

## **Using Outdoor Environments to Support Children's Scientific and Mathematical Thinking**

Outdoor learning is a crucial component of early childhood education this is due to the many benefits it brings. Children have the chance to explore, investigate, and learn via real life experiences, Through activities like measuring, counting, and problem-solving, children can develop their scientific and mathematical thinking while fostering curiosity in natural settings.

(Harvey, 2022) This portfolio will demonstrate how an outside environment may help children's learning and development. It will provide numerous environmental opportunities and activities that support key learning areas while encouraging critical thinking, creativity, and discovery. The role of practitioners will also be examined, emphasizing how adults use techniques like prolonged shared thinking, questioning, and observation to enhance and expand children's learning. In order to facilitate children's meaningful exploration of mathematical and scientific concepts, practitioners play a crucial role in developing rich outdoor habitats, offering open-ended resources, and promoting child-led play.



(Louise Kool & Galt, 2023)

### **Outdoor environment**

The image represents a well equipped outdoor learning space that young children can explore through play. The location is surrounded by a natural garden with grass, trees, and other greenery, which creates a comfortable and interesting environment. Mud kitchens, low tables, and storage units with bowls, pots, utensils, and natural materials are among the wooden play stations scattered throughout the space. Children are encouraged to experiment with materials like dirt, water, and leaves by using these resources.

The outdoor setting also enhances the learning outcomes specified in the Curriculum for Wales and the Curriculum for non-maintained nursery provisions. Both frameworks highlight the significance of experiential, play-centered learning and motivate children to discover

mathematical and scientific ideas through practical experiences. (Welsh Government, 2022) Natural settings offer children chances to enhance early math skills through activities like counting, sorting, measuring, and comparing items like sticks, leaves, or stones. (Ranheim, 2020) It has been demonstrated that teaching science to young children has many advantages. Scientific learning is enhanced as children examine natural materials, notice changes, and delve into concepts like forces, movement, and cause and effect. These experiences foster the growth of problem-solving, curiosity, and critical thinking, which are essential components of the curriculum. (Raven and Wenner, 2022) By offering diverse outdoor learning settings and encouraging children's exploration, educators assist children in connecting with mathematical and scientific ideas in ways that correspond with these early years frameworks.

### **Mathematical and scientific concepts**

The outdoor setting shown in this picture offers children a variety of chances to use play to explore mathematical and scientific concepts. Children can learn through hands-on experiences through outdoor play, where they can experiment with movement, explore objects, and solve problems organically. Children can interact with natural materials and equipment in this area while gaining an early awareness of concepts like forces, gravity, size, weight, balance, counting, and measurement. In a relevant and captivating way, these activities foster children's curiosity, investigation, and critical thinking while assisting them in developing fundamental scientific and mathematical skills.

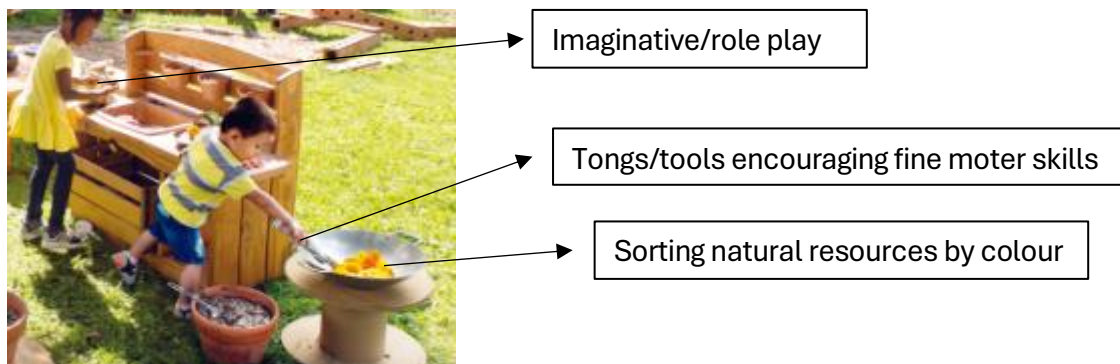


Water play - exploring cause and effect

Varied resources to encourage quantity and capacity exploration

Children can learn scientific topics like motion and forces in an outdoor setting. When pushing, dragging, lifting, and pouring things like dirt or water at the play stations, children

