement and comparison through practical experiences (Welsh Government, 2022b).

The Curriculum for Funded Non-maintained Nursery settings also demonstrates opportunities for children to develop mathematical concepts and language through authentic experiences, exploration and problem-solving (Welsh Government, 2022a).

10:00AM

Child A then noticed a long branch on the ground and suggested using it to see if it was as wide as the tree. I didn't show Child A what to do, instead I asked, "How could you test your idea?" and allowed time for Child A to think and respond. Child A placed the branch against the tree trunk and noticed that the branch was much longer than the width of the tree trunk. This experience also provided opportunities for scientific thinking, as Child A was encouraged to investigate an idea through exploration and observation. This connects to Science and Technology at Progression Step 1, which includes showing curiosity, exploring the environment, making observations and communicating ideas (Welsh Government, 2022c).

The children then searched for shorter branches to try again. This encouraged the children to predict, test and compare before adapting their original idea. This further demonstrates the Curriculum for Wales emphasis on children developing curiosity through exploration, investigation and opportunities to put their developing ideas into practice. (Welsh Government, 2023). This also reflects the Curriculum for Wales Enabling Learning guidance on exploration, where children's curiosity can develop through investigating and being given opportunities to test their initial ideas (Welsh Government, 2023).

As all the children kept exploring around the tree, Child B began discussing what they could make by using the tree. One of children suggested creating a place where they could sit, which then developed into the idea of making a hammock. I asked, 'How do you think you could make one?' instead of giving them ideas of the resources they would need. This encouraged the children to discuss possible approaches and consider solutions themselves, rather than relying on a member of staff to show them how to make the hammock. Their ideas therefore played a key role in determining the direction of the activity.

The children gathered resources including different lengths of materials and ropes. One of the children picked up a piece of material and tried to stretch it between the branches but realised it would not reach. They said, "this needs to be bigger." I responded, "What needs to be bigger?" After looking they said, "It needs to be longer." The child's change from 'bigger' to 'longer' suggested a growing understanding that length, rather than the general size was the correct measurement needed to solve the problem. This allowed mathematical vocabulary including longer, shorter, length and distance to develop naturally through solving a problem between the group of children. When the children's initial idea was unsuccessful, the children changed their approach and explored other ideas. This allowed mathematical reasoning to emerge naturally through problem solving, as the children discussed

length and distance in relation to whether the material would reach between the branches. This links to the Curriculum for Wales Enabling Learning guidance which highlights authentic and purposeful learning where children are encouraged to explore, identify problems, take suitable risks and find possible solutions. (Welsh Government, 2023)



Figure 2: Children using a hammock in an outdoor environment (Lightfoot, 2019)

10:30am

While the children kept exploring the surroundings, one child looked across the water towards the wind turbine and asked, “Why is that spinning?” I asked the group “What do you think is making it move?” One child suggested, “the wind”, while another began looking at the movement of the nearby trees. I encouraged all the children to look around the environment for other things that they could see moving. The children could spot the branches swaying and the leaves moving, they then began to make connections between the movement they could see and the wind they could feel.

The children’s observations indicated an increasing understanding of cause and effect, as they began to connect the effect of wind on different objects. Instead of myself confirming the ideas straight away, I asked, “How could we find out if the wind is making things move?” This inspired the children to consider how they could develop their idea.

The children collected natural materials from the ground such as twigs, leaves, stones and predicted which they thought the wind would move most easily. One child predicted that the leaf would move because it would be ‘lighter’. This response suggests that the child is beginning to connect the properties of an object, particularly its weight, with how easily it may be moved by a force such as wind. The children then placed the objects in an open area and observed what happened when the wind blew. The children observed that some of the lighter materials moved more easily, while some of the heavier objects stayed moderately still. This activity created opportunities for the children to compare their predictions with their observations and reconsider their early ideas.

