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Awe and Wonder Mathematics and Science in the outdoors

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Section 1 - The environment



(Kus,N.D.)

Section 2 – The Story

The environment we are exploring today is an open space and it is a woodland area which is snowy. I have decided to bring the children here as they have been very interested in the snow recently, asking questions and being curious. As a setting, we are following their interests and giving them an opportunity to build on their curiosity, allowing them to have an engaging and meaningful learning experience (Welsh Government, 2022). The children run into nursery very excited about their visit to the woodlands. I remind the children to stay dressed as they are, as they are all wearing suitable clothing and footwear for their visit. I also remind them about staying safe, listening to instructions and remaining close to the group while exploring the woodland. This helps the children feel confident and prepared while encouraging them to explore their surroundings and develop their sense of wonder, and promoting their learning around maths and science, two areas of learning in the curriculum for Wales (Welsh Government, 2022).



(iStock, n.d.)

It is nearly time to leave nursery and go to the woodlands, and all the children are very excited and eager to get ready to go. One little boy has taken his shoes off and insists that he wants to wear his normal nursery shoes instead. I gently explain to him that he needs to keep his outdoor shoes on because we are going somewhere snowy, and his normal nursery shoes could get very wet and dirty. I also explain that the woodland might be slippery, so his outdoor shoes would help to keep his feet warm and help him walk safely.

He is still determined that he wants his nursery shoes on, so instead of making it into a disagreement, I decide to make the situation more playful. I start talking to him about how his outdoor shoes are his “special woodland adventure shoes” and that they are ready to go exploring in the snow. This made him smile and helped to change his focus. I ask him if his “adventure shoes” are ready to go and he joined in with the playful conversation. After a little while, he happily put his outdoor shoes back on. I am pleased that I am able to support him in making a safe choice while keeping the experience positive, fun and enjoyable for him.

The time is now 9:20am, and we can see that the bus is arriving. The children and staff are still very excited, talking to one another about what they think we might see when we arrive at the snowy woodlands. Before we get onto the bus, I remind the children about staying safe and ask them to get into pairs and hold hands with their partner. Once everyone is safely paired up, we count the groups together. I encourage the children to look carefully and count how many pairs we have. Together, we count loudly: “2, 4, 6, 8, 10!”

I respond, “Da iawn!”, praising their counting skills and encouraging them to recognise that we are counting in twos. I then ask the children, “If we have 10 children, how many pairs have we made?” The children begin to think and work it out, using their knowledge of sharing and grouping, this was a tricky question, but one little boy shouted “5”. As we get on the bus, the excitement grows. The children find their seats, and I encourage them to look out of the windows and notice what they can see around us. As we begin our journey, I introduce some questions to encourage their mathematical and scientific thinking. I ask, “I wonder what the temperature will be when we get to the snowy woodlands?” The children share their ideas. Some of the children think it will be very cold, while others suggest that it might be colder than it is where we are now.



(Illinois Early Learning Project, 2023)

We talk about how snow and ice are frozen water and how, when they become warmer, they can change from a solid into a liquid. I ask the children, “What do you think would happen if we left the snow outside instead? Would it melt as quickly?” This leads to further discussion about how the temperature around us can affect how quickly snow melts. As we travel, I encourage the children to look for numbers and patterns. We look at road signs; count vehicles passing us and compare different things we can see. I ask questions such as, “How many red cars can you spot?”, “Which number can you see on that sign?”, and “Do you think we will see more cars or buses on our journey?” The children also begin asking their own curious questions. One child wonder why we cannot see snow everywhere, while another asks whether snow is always cold. I respond by encouraging them to make predictions and think like scientists.

Finally, the bus begins to slow down. We can see the snowy woodland ahead of us. The children are excitedly pointing towards the trees and snow, and I remind them that we will soon have the opportunity to explore, investigate and discover what is around us. I say, “well done boys and girls, you have been amazing”. Now let’s get ready to explore the snowy woodlands and find out what we can discover!”

As we walk towards the woodlands, a member of staff calmly reminds one of the boys to stay with the group until an adult tells him that he can go and explore. He is very excited and tries to run ahead because he is eager to play in the snow. The staff member gently explains the importance of staying together and listening to instructions so that everyone remains safe.

As we continue walking, I ask the children, “What can you see around us?” The children begin pointing out the trees that are full of snow, footprints, branches and frozen areas around us. I then ask, “What can you hear?” We pause for a moment and listen carefully. The children notice birds singing, the wind blowing through the trees and the crunching sound of snow underneath our feet. I encourage them to use descriptive words to explain what they can see, hear and feel as we get further into the snowy woodland. Before letting the children go and play, I explain what area they must stay in, and we as staff go to our designated spots. I then let the children go and play, they shout loudly with excitement, “yay!” says one little girl.

