

Science, mathematics **and the outdoors**

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I have not used AI to complete my work

Chosen image

(National Trust, 2025)

Learning Journal

The outdoor woodland play environment shown in the image provides a range of opportunities for young children to develop scientific and mathematical understanding through play. The space includes natural materials such as wood, mud and plants, as well as features like a mud kitchen, tree stumps and uneven ground. These elements can support exploration, investigation and problem-solving in a way that feels natural and engaging. In my opinion, this type of environment reflects the principles of the Curriculum for Wales, as it encourages learning through experience, curiosity and active involvement.

One of the most noticeable aspects of the environment is the uneven ground, which includes grass and woodchip surfaces. These different textures could support children in developing an understanding of movement, balance and forces. As children move around the space, they may begin to notice how their bodies respond to different surfaces. For example, a child might say, “It’s slippery here” or “I’m sinking in this bit”, showing an awareness of how surfaces affect movement. This links to early scientific ideas about forces and energy, as children experience how their movements change depending on the environment. It also supports physical development, as children adjust their balance and coordination.



Uneven ground (grass and woodchip surfaces)

The tree stumps and wooden seating provide further opportunities for both scientific and mathematical learning. Children may use these to climb, balance or move between different heights. During this type of play, they are likely to develop an understanding of distance and space. For example, one child may say, “I can jump to that one”, while another might respond, “That one is too far”. This shows early mathematical thinking, particularly in relation to estimation and comparison. At the same time, children are learning about gravity and stability, as they experience what happens when they

balance successfully or lose their footing. These experiences encourage problem-solving, as children must decide how to move safely and confidently.



Tree stumps and wooden seating, used for climbing, balancing, and estimating distance

The natural materials within the environment, such as bark, leaves and wood, also provide valuable learning opportunities. Children may explore these materials through touch and observation, noticing differences in texture, shape and size. For example, a child might say, “This one is rough” when touching bark, or “This leaf is bigger than that one”. These simple observations support scientific skills such as noticing and describing, while also linking to mathematical concepts such as comparing and sorting. Children may group objects based on their features, even without being directly instructed, which shows how learning can happen naturally through play.

Patterns found in nature could also support early mathematical understanding. Children may begin to notice similarities in shapes, colours or lines within leaves and bark. For example, a child might say, “They all look the same”, identifying repeating patterns. This type of observation helps to develop early maths skills and encourages children to make connections within their environment.



Natural materials such as leaves showing different textures and patterns.

The mud kitchen area provides particularly strong opportunities for both scientific and mathematical learning. Children may explore how materials change when mixed, for example combining mud and water to create different textures. A child might say, “It’s too dry, it needs more water”, showing an awareness of how materials can be changed.

This links to scientific concepts such as properties of materials and change. At the same time, children are likely to engage in mathematical thinking as they fill and empty containers, compare amounts and experiment with capacity. For example, they may say, “Mine is full” or “You have more than me”, demonstrating an understanding of volume and comparison.



Mud kitchen area supporting exploration of materials and mathematical concepts such as capacity.

In my opinion, this type of hands-on learning reflects the theory of Jean Piaget, who suggested that children learn best through active exploration and direct interaction with their environment (Piaget, 1952). Rather than being told information, children in this environment are discovering ideas for themselves through play, which helps to build a deeper understanding.

The mud kitchen also encourages imagination and creativity, which supports cross-curricular learning. Children may engage in role play, pretending to cook or create meals. For example, one child might say, “I’m making a cake”, while another responds, “Can I have some?” This type of interaction supports communication and language development, as well as social skills such as sharing and turn-taking. It shows that

learning in this environment is not limited to science and maths but is instead holistic and connected.

Creativity is further supported through the use of loose parts within the environment. Many of the materials available, such as sticks, leaves, mud and small wooden objects, do not have a fixed purpose and can be moved, combined and used in different ways. These are often described as “loose parts”. Children may use these materials to create their own play experiences, for example building structures, mixing materials or creating imaginary scenarios. A child might say, “This is my cake” while using mud and leaves, showing how imagination is being used alongside exploration. In my opinion, loose parts play is important because it encourages creativity and independent thinking, as children are able to decide how to use the materials themselves. It also supports problem-solving and mathematical thinking, as children may sort, count or arrange objects in different ways. This links to the Curriculum for Wales, as it promotes creativity, exploration and child-led learning.