apply force. Children can investigate how objects move when a force is applied, for instance, by lifting containers or moving equipment. Additionally, these exercises can aid in the growth of mathematical ideas. Children can experiment with how much liquid or material each container can hold by using bowls, pots, and other containers. Children learn to compare quantities and comprehend capacity through pouring and filling. Children's comprehension will grow when they are engaged and challenged. You may attract children's curiosity by asking questions like "how much water can this container hold?" Additionally, use comparative language such as more than or less than to make a decision or make an estimate with children first. **(Outhwaite et al., 2024)** Children also learn about cause and consequence from their surroundings. Children start to realize that their actions have varied effects. For instance, stirring combinations can affect their texture, and adding more water can modify the consistency of mud, children may ask each other to add more water/soil to their potions to create their preferred consistency. Children can see how minor adjustments result in many consequences through this investigation.



Children's growth in sorting, classification, counting, and number identification can also be benefited by this outdoor setting. Children can count objects like stones and leaves while playing, which aids in the development of early number abilities. Additionally, they might categorize natural things like sticks, leaves, stones, or flowers according to characteristics like size, shape, or colour. Children may help each other and sort themselves into groups to learn and identify patterns and differences through these exercises.



Balance and stability

Shape and spatial awareness

Additionally, children can carry containers throughout the space, stack goods, and arrange objects on surfaces. For instance, children in the background are building bridges and balancing blocks on top of one another. As they figure out how to maintain the structures upright. Children are learning about forms and how things fit together by placing the blocks in various ways. As children choose where to put each block in the construction, they are also developing their spatial awareness, this kind of play enables them to investigate concepts of stability and balance while also honing their problem-solving abilities.

The usage of loose parts and open-ended resources is another significant aspect of this outdoor setting. Open-ended resources are those that don't have a single, definite purpose but can be used in a variety of ways. Children can explore, create, and experiment using objects like wooden blocks, bowls, sticks, stones, leaves, and containers based on their own ideas. Children are encouraged to move, combine, construct, and rearrange objects with loose bits, which fosters creativity and problem-solving skills. Children may explore mathematical and scientific ideas like balance, size, number, and cause and effect while they play since these materials can be used in a variety of ways. Since children are in charge of choosing how to use the resources, this kind of play additionally promotes independence and creativity. (Cremin et al., 2015)

By giving children a place to freely explore and learn about their surroundings, the outdoor setting promotes children's curiosity and observational abilities. Children are encouraged to ask questions, observe changes, take risks and make discoveries using hands-on play with natural materials like soil, water, plants, and wooden objects. For instance, children might monitor how objects move when they are poured or lifted, note variations in size or texture, or see how materials change when water is introduced. Through these encounters, children can pay close attention to their environment and start to grasp how things operate. Children who explore at their own pace naturally grow more inquisitive, inspired to learn more, and acquire critical early scientific thinking abilities. (Little and Eager, 2010)

According to Bronfenbrenner's Ecological Systems Theory, children's learning and development are greatly aided by their surroundings. Urie Bronfenbrenner believes that interactions within the children's immediate surroundings are how children develop. The outdoor setting in the picture serves as this microsystem, with children actively interacting with equipment, natural materials, and one another. Children can learn mathematical and scientific concepts like balance, measurement, and materials by engaging with their environment in meaningful ways through activities like playing in the den, building with wooden blocks, and using the mud kitchen. Social connection and shared play are two essential components of Bronfenbrenner's theory that further strengthen these experiences. The picture clearly demonstrates how a properly equipped outdoor setting may offer abundant chances for inquiry, learning, and exploration, demonstrating how the environment and the experiences it provides influence children's development. (Antony, 2022)