This activity supported early scientific enquiry through observing, questioning, predicting and exploring. This can be connected to Science and Technology at

Progression Step 1, where children's curiosity about the physical world can be developed through exploration, observation and communicating their developing ideas (Welsh Government, 2022c). The investigation followed the children's emerging interests, as their initial question about the turbine developed into a wider exploration and movement.

Overall, the learning journey demonstrated how the outdoor environment and the children's curiosity created opportunities to improve both mathematical and scientific understanding. The children strengthened their skills in measurement, comparison and problem solving through activities involving the tree and the hammock. They developed prediction, observation, cause and effect through investigating wind. My role was to observe the children, use open-ended questions and allow time for the children to answer questions and test their own ideas rather than directing their learning. This demonstrates Enabling Learning guidance, which emphasises effective environments, engaging experiences and enabling adults in supporting children's curiosity and exploration (Welsh Government, 2023).

Part 3- Risk benefit assessment

Activity	How will children Benefit from this activity? (Science and Maths Learning	Hazards and Risks	Who is at risk?	Precautions/control measures	Overall Risk Rating Low/Medium/High
Exploring and measuring around the tree	Children can explore size, length width and comparison through first-hand experiences. Using their arms and the natural resources such as branches as non-standard forms of measurement allows them to begin understanding that objects can be measured and compared in different ways. Mathematical vocabulary including bigger, smaller, narrower, longer and shorter can develop naturally. Children can estimate, compare their ideas and test whether different objects can be suitable for measuring. Scientifically, close exploration of the tree can encourage observation, investigation and curiosity about	Rough or sandy surfaces and visible tree roots can cause trips or falls. Low branches are likely to cause bumps or scratches. Fallen sticks may have sharp or broken edges and could cause cuts or splinters. Children could hurt others if carrying long branches/sticks without awareness of the space around them. Vegetation close to the tree may include stinging nettles, which could cause skin irritation.	Children exploring and measuring around the tree. Other children around the area could also be injured by sticks being carried or moved. Staff could also be at minor risk while supporting the children with the materials or being in the surrounded areas.	Staff to check the areas before the activities start for significant hazards, such as unstable branches, sharp objects and hazard vegetation. Children are made aware of nettles and obvious hazards while still being able to explore the natural outdoors. Suitable footwear and clothing are essential. Children are shown how to carry longer sticks safely, with sufficient space between the other children. Staff to always supervise closely but allow children to encounter manageable challenge and begin recognising risk	Low-medium. Minor injuries such as trips, scratches or nettle stings remain possible, but appropriate supervision and checks reduce the likelihood of significant harm while keeping the benefits of natural exploration.

	the natural environment.			themselves. Minor first-aid equipment should be accessible.	
Creating and testing a hammock between the trees	Children can develop understanding of length, distance, size and comparison by using ropes and materials that can reach between suitable points. They will be able to estimate, test and compare materials while using language like shorter, wider and distance. When an original material does not reach, the children have an opportunity to problem solve, adapt and retest their ideas. Scientifically, they can explore	A child could fall while testing or using the hammock that they created. Material or rope could tear, loosen or slip. An unsuitable branch could break. Rope presents a potential hazard if used incorrectly. Fingers could become trapped when manipulating or securing materials. A swinging hammock could cause a	Children creating or testing the hammock, children standing nearby and staff supporting the construction.	Staff inspects the tree where the children create the hammock, assess the attachment points before use, check ropes and the materials for damage and suitability. The hammock is placed low to the ground with a clear area around it. Adults supervise the children when using the rope closely and support any securing that children cannot do safely. Ropes	Medium. there are potentially more serious hazards than those encountered during general tree exploration, particularly the risks of falling and entanglement. Close supervision, low positioning and checks of the tree and materials reduce the likelihood and severity while retaining the learning benefit.