The wider outdoor environment also provides opportunities for children to explore living things and the natural world. Children may look for insects, observe plants or notice changes in their surroundings. For example, a child might say, “There’s a bug under here” or “This one is different”. These experiences support early scientific understanding of living and non-living things, as well as life cycles. They also encourage curiosity and questioning, which are key aspects of learning within the Curriculum for Wales.

Another important aspect of this environment is how it supports holistic development. Children are not only developing scientific and mathematical understanding, but also physical, social and emotional skills. For example, when balancing on tree stumps, children are developing coordination and strength, while also building confidence. If a child is unsure at first but then succeeds, this can support their self-esteem and resilience.

The environment also allows children to experience manageable risk, which is an important part of learning. For example, deciding whether they can jump from one stump to another requires children to assess their own ability. This supports decision-making and risk awareness. These experiences are valuable because they help children to develop independence and confidence in their abilities.

Overall, the outdoor woodland play environment provides a wide range of opportunities for children to develop scientific and mathematical concepts through play. The combination of natural materials, physical challenges and open-ended resources supports exploration, curiosity and creativity. In my opinion, this environment reflects the principles of the Curriculum for Wales by promoting experiential and holistic

learning. It highlights the importance of outdoor play in supporting children's development in a meaningful and engaging way.

Risk Assessment

Location / Activity:	Woodland Play	Date:	25/03/26
Assessor:	Abbie Mottram	Review date:	30/09/26

The boxes in the table below will expand as you type into them; pre-entered text is simply for illustration. You should delete irrelevant items and replace with text relevant to your circumstances.
Your overall risk rating – Low, medium or high – is based on your judgement about whether the BENEFITS of the activity or opportunity outweigh the RISKS.

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
Mud kitchen and water play using pots and utensils	Children develop scientific understanding through exploring materials such as water and mud, including texture and change. Mathematical skills are supported through measuring, pouring and comparing quantities. It also encourages imaginative play and social interaction.	The mud kitchen area contains water, mud, and a wooden work surface, which can become wet and slippery. This could cause a child to slip and fall onto the hard wooden edges or ground, potentially resulting in cuts or bruising. The metal pots and utensils on the table could be dropped onto a child's foot, which may cause pain, bruising, or more serious injury depending on the weight. Children handling mud and dirty water may transfer bacteria to their hands, and if hands are placed near the mouth, this could lead to illness or possible infection.	Children and supervising adults	Children should be supervised closely to ensure they move carefully around the mud kitchen and use equipment appropriately. The area should be checked regularly to ensure surfaces are not excessively slippery, and wood can help absorb water and reduce impact from falls. All utensils should be age-appropriate, lightweight, and free from sharp edges. Children should be encouraged to wash their hands thoroughly after playing to reduce the risk of infection.	M

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
Climbing, balancing and sitting on logs, benches and tree stumps	Supports physical development such as balance, coordination and strength. Encourages risk-taking and problem-solving. Children can also explore mathematical concepts such as height, distance and comparison.	The wooden benches, table, and tree stumps may encourage children to climb or stand on them. This creates a risk that a child could fall from a height onto the wood or surrounding ground, which could result in injuries such as bumps, bruises, or in more serious cases, fractures. The uneven height and spacing of the stumps could cause a child to misjudge their step, leading to a loss of balance and a fall. If the wood becomes worn, splinters could enter the skin, causing pain and possible infection if not treated.	Children	All wooden equipment should be regularly inspected to ensure it is stable and smooth, reducing the chance of splinters. The wood surface should be maintained at a suitable depth to help cushion any falls and reduce injury severity. Children should be supervised when using the equipment, and clear guidance should be given, such as not standing on benches and using the stumps carefully to balance rather than jump from height.	M