The Curriculum for Wales and the Curriculum for unmaintained nursery settings highlight learning outcomes that children can practically engage with through outdoor activities like mud kitchen play, building with wooden blocks, and investigating natural materials. Children are investigating scientific ideas like materials, change, and cause and effect, for instance, when they pour water or combine soil and natural materials in the mud kitchen. By counting objects, measuring capacity, and comparing amounts, they can simultaneously gain a grasp of mathematics. In the same way, young children explore concepts like balance, stability, shape, and spatial awareness when they construct constructions out of natural loose bits or wooden blocks. These hands-on experiences support children in developing early problem-solving and reasoning skills, which are key aspects of both frameworks. By engaging in play-based exploration outdoors, children are able to develop mathematical and scientific understanding in meaningful and relevant contexts. (Welsh Government, 2020)

Overall, the setting offers a rich outdoor learning environment that promotes critical thinking, discovery and hands-on experiences. The space is carefully designed to encourage children

to explore and investigate through play, allowing them to take an active role in their own learning. Through the use of natural materials, loose parts and open-ended resources, children are provided with multiple opportunities to engage with scientific and mathematical concepts in meaningful ways. For example, they may develop an understanding of counting, measuring and capacity, as well as exploring scientific ideas such as forces, balance and cause and effect.

These types of environments support children in becoming curious and independent learners, as they are free to experiment, make predictions and solve problems through trial and error. Open-ended resources are particularly valuable as they can be used in a variety of ways, encouraging creativity and deeper levels of thinking. Research suggests that outdoor learning environments can significantly enhance children's cognitive development and engagement, as they provide real-life contexts for learning and exploration (McCree, Cutting and Sherwin, 2018). Therefore, outdoor play spaces such as this are essential in supporting the development of early scientific and mathematical understanding. (McCree, Cutting and Sherwin, 2018)

A risk-benefit analysis takes into account both the possible hazards and the advantages of activities in a setting for development. Children should be given the chance to experiment, explore, and take reasonable risks while playing in early childhood settings since these activities promote learning and growth. Natural materials, loose parts, and physical obstacles are common in outdoor settings, which inspire children to explore their surroundings and develop abilities like independence, problem-solving, and coordination. Instead of eliminating every risk, practitioners try to control and reduce risks so that children can still benefit from active inquiry. The outdoor setting shown in this picture offers a variety of educational

opportunities, but it also necessitates proper supervision and safety precautions to guarantee children may play in a safe manner.

## RISK BENEFIT ASSESSMENT

|                             |                        |                     |                                |
|-----------------------------|------------------------|---------------------|--------------------------------|
| <b>Location / Activity:</b> | Woodland Creative Play | <b>Date:</b>        | March 10th<br>2026             |
| <b>Assessor:</b>            | Charlie Burman         | <b>Review date:</b> | April 15 <sup>th</sup><br>2027 |

| <b>Experience exploring outdoor space in photograph</b> | <b>How will young people BENEFIT from this activity?</b>                                                                             | <b>Hazards and associated risks</b>                                                             | <b>Who is at risk?</b>                                                   | <b>PRECAUTIONS in place to reduce the risk of injury</b>                                                                   | <b>Overall risk after precautions<br/>RATING:<br/>L/M/H</b> |
|---------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------|
| Mixing water and natural resources.                     | Playing with water and mud supports sensory exploration, scientific investigation, and curiosity. Children can explore concepts such | Children could slip on wet surfaces or spill water and mud, which may make the ground slippery. | The children involved in the activity as well as the people surrounding. | Responsible adults must supervise the area. Ensuring surfaces are monitored for excessive water and that the children wear | M                                                           |