I ask the children while I walk around, “How does the snow feel?” and “How does the ice feel?” The children describe it as cold, hard, slippery and freezing. I introduce and reinforce vocabulary such as temperature, freezing, melting, winter, ice and snow. We then discuss how the temperature changes throughout the year and how winter can bring colder temperatures, while other seasons can be much warmer. I ask the children, “What do you think will happen to the snow when the weather becomes warmer?” The children make predictions, with some suggesting that the snow will melt and turn into water. I encourage them to explain why they think this will happen. The children then become involved in making snowballs. They count how many snowballs they have made and compare them with one another. I ask, “Which snowball is the biggest?”, “Which one is the smallest?”, and “Can you make a snowball bigger than your friends?” The children use mathematical language such as bigger, smaller, more, less and equal while developing their understanding of size and quantity.

We then move onto another part of the woodland to collect natural materials. The children search for sticks, stones, leaves and small pieces of bark. As they collect their materials, I ask, “Where do you think this stick came from?” and “Did somebody make this stone, or did it come from nature?” This encourages the children to think about where natural materials come from and how they are part of the natural environment. The children explore and begin to describe the different textures of the objects they find, however one little boy struggles to give some words, to help him i give him some words like rough, hard, soft, cold and bumpy, promoting an environment that is communication rich (Welsh Government, 2026). We sort the materials together by their different characteristics. The children count how many sticks, stones and leaves they have collected and compare their sizes, lengths and weights. Some children arrange their sticks from shortest to longest, while others create groups based on colour, shape or texture.



(iStock, n.d.)

The children are also developing their physical skills as they move around the woodland, bend down to collect objects, carry their materials and carefully walk over the uneven snowy ground. They support one another and work together to find interesting natural objects. Finally, we explore the different trees around us. The children notice that some trees are much taller than others. I ask, “Why do you think some trees are taller?” The children suggest ideas such as the trees being older, having more water, sunlight or better soil. We discuss how these things can help trees grow.

To bring maths into our exploration, I challenge the children to guess how many sticks they would need to measure the height of a tree, and how many it would take to climb to the top. The children make their predictions before working together to place sticks end-to-end along the ground to compare lengths. We talk about which tree appears tallest and which is the shortest. Throughout the activities, the children demonstrate curiosity, ask questions, make predictions and share their ideas with their peers and adults. They use new vocabulary, develop their mathematical thinking and begin to understand how temperature, seasons, nature and living things are connected. The snowy woodland provides the children with a hands-on opportunity to explore, investigate and learn through their own experiences.

Section 3

Activity	How will the children benefit from this activity?	Hazards/Risks	Who is at risk	Control measures	Overall risk level (LMH)
Exploring a snowy woodland area discussing temperatures	The children will discuss and begin to develop and understanding of temperature changes throughout the year. They can explore how snow feels and how the ice feels, they can begin to expand their vocabulary using words such as freezing, melting, temperature and winter. Through this they can begin to develop an understanding of the different seasons. They can begin to make predictions on how the snow will melt and what will	The children may slip and fall over when walking in the snow. The ground may be uneven when walking along it. Children may experience discomfort due to the cold conditions. Children may get separated from the group if conditions get worse.	Children and adults. Children who have poor sense of awareness when walking.	The adults will make a visit to the woodlands prior to the visit. Ensure staff ratios are followed and make sure that clear rules in the woodlands area are established before the visit. Ensure that children and staff are wearing appropriate footwear and ensure that their clothing is sufficient. Staff should ensure that children's comfort levels remain sound, staff should also monitor conditions of the woodlands and if it becomes	Medium

	happen when the snow melts. The children can develop their maths skills by counting snowballs and comparing the sizes of the snowballs.			unsuitable then children should be taken back indoors. Children and staff should wear hats, scarf and gloves. Regular head counts of the children should take place by the staff.	
Collecting natural materials in woodlands area	The children will benefit from exploring a natural environment. For developing their science skills children can begin to discuss where natural materials come from, for example where do sticks, rocks, leaves and stones come from? And the children can also discuss the texture of the snow and natural materials expand their	The children could get cuts or splinters from broken sticks. Children may fall over branches. Branches may fall from trees and could hurt staff or the children in the group.	Children and staff. Staff should also consider their children's sensory and developmental needs, for example a child with additional learning needs may at a stage where everything is going in their mouth, therefore staff should monitor this as what they are putting in their mouth be not appropriate.	Before the visit staff can take time to explain to the children about the woodlands area. Explain to the children about overly sharp sticks. Children can also be reminded that natural materials in a woodlands area should not go in their mouths because of germs.	Low