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
Exploring natural environment (walking, running, observing nature)	Promotes understanding of the natural world, including plants and living things (science). Develops mathematical skills such as counting, sorting and pattern recognition. Encourages curiosity and exploration.	The natural ground surface includes uneven grass, soil, and woodchip, which may cause a child to trip while walking or running. A fall onto these surfaces could lead to grazes, cuts, or bruising. Sticks or branches on the ground could be picked up and misused, potentially causing injury to themselves or others, such as poking which could damage eyes or skin. Insects present in the environment may bite or sting a child, which could cause pain, swelling, or in some cases an allergic reaction that may require medical attention.	Children and adults	The outdoor area should be checked to remove hazards such as sharp sticks or debris. Children should be encouraged to walk rather than run in uneven areas and to use natural materials safely. Appropriate footwear, such as closed-toe shoes with good grip, should be worn to reduce the risk of slipping or injury. Staff should supervise children at all times and be aware of any allergies, with procedures in place to respond quickly if a reaction occurs.	L

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
Exploring sounds and cause-and-effect using the wooden musical parts	Children can explore sound by hitting or tapping the wooden panels, which supports scientific understanding of materials and how sound is produced. It also encourages mathematical thinking through recognising patterns, rhythm, and repetition. This type of activity supports sensory development and allows children to experiment with cause and effect, while also encouraging cooperative play if used in groups.	The wooden musical panels are fixed, solid structures, and a child may run into them if not paying attention, which could result in bumps or head injuries. There is also a risk that children may trap their fingers between parts of the equipment while playing, leading to pain or minor injury. If children use objects such as sticks to hit the panels, these could be swung too forcefully and accidentally hit another child, potentially causing injury.	Children	Children should be supervised while using the musical panels to ensure they are playing safely and not running in the area. Practitioners should encourage children to use appropriate objects and avoid swinging items near others. The equipment should be regularly checked to ensure there are no gaps or loose parts where fingers could become trapped. Clear guidance should be given on safe use, such as taking turns and being aware of others nearby.	L

How adults support science and maths in the outdoors

The role of adults in supporting children's scientific and mathematical development in outdoor environments involves more than supervision. It requires a considered and responsive approach, where adults balance child-led exploration with appropriate guidance. This reflects a move away from more traditional teaching approaches towards perspectives where learning is understood as something children actively learn through experience and interaction (Edwards, 2017; Leggett and Ford, 2016). Within outdoor contexts, this role becomes more complex, as learning is less structured and more dependent on the interactions between the child, the environment and the adult.

Outdoor environments are often identified as useful contexts for learning in early childhood. Research suggests that outdoor play can support children's cognitive, social and physical development, as well as their engagement with natural environments (Coates and Pimlott-Wilson, 2019; Ernst, 2018). These environments provide opportunities for movement, exploration and interaction that are not always available indoors. However, these outcomes are not guaranteed. The extent to which learning takes place depends on how adults support children's experiences and interactions (Waite, 2017). This indicates that while the environment provides potential, it is the adult's role that often determines whether this potential is realised.

Affordance theory provides one way of understanding how outdoor environments can support learning. Gibson (1979) described affordances as the opportunities for action that an environment provides. In outdoor spaces, elements such as uneven ground, natural materials and open space offer a wide range of possible actions, including climbing, building and exploring. These affordances can support scientific understanding, such as forces and materials, as well as mathematical concepts including space, measure and pattern (Gibson, 1979; Smedsrud, 2025). However, children engage with these affordances differently, influenced by their individual abilities, confidence, and prior experiences with natural environments (Smedsrud 2025). This means that some children may not recognise or use certain affordances without support. For example, a child may walk past a puddle without engaging with it, unless an adult draws their attention to how the water moves when interacted with. This suggests that affordances are not genetically beneficial, as their value depends on the child's ability to engage with them meaningfully.

A further limitation of affordance theory is that it can assume that environments naturally promote learning, without fully considering the role of interpretation. For example, while a tree may afford climbing, not all children will perceive it in this way, particularly if they lack confidence or prior experience. Similarly, open-ended materials may not automatically lead to mathematical or scientific thinking unless children are supported to make connections. This indicates that affordances alone do not ensure

learning, as they require engagement, interpretation and often guidance. In this context, the role of the adult becomes important in supporting children to recognise and act upon these opportunities, while still maintaining a level of independence.