	properties of materials, including strength and flexibility, as well as early experiences of weight, balance, forces and movement when considering how the hammock could hold a person.	child to hit the tree or another child. Overloading it with more children than it could hold would increase the risk of failure.		are not placed around children's bodies or necks. Only an appropriate number of children use is at one time. Children can contribute to identifying whether materials appear strong, long and suitable, keeping opportunities for risk assessment and problem-solving rather than adults making every decision for them.	
Investigating wind and movement using natural materials	Children can develop early scientific understanding of cause and effect, forces and movement by observing the wind turbine, moving branches and leaves and then investigating how wind affects different objects. The children can predict, observe, test and compare what happens to leaves, twigs and stones. Comparing lighter and heavier	Strong wind could cause loose branches or natural materials to move unexpectedly. Children could trip while collecting materials on rough and sandy surfaces. Sticks may cause cuts, splinters or injury if they are chucked or waved around. Small natural	All children participating. Other children nearby could be injured with sticks, stones, branches. Staff supervising each group.	Weather and environmental conditions are checked before the activity, and it does not happen close to trees during unsafe/high winds. Clear boundaries are established, particularly between the investigation and the water edge. Children stay under adult supervision and are told not to chase objects	Medium. Most aspects of exploring wind and natural materials present manageable risks, however, proximity to water and the possibility of falling branches and materials increase level of risk. Clear boundaries, appropriate weather conditions and close supervision reduce these risks.

	objects also creates maths concepts of weight and comparison. Differences between predictions and observations encourage children to reflect on their first ideas, supporting early enquiry and problem-solving rather than simply being given an explanation.	objects may be a choking risk especially for the younger children. Vegetation may include nettles or thorns. The nearby water presents a significant hazard if children move towards it while following the objects they are watching being blown by the wind.		towards the water. Staff check for natural materials for obvious sharp edges and model safe handling using the sticks and stones. Small objects are closely supervised and inappropriate items removed children are still encouraged to select and test natural materials independently within the checked area.	
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Part 4- Academic Evaluation

This section will analyse the role of adults in supporting and encouraging young children's engagement with mathematical and scientific approaches within the outdoor learning environment. Outdoor learning can provide children with opportunities to explore, gain natural experiences, play and investigate, while encouraging curiosity and problem-solving (White, 2020: Bilton, Bento and Dias, 2017). This is also supported by the Curriculum for Wales, which shows the importance of enabling adults, engaging experiences and effective environments in supporting children's learning and development (Welsh Government, 2023). This part of my portfolio will discuss how practitioners can support mathematical concepts such as number, shape, measurement and problem-solving as well as scientific concepts like forces, movement, materials and the natural world. It will also explore the role of observation, questioning, scaffolding and sustained shared thinking. Adult involvement and allowing children sufficient independence to explore, investigate and develop their own ideas outdoors will also be explored.

Adults have an essential role in supporting young children's engagement with mathematical and scientific ideas within outdoor environments, although effective practice requires practitioners to balance adult support with opportunities for children to explore independently. Welsh Government (2023) recognises enabling adults, engaging experiences and effective environments as three parts of meaningful early learning and highlights that practitioners should observe and respond thoughtfully to children while making informed decisions about when and how to get involved. This particularly is relevant within outdoor learning, where maths and science learning may develop naturally as children compare, investigate movement, explore materials and start to understand cause and effect (Welsh Government, 2023). Research also shows that the nature of adult interaction may influence children's mathematical development.

Weiers (2025), in a systematic review of 108 studies involving children aged eight and under, found a reliable but small association between adult-child maths talk and children's maths skills, however, the strength of this relationship varied according to how the mathematical interactions were framed and measured. This highlights that expanding language between adults may not make the mathematical learning stronger and shows the importance of considering the quality and the main purpose of practitioner's interactions. This can be considered alongside sustained shared thinking, which earlier research linked to early years pedagogy, mainly when adults and children collaboratively develop ideas and solve problems (Siraj-Blatchford et al., 2002: Siraj-Blatchford and Sylva, 2004).