	vocabulary. For maths children can count, sort, and compare the materials, they can explore the different size, shape, weight, length of the materials. Finally, the activity also supports the children's physical development.		Children who have additional learning needs and are impulsive, for example a pupil who may not be safe with natural materials.		
Measuring and comparing the heights of trees within a woodland area	The children will observe and notice the difference between trees and discuss why trees may be different heights, in this conversation children could discuss how water and rain, age, sunlight and soil could affect growth, at this point staff could support vocabulary development. To	Children and staff may fall or slip while doing this activity if unaware of surroundings. Branches could fall or break if children are climbing on them	Children and staff are both at risk of hazards. Children who have additional learning needs and are impulsive, for example a pupil who may not be safe with natural materials.	Adults will ensure that the group of children will avoid unstable trees if possible. Staff will also ensure that children know they can only climb trees to a certain height. Staff will make sure that measuring equipment that the children use that are natural materials, and to ensure that the natural materials	Low

	promote maths staff could ask children to measure the trees using natural materials, at this point children could estimate, for example, how many sticks would you need to get to the top of the tree.			are safe to be used and children are using them safely and appropriately. Children and adults should be wearing appropriate footwear.	
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Section 4

This section will discuss the importance of outdoor play in the early years and in early childhood, and how it can promote maths and science which is a big part of the curriculum. As stated by the Welsh Government (n.d.), the Curriculum for Wales includes six Areas of Learning and Experience, including Mathematics and Numeracy and Science and Technology. Outdoor learning can provide meaningful opportunities for children to apply knowledge through practical, real-world experiences. Dauncey (2022) highlights the importance of outdoor learning within the curriculum and its impact on children's development. This is supported by Jucker et al. (2022), who emphasise that effective outdoor learning environments should be rich in opportunities, encourage deeper thinking, provide appropriate challenges and allowing children to be imaginative. For example, outdoor activities can support Mathematics and Numeracy through measuring, counting and exploring patterns, while Science and Technology can be developed through investigating plants, animals and the natural environment. Therefore, well-planned outdoor learning can extend on what the children learn in the classroom while supporting children's curiosity, creativity, problem-solving and independence. Furthermore, it is key that children are given

opportunities in the outdoors to play and learn, this can promote their emotional wellbeing, physical development and emotional development (Little, Sandseter and Wyver, 2012).

According to White (2019) Outdoor play is important because it provides children with opportunities to develop physical skills, confidence and awareness of their bodies and surroundings, promoting their gross and fine motor skills. Through activities such as running, climbing, balancing and manipulating natural materials, children develop cognitive development because children learn through sensory exploration and interaction with their environment. Outdoor play can therefore encourage curiosity, exploration and problem-solving, which are important characteristics of effective learning, and white also claims that children enjoy being outside the classroom and outdoors rather than being indoors.

Tovey (2013) explains that in a Froebelian approach, children should have consistent access to a real, authentic and enriching experiences that support children with their learning and development. This is relevant to outdoor learning, as the natural environment provides the children with opportunities to explore and interact with real objects and experiences rather than learning only through adult-led structured activities. For example, children can investigate plants, observe insects, collect natural materials and explore changes in weather and the environment. These experiences can support children's curiosity and encourage them to ask their peers or adults questions, make observations and develop their own ideas. Adults therefore have an important role in providing an environment that encourages exploration while observing children's interests and extending their learning through appropriate questions and resources. This can support mathematical and scientific learning in a natural way, as children can develop concepts such as counting, measuring, comparing, sorting and observing through meaningful experiences in the outdoor environment. science is particularly important in the early years because children are naturally curious about the world around them and are motivated to investigate how things work. Waite-Stupiansky and Cohen (2020) highlight that science education in early childhood can support later science learning, as well as children's cognitive development and attitudes towards learning. They suggest that young children naturally engage in

behaviours associated with scientific exploration such as asking questions, making observations, experimenting and exploring their environment.

While outdoor environments can naturally provide opportunities for mathematical and scientific learning, the role of the adult is important in ensuring that these opportunities are recognised and developed. Adults can observe children's interests, introduce appropriate vocabulary, ask questions and provide support that encourages children to think more deeply. This role can be understood through Vygotsky's theory of the Zone of Proximal Development (ZPD).

Eun (2019) discusses Vygotsky's theory of the Zone of Proximal Development (ZPD) and it is relevant for the role of adults in the setting in supporting children's learning. The ZPD explores the difference between what children can achieve independently and what they can achieve with appropriate guidance from a adult. When this is applied in the setting and in life, adults have an important role in recognising children's existing knowledge and providing support that enables them to progress beyond what they could initially achieve alone. This support can be reduced over time as children develop greater understanding and independence.