|                             |                                                                                                                                                                                   |                                                                                                                                        |                                                                  |                                                                                                                                                           |   |
|-----------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------|---|
|                             | as cause and effect, mixing materials, and changes in texture.                                                                                                                    |                                                                                                                                        |                                                                  | appropriate footwear.                                                                                                                                     |   |
| Building and stacking wood. | Children's problem-solving abilities, spatial awareness, balance, and stability ideas are all enhanced by building with blocks. Additionally, it fosters innovation and teamwork. | Structures could collapse, or blocks could fall on hands or feet. Additionally children may climb or balance on the wood and fall off. | The children surrounding or playing with the blocks at the time. | Adult supervision to guide safe play. Encourage children to build on stable surfaces using lightweight wooden blocks suitable for children when possible. | M |
| Playing with loose parts.   | Loose parts support open-ended play, creativity, and exploration. They also encourage children to practice sorting,                                                               | Small objects may be thrown or placed in the mouth by younger children.                                                                | All children outside who have access to the materials.           | Ensure materials are age-appropriate and regularly check materials for damage or sharp edges. Supervise                                                   | H |

|                                      |                                                                                                                                                                                      |                                                                                                 |                                                                              |                                                                                                                                   |   |
|--------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------|---|
|                                      | counting, and classifying materials.                                                                                                                                                 |                                                                                                 |                                                                              | children at all times during play.                                                                                                |   |
| Walking or running on uneven ground. | Uneven ground helps develop balance, coordination, and spatial awareness, which are important physical development skills.                                                           | Children could trip or fall while running or moving/carrying resources around the outdoor area. | Everyone in the outdoor area.                                                | Regularly check the play area for hazards, Maintain clear walkways and encourage safe movement around the space.                  | L |
| Lifting and carrying resources.      | Carrying buckets, bowls, and natural materials helps develop physical strength, coordination, and awareness of weight and balance. It also supports early mathematical understanding | Children may drop containers or struggle with heavier objects, which could cause injuries.      | Children participating in the activity and potentially children surrounding. | Adults should supervise lifting activities. Provide suitable child sized containers and encourage children to carry items safely. | L |

|                                 |                                                                                                                                                                                                                                                                                                      |                                                                                                                                                                                                        |                                              |                                                                                                                                                                                                                                                                                                   |   |
|---------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---|
|                                 | of size and quantity.                                                                                                                                                                                                                                                                                |                                                                                                                                                                                                        |                                              |                                                                                                                                                                                                                                                                                                   |   |
| Exploring/<br>building a<br>den | <p>Dens can support scientific curiosity, as children observe natural materials such as branches, leaves, and plants, and explore how structures are built.</p> <p>Additionally, the space encourages collaboration and communication, as children often work together to create or use the den.</p> | <p>Children may pull down the netting or fall into the sticks that hold up the den. There is also a small risk of children bumping into branches or the structure becoming unstable if climbed on.</p> | <p>The children playing in the den area.</p> | <p>Ensure the structure is stable and regularly checked by staff, removing any sharp or damaged branches.</p> <p>Adults should supervise the area while allowing children to explore independently and provide clear guidance that the den is for sitting and role play rather than climbing.</p> | M |

## **How adults working with early years children support and encourage children engage with mathematical and scientific concepts in an outdoor environment?**

Sustained shared thinking is a key strategy used by adults to encourage children's interest in mathematics and scientific ideas in outdoor settings. When adults and children interact to solve issues, investigate concepts, or extend learning through discussion and engagement, sustained shared thinking takes place. (Leatherbarrow, 2025) High-quality early years settings frequently involve adults having meaningful conversations with children that extend their thinking, according to research from Kathy Sylva and colleagues Effective Provision of Pre-School Education (EPPE) study. By posing open-ended questions, encouraging children to make predictions, and assisting them in thinking back on their observations, educators can enhance learning in outdoor settings. When children are building with wooden blocks outside, for instance, an adult could inquire as to why a construction keeps collapsing or offer alternative strategies for balancing the pieces. Children are encouraged to think critically about ideas like stability, weight, and balance through these encounters. While preserving the

child-led and exploratory aspect of outdoor play, adults can assist children in gaining a deeper comprehension of mathematics and scientific concepts by engaging in prolonged shared thought. (Sylva et al., 2004)