However, excessive adult direction could possibly reduce opportunities for children to investigate their own ideas, as the Curriculum for Wales stresses uninterrupted active

learning, independence and opportunities for children to explore and test emerging theories (Welsh Government, 2023). Therefore, effective adult support within the outdoor maths and science areas of learning may depend not only on the practitioner's knowledge but also on their ability to see when questioning, modelling or scaffolding will extend children's thinking and when allowing the children to think for themselves may develop greater independence and curiosity.

A way practitioners can extend mathematics and scientific thinking outdoors is through adaptive support and targeted questioning. Rather than providing children with the answers immediately, adults can use observations and open-ended questions to encourage children to explain their ideas, make their own predictions and solve problems. This represents Vygotsky's concept of the Zone of Proximal Development, through which appropriate support from a more knowledgeable individual can allow a child to progress beyond what they could achieve independently (Vygotsky, 1978). Research into early mathematics has equally demonstrated that structured adult scaffolding within playful problem-solving activities can contribute the development of mathematical concepts (Coltman, Petyaeva and Anghileri, 2002). Collaborative thinking may provide a valuable form of interaction, as it involves the adult and the child taking part together to create an idea or to solve a problem rather than the practitioner stating their knowledge.

Recent literature by Cheung et al. (2025) studied sustained shared thinking during maths activities and identified strategies including exchanging ideas about problem-solving, creating a child-centred learning environment and engaging children in mathematical thinking. However, this research concerned parent and child interactions rather than outdoor early years provision, meaning its findings should be applied carefully to practitioner-led outdoor learning. Despite this, outdoor environments provide valuable opportunities for these interactions because natural materials, movement, construction and experiences of living things offer practical foundations for children's investigations. For example, White, (2020), demonstrates these experiences as essential parts of high-quality outdoor provision for early years children. Although, effective scaffolding does not have to mean that the adults have more control. Research by Hunter et al. (2020) highlighted challenges between practitioners' preference for child-led outdoor learning and perceived needs for more adult intervention, suggesting that the adult role outdoors needs balancing intentional teaching with opportunities for children to direct their own play. Therefore, questioning and scaffolding may be most effective when practitioners respond to children's existing interests and thinking, instead of using the questions to redirect play towards planned mathematical or scientific outcomes.

Outdoor environments can provide meaningful opportunities for mathematical learning because mathematical ideas can develop through children's movement, play and interaction with real objects rather than being restricted to planned numeracy activities. Keith (2018) highlights the potential for developing young children's mathematical learning outdoors, while Robertson (2017) indicates how outdoor learning can provide opportunities to investigate mathematical ideas through practical and playful experiences. For example, practitioners may recognise number as children count natural objects, shape during constructions, measurement when comparing sticks or trees and concepts such as distance and position.

The practitioner's role would be to make the activity engaging for the children instead of a formal maths lesson. A practitioner might introduce mathematical vocabulary such as, longer, shorter, heavier, lighter, more, less, beside or introduce a problem that encourages children to engage in reasoning. Welsh Government guidance supports the development of mathematical concepts through the natural experiences and environments, including opportunities to compare, sort and problem solve (Welsh Government, 2023). However, the availability of mathematical opportunities does not always mean that children will understand the underlying mathematical concepts independently. (Speldewinde et al., 2022). This then gives practitioners an important role in noticing and extending mathematical thinking, using open-ended questions. Alongside this, if practitioners keep using planned maths questions, then children's play could become adult-directed instead of child-led. Therefore, effective mathematical support outdoors depends on the practitioner's skills to recognise mathematics within children's existing play and extend it gradually, rather than imposing mathematical outcomes onto every outdoor task.