This highlights the importance of adult involvement in helping children to engage with the environment. Rather than directing play, adults may support learning through subtle strategies such as drawing attention to features or suggesting possibilities. These are sometimes referred to as “provocations” or “invitations” (Waller et al., 2017). For example, an adult might place containers near a muddy area, encouraging children to explore mixing and measuring. This approach allows children to remain in control of their play while still being supported to extend their thinking. However, the effectiveness of this approach depends on the adult’s ability to judge when to intervene and when to step back, as unnecessary intervention may limit children’s independence.

However, there are limitations to relying solely on child-led exploration. Research suggests that without adult input, children may engage in repetitive or surface-level play that does not lead to deeper understanding (Harris, 2017). For example, a child may repeatedly fill and empty a container without developing an understanding of capacity unless supported through questioning or discussion. This suggests that while child-led play is important, it may not be sufficient on its own to support scientific and mathematical development, particularly where more complex concepts are involved.

Sustained shared thinking provides one way of addressing this issue. This involves adults and children working together to develop ideas, often through dialogue and joint problem-solving. Through questioning and discussion, adults can encourage children to think more deeply about their actions. For example, asking what might happen if more water is added, or why a structure collapses, can support both scientific enquiry and mathematical reasoning (Leggett and Ford, 2016). However, this approach requires thought, as poorly timed or overly directive questioning may interrupt play or limit children’s independence. This suggests that the quality of interaction is more important than the quantity, and that adults need to be responsive to the context of play.

The role of the adult can therefore be understood as complex and multi-layered. In outdoor environments, adults take on a range of roles, including facilitator, observer, co-learner, language model and risk manager. Each of these roles requires different forms of engagement and decision-making. For example, as observers, adults must identify when children are engaged in meaningful exploration and when intervention may be needed to extend learning. As co-learners, they may join in play, modelling curiosity and problem-solving. At the same time, they are required to manage risk and ensure safety, which adds another layer of responsibility. This highlights that adult involvement is dynamic and changes depending on the situation. However, there is a

risk that too much involvement may lead to excessive support, where children become dependent on adult input, while too little involvement may result in missed learning opportunities. This suggests that effective practice depends on the ability to make informed and responsive decisions in the moment.

The role of social interaction in learning is emphasised by Lev Vygotsky, who argued that learning takes place through communication and collaboration (Vygotsky, 1978). In outdoor environments, this can be seen when children work together, share ideas or negotiate during play. Adults can support this by modelling language, introducing new vocabulary and encouraging discussion, particularly in relation to scientific and mathematical concepts.

In contrast, Jean Piaget focused on individual exploration, suggesting that children construct knowledge through direct interaction with their environment (Piaget, 1952). From this perspective, outdoor environments are valuable because they provide opportunities for hands-on learning and experimentation. However, Piaget's theory places less emphasis on social interaction and the role of language in learning.

The comparison between these perspectives highlights a key tension within outdoor learning. While Piaget's emphasis on independent exploration aligns with the open-ended nature of outdoor environments, it may underestimate the importance of interaction in developing more complex scientific and mathematical understanding. In contrast, Vygotsky's focus on social learning highlights the value of adult support and shared thinking but may place less emphasis on the role of independent discovery. This suggests that neither theory fully captures for the complexity of learning in outdoor environments. Instead, a combined approach may be more appropriate, where children are given opportunities to explore independently while also being supported through interaction with adults and peers. This balanced approach reflects current practice, where both independence and guidance are considered important.

The Reggio Emilia approach offers another perspective, emphasising the role of the environment and the adult as a facilitator of learning. Within this approach, the environment is considered a "third teacher", and learning is seen as a collaborative process. Adults observe children's interests and provide resources or experiences that extend their thinking (Waller et al., 2017). This aligns closely with outdoor learning, where environments support open-ended materials and possibilities. However, this approach relies heavily on practitioner skill, as adults must be able to interpret children's actions and respond appropriately.

Observation is a key aspect of this process. By observing children, adults can identify interests, assess development and decide when to intervene. This allows learning to be extended without disrupting play (Macintyre, 2017). Observation also supports

assessment, particularly in play-based contexts where learning may not be immediately visible (Duffy, 2019). However, observation requires time, experience and professional judgement. Some practitioners may lack confidence in using observation effectively, particularly in outdoor environments where activities are less structured (Gray and Pigott, 2018), suggesting a need for ongoing professional development.