Open-ended, child-led play is a crucial way that adults encourage children to interact with mathematical and scientific ideas in outdoor settings. With tools that can be used in a multitude of ways, open-ended play gives children the freedom to experiment and explore without worrying about the final result. Children can use and combine natural elements like sticks, stones, water, sand, and wooden blocks in a variety of ways in outdoor settings. By giving them these tools, adults help children explore concepts like size, number, balance, and cause and effect on their own. This method is in line with Jean Piaget's theories, according to which infants actively create knowledge by interacting with their surroundings and experimenting with items. (Prins et al., 2023) By fostering rich environments, letting children take charge of their play, and posing open-ended, provocative questions, adults facilitate this learning. For instance, children are investigating mathematical and scientific ideas while developing their problem-solving and reasoning abilities when they construct structures out of loose materials or combine natural materials in a mud kitchen. (Malik and Marwaha, 2023)

Observation is another crucial way adults encourage children to interact with scientific and mathematical ideas in outside settings. Through observation, professionals may keep a careful eye on how children engage with objects, what attracts them, and what they are already learning while playing. Adults might find opportunities to extend learning and teach new concepts by watching child behaviour and conversations. (Rodriguez et al., 2024) When children are pouring water between containers outside, for instance, a practitioner can see that they are starting to compare how much each container can hold. The adult can then promote more research into capacity and volume by adding measuring jugs, funnels, or other containers. Lev Vygotsky, who emphasized the value of adults assisting children's learning by identifying their present level of understanding and directing them toward deeper thinking, is connected to this method. Adults may respond to children's interests, foster curiosity, and

provide chances for them to meaningfully explore scientific and mathematical topics by closely observing them. (Shabani, Khatib and Ebadi, 2010)

Using loose components is another method adults can encourage children to interact with scientific and mathematical ideas in outdoor settings. Sticks, stones, leaves, shells, wooden blocks, and containers are examples of loose elements that children can move, mix, modify, and utilize in a variety of ways. Giving children access to these materials enables them to freely experiment and explore, enabling them to learn about ideas like size, balance, weight, and amount. (Ozlem Cankaya et al., 2025) For example, children may use sticks and blocks to build structures, exploring ideas of stability and balance, or collect and sort natural objects by shape, size, or colour, which supports early mathematical thinking. Simon Nicholson created the concept of loose components, arguing that settings with a range of movable elements foster imagination, investigation, and learning. By offering a variety of resources, watching how children utilize them, and occasionally expanding learning through inquiries or recommendations, adults play a crucial role. In this approach, loose pieces give children lots of chances to explore scientific and mathematical concepts through play. (Robertson, 2017)

The Reggio Emilia method is another strategy that encourages children to interact with scientific and mathematical ideas in outdoor settings. This method, which was created by Loris Malaguzzi, sees the physical environment as the "third teacher," meaning that it is crucial for promoting children's learning and growth. Children are encouraged to explore, discover, and experiment in outdoor environments that are thoughtfully built with natural materials, open spaces, and loose pieces. Through practical encounters, these settings enable children to grow in their curiosity and create discoveries. Children might research scientific themes like materials and change when combining soil and water in a mud kitchen, or they might investigate mathematics concepts like counting, sorting, and measuring while gathering natural objects. In Reggio Emilia inspired settings, adults facilitate learning by noticing children's interests, offering engaging resources, and promoting conversation and reflection. This method emphasizes child-led inquiry, enabling children to grow in their

comprehension of scientific and mathematical ideas via creativity, curiosity, and group learning. (xavier, 2025)