In an outdoor environment, this theory can be applied to both mathematical and scientific learning. For example, if a child is attempting to compare the length of sticks, an adult could support their thinking by asking questions such as "How could we find out which one is longer?" rather than simply providing the answer. Similarly, when exploring the natural environment, an adult could encourage a child to make predictions, observe changes and explain their ideas. When this is done, children can develop new knowledge and skills which they may later on be able to apply independently. This suggests that effective adult involvement in outdoor learning is not about directing every activity, but about providing appropriate guidance and extending children's thinking within their ZPD. However, if adults over direct and support children to much, they may risk hindering children's progress and may encourage children to constantly ask an adult the answer to their questions, before thinking for themselves.

National Numeracy (n.d.) explains that everyday outdoor experiences can provide opportunities for children to apply mathematical concepts in practical meaningful, and fun ways that they really enjoy. For example, children can develop their understanding of multiplication by arranging natural materials into groups, explore measurement by measuring outdoor spaces, investigate capacity using containers and water, and develop estimation skills by predicting the number of objects or the distance between locations. Adults can support these experiences by asking children to explain how they reached their answers and encouraging them to make predictions before testing their ideas. This demonstrates how mathematical learning does not need to take place just in the classroom environment, as practitioners can recognise and extend mathematical opportunities within children's everyday outdoor experiences. Such approaches can also help children understand the relevance of mathematics to the world around them.

McCrorie et al. (2025) says that risky play can provide children with valuable opportunities to develop confidence, independence and problem-solving skills. However, Scholar's Choice (2026) says that settings may worry about parents complaining if children get hurt during risky play, but research involving Scottish parents and Early Learning and Childcare practitioners, completed and done by McCrorie et al. (2025) found that perceptions of the benefits of risky play were relatively high, while perceptions of danger were relatively low within the sample. The research also found that what parent's thought were benefits were positively associated with children's opportunities to engage in risky play, where as what parents' thought were dangers were negatively seen with these experiences. This highlights the importance of adults considering the potential benefits alongside possible hazards, rather than removing risk completely. Practitioners can therefore use a risk-benefit approach to provide children with appropriate opportunities to explore, challenge themselves and develop through outdoor play.

However, while parents may be happy for their children to take risks in their play outdoors, Dahl et al. (2024) found that children's opportunities and chances to engage in outdoor play can be influenced by barriers within their local communities. Children living in lower income communities may experience reduced outdoor play because of concerns about neighbourhood safety, limited access to

suitable green spaces and a lack of convenient places to play. This indicates that barriers to outdoor learning are not solely related to children or practitioners but can also be influenced by wider social and environmental factors. Limited access to parks and greenspace may reduce opportunities for children to develop physical, mathematical and scientific skills through exploration. Therefore, communities and policymakers have an important role in providing safe, accessible and inclusive outdoor spaces for all children to access. This is also shown in Waller (2017) where it says parents concerns about their children's safety can also affect their opportunities to engage in outdoor play. Waller also shows highlight that parents in different communities have expressed concerns about children playing outdoors due to perceived dangers such as strangers, traffic and unsafe neighbourhoods. Waller identify unsafe neighbourhoods, limited access to suitable play spaces and increased parental control over children's play as factors that can contribute to reduced outdoor play experiences. This suggests that parents' concerns are not necessarily based on children's lack of interest in outdoor play but can be influenced by wider environmental factors and perceptions of safety. However, restricting outdoor play can reduce children's opportunities to explore, exercise and socialise. Waller therefore identified school outdoor spaces as an important environment where children can experience opportunities for exploration and play within a setting that adults perceive as safer. For early years practitioners, this highlights the importance of creating outdoor environments where children can experience appropriate levels of independence and challenge while adults ensure children's safety comes first.

In conclusion, outdoor environments provide valuable opportunities for children to develop their mathematical and scientific understanding through meaningful, practical and real-life experiences. The research discussed demonstrates that outdoor learning can support children's curiosity, problem-solving, creativity, independence and wider development. However, simply providing access to an outdoor environment does not automatically result in effective learning. Adults have an important role in recognising opportunities in children's play, introducing new vocabulary is key, asking open-ended questions and providing support that extends and promotes children's current knowledge. Vygotsky's Zone of Proximal Development highlights how appropriate adult guidance can help children develop skills that they may not yet be able to achieve by themselves, while gradually encouraging more independence. Risky play can

further support children's confidence, independence and problem-solving when adults consider potential benefits alongside possible hazards. However, wider barriers such as limited access to safe and suitable outdoor spaces can affect children's opportunities to experience outdoor learning. Therefore, settings that give children outdoor play that requires adults to create inclusive and appropriately challenging environments is key, so that children can explore mathematical and scientific ideas through both planned experiences and child-led play.

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ALPHABETIVAL ORDER