Child-led play is central to outdoor learning and is reflected in the Curriculum for Wales, which emphasises independence and experience-based learning (Welsh Government, 2022). Outdoor environments support this approach by providing flexible spaces and open-ended resources. However, there are ongoing discussions about the balance between child-led and adult-guided learning (Waite, 2017). While independence supports engagement, there is a risk that without guidance, some learning opportunities may not be fully developed (Harris, 2017). This creates tension between maintaining a play-based approach and meeting curriculum expectations.

The concept of loose parts further supports learning in outdoor environments. Loose parts, as described by Nicholson (1971), are materials that can be moved and used in multiple ways. In outdoor settings, natural materials such as sticks, leaves and stones provide opportunities for exploration and problem-solving. These materials can support mathematical skills such as sorting, counting and pattern-making, as well as scientific understanding of materials and change (Speldewinde and Campbell, 2022). However, the presence of loose parts alone does not guarantee learning, as children may not always make connections without adult support.

Outdoor learning also presents a number of challenges that may impact its effectiveness. These include access to suitable outdoor spaces, variations in practitioner confidence and external factors such as weather conditions (Knight, 2016; Waite, 2017). In some settings, outdoor learning may be limited due to space constraints or safety concerns, which can reduce opportunities for children to engage with the environment. Additionally, the unpredictable nature of outdoor environments may make it more difficult for practitioners to plan and assess learning in comparison to classroom-based activities. There may also be pressure to meet specific curriculum outcomes, which can lead to a preference for more structured approaches (Waite, 2017). This may limit the use of outdoor environments, particularly for scientific and mathematical learning, where outcomes are expected to be measurable.

One further aspect to consider is the extent to which outdoor environments support progression in scientific and mathematical understanding over time. While outdoor play offers strong and beneficial opportunities for exploration (Ernst, 2018), the learning that occurs may not always develop in a structured way. This can make it difficult for practitioners to ensure that children are building on prior knowledge and developing more complex concepts. For example, while a child may explore concepts such as

volume or balance through play, without intentional support these experiences may remain at a practical level rather than developing into more abstract understanding. This suggests that adult involvement is necessary not only to support immediate learning, but also to ensure continuity and progression over time. However, introducing too much structure may reduce the open-ended nature of outdoor learning, creating further tension between planned outcomes and child-led exploration.

Furthermore, there are challenges in recognising and documenting learning that takes place outdoors. Because outdoor learning is often informal and play-based, it may not always be immediately visible (Duffy, 2019). This can make it difficult for practitioners to assess progress or demonstrate learning, particularly in relation to specific scientific and mathematical concepts. As a result, valuable learning experiences may be overlooked. This suggests that approaches such as observation and documentation are important in making learning visible and supporting reflective practice (Macintyre, 2017).

Another consideration is the extent to which outdoor learning supports all children equally. While outdoor environments are often described as inclusive, individual differences may influence how children engage with these spaces (Smedsrud, 2025). Factors such as confidence, prior experience and physical ability can affect participation, meaning that some children may be more likely to engage in activities that support scientific and mathematical learning than others. For example, a child who is less confident physically may avoid climbing or balancing activities, limiting their exposure to concepts such as force and movement. This highlights the importance of the adult in recognising and responding to these differences, ensuring that all children are supported to access learning opportunities. However, this also adds complexity to the adult role, as practitioners must adapt their approach to meet a range of needs within the same environment.

In conclusion, adults play a significant role in supporting children's scientific and mathematical learning in outdoor environments. This involves balancing child-led exploration with appropriate guidance, using strategies such as observation, questioning and shared thinking. Theories from Piaget and Vygotsky, along with approaches such as Reggio Emilia, provide useful frameworks for understanding this role. However, effective practice depends on the ability of adults to respond to children's needs, recognise learning opportunities and make informed decisions. Outdoor environments provide a range of opportunities for learning, but these opportunities are shaped by the quality of adult interaction and support.

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