Affordance is another key idea that encourages children to learn science and math in outdoor settings. The options for action that a child's surroundings offer are referred to as affordances. Various elements of an outdoor area can inspire children to engage with objects and investigate concepts in different ways. For instance, children can construct, stack, balance, pour, and measure using natural materials like logs, stones, sticks, water, and sand. Children can learn about scientific concepts like forces, gravity, and materials as well as mathematics concepts like size, shape, number, and measurement through these interactions. Adults play an important role in recognising these affordances and designing outdoor environments that provide a range of stimulating resources. By observing how children use the space and adding materials that encourage exploration, practitioners can support children in discovering new ways to engage with mathematical and scientific concepts through play. (Waters, n.d.)

Since children learn best when they actively engage with their surroundings, the Curriculum for Wales places a heavy focus on experiential, play-based learning, especially in the early years. Through the Areas of Learning and Experience (AoLEs), such as Science and Technology and Mathematics and Numeracy, which are extremely pertinent to outdoor learning, it encourages a comprehensive approach to development. By examining real-life situations, the program helps children develop abilities like problem-solving, critical thinking, and curiosity. These goals are supported by outdoor settings, which provide children the chance to measure, count, inspect natural materials, and meaningfully investigate ideas like forces and change. The program also emphasizes the value of independence and child-led learning, letting kids pursue their passions and learn by doing. By supporting outdoor play, practitioners are aligning with the Curriculum for Wales by creating engaging, hands-on experiences that foster both mathematical and scientific understanding. (Welsh Government, 2020b)

Although outdoor settings offer abundant chances for the development of scientific and mathematical knowledge, there are a number of restrictions and obstacles that may limit children's ability to participate in their education. The weather is a major obstacle since it can restrict access to outdoor areas or cut down on the amount of time children spend exploring. Some settings are not always fortunate to have a great outdoor space for children to safely explore and play. Furthermore, some practitioners might not have the confidence or expertise to promote scientific and mathematical learning outside, which could lead to lost chances to help children think more deeply. Adults could prevent certain activities, such climbing or utilizing loose parts, in order to reduce risk. This might limit opportunities for problem-solving and exploration. Additionally, insufficient supplies or poorly planned outdoor areas can not offer enough affordances or variation to properly support learning. (Edwards, 2023)

Additionally, children's ability to completely explore and develop ideas may be limited by time limits within the daily routine, which can limit opportunities for prolonged outside play. The amount of individual help and engagement that children receive may also be influenced by personnel levels and ratios, especially when it comes to ideas like sustained shared thinking. A child's involvement and eagerness to explore may be impacted by their lack of confidence or familiarity with outdoor settings. Additionally, outdoor play may be seen as less significant due to curriculum requirements or a greater emphasis on indoor learning. These obstacles show how crucial it is to have skilled professionals, careful preparation, and a balanced approach to risk in order to provide children with worthwhile, regular outdoor learning opportunities.

In conclusion, children can learn mathematical and scientific concepts through play, discovery, and practical experiences in outdoor settings. It has been demonstrated throughout this essay that when children work with natural materials and open-ended resources, they connect with concepts like counting, measuring, forces, balance, and cause and effect. Adults have a crucial role in facilitating this learning, especially through prolonged shared thought, scaffolding, and observation, all of which aid in expanding children's comprehension. (McCree, Cutting and Sherwin, 2018) Theories of Loris Malaguzzi, Lev

Vygotsky, and Jean Piaget emphasize the significance of social contact, learning environments, and exploration in influencing children's development. Furthermore, frameworks like the Curriculum for Wales encourage the development of critical skills through play-based, outdoor learning. Weather, resources, and practitioner confidence are just a few of the constraints and obstacles that can be overcome with careful planning and assistance. All things considered, early mathematics and scientific understanding, critical thinking, and curiosity are all greatly enhanced by outdoor learning.

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