Outdoor environments can provide meaningful experiences for children to develop their scientific thinking through exploration of the natural world. Experiences involving water, wind, plants, animals, materials and movement may encourage children to notice changes, make predictions and test their own knowledge or thoughts. The practitioner's role is important because adults can help children recognise their own scientific ideas within their play by asking them open-ended questions and encouraging them to explain what they think is happening. An example would be if a child asks a question such as "Why does the leaf move in the wind", an adult instead encourages the children to compare different objects and predict which will move furthest. Tunnicliffe (2015) connects early science learning with children's curiosity and questioning, while Sargent (2015) indicates the value of practical outdoor experiences for developing early scientific skills. However, adult involvement may not always improve scientific learning if practitioners provide the answers and explanation too quickly or does not allow the child to investigate themselves. Ramanathan, Carter and Wenner (2022) support this by

stating that practitioners should act as guides in children's scientific inquiry, supporting them to explore, question, investigate, and develop their understanding independently. This could then reduce opportunities for children to test their own ideas, make mistakes and develop problem solving skills. Therefore, effective adult support may depend on recognising when to extend children's thinking and when to allow them space to explore independently.

Whilst outdoor environments can offer opportunities for mathematical and scientific learning, the quality of these experiences may depend on the practitioner's confidence and knowledge towards outdoor learning. Adults who are not fully confident in science and maths may struggle more to recognise learning opportunities as they develop through children's play. Issues relating to weather, safety, risk and the management of outdoor spaces may also influence how much freedom children are given to explore. Szpunar et al. (2023) found that early childhood educators identified problems about liability as a barrier to outdoor risky play, while professional training improved educators' confidence in supporting these experiences. However, the training did not change all aspects of their knowledge or risk tolerance, suggesting that practitioner confidence alone may not remove every barrier to outdoor provision. White (2020) highlights the importance of considered adult practice in creating high-quality outdoor provision, while Knight (2013) explores the role of appropriate challenge and risk within outdoor learning. However, completely removing hazards and risks could also limit opportunities for children to experiment, solve problems and learn through being outdoors. Practitioners therefore need to balance their responsibility for children's safety with providing safe challenge and independence. This implies that effective outdoor maths and science provision relies not only on being able to gain access to an outdoor environment but on adults/practitioners who are confident and knowledgeable enough to recognise learning opportunities to benefit the children.

Practitioners also need to make sure they are observing children carefully to recognise mathematical and scientific learning as it develops through outdoor play. Observation is a beneficial skill to use and can help adults identify children's likes, dislikes, current understanding and different questions. This can allow future experiences or interactions to be adapted the correct way. This is particularly important within the outdoors as learning may not always appear as a planned, structured activity and may instead develop through movement, construction, exploration or interaction with natural materials. The Curriculum for Wales promotes observation as part of responsive early-years practice, while methods like learning stories and the Reggio Emilia documentation which is an approach linked to children's curiosity, observation and reflection and more, these approaches can make children's thinking more visible. On

the other hand, excessive recording or assessment may interrupt natural play or lead practitioners to focus too heavily on planned outcomes. Observation evidently may be most effective when it supports responsive decision making instead of it being the main point of the interaction.

Overall, outdoor environment can provide significant opportunities for young children to engage with mathematical and scientific approaches through practical, meaningful and child-led play. However, just the environment on its own does not guarantee effective learning. Practitioners play a crucial role in understanding mathematical and scientific thinking as it develops, using observation, questioning and appropriate scaffolding to extend the children's ideas. Alongside this, this support must be carefully balanced, as excessive adult direction may reduce opportunities for children to investigate and solve problems independently. Practitioner knowledge and confidence towards risk can also influence the quality of outdoor learning experiences for the children. Therefore, effective outdoor mathematics and scientific provision depend on adults being responsive to children's likes and knowing when to involve themselves. When this balance is achieved between the practitioner and child, outdoor learning can improve curiosity, independence, problem solving and deeper engagement with maths and science. This reflects the Curriculum for Wales approach, which tells us the importance of enabling adults, engaging experiences and effective environments in supporting children's learning and development (Welsh Government, 2023).

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