

Awe and Wonder - Science, mathematics and the outdoors



(St Nicholas School Canterbury, n.d)

9:30 A.M:

All the students were excited to visit St. Nicholas Forest School when they arrived at school.

Miss! Why are we going to a forest school, a child asked?

Why do you think we are going to a forest school, I asked?

The child said so we all see different things.

What kinds of wonderful things can we see there, I asked.

The child mentioned bugs and many trees.

Wow! I said, I absolutely cannot wait to see these wonderful things.

9:45 A.M:

All the children leaped in excitement as the bus approached.

We conducted a head count to determine the number of people present before boarding the bus.

There were 21 children (ages 4-7) and 8 adults overall (consisting of staff and parents).

One of the children exclaimed, "Miss, this is a very huge bus," as we got on the bus.

Indeed, it is a big bus, I responded.

They sang "Wheels on the bus" and played "Eye Spy" with my small eyes as we travelled.

One toddler remarked, "I see something large outside with my small eyes."

Everyone was thrilled with delight to see the cows and sheep heading towards the forest. They even counted how many there were.



(Source: Bing, n.d)

10:30 A.M:

We arrived at St. Nicholas Forest School.

We were surrounded by trees, muddy patches, and fallen leaves.

As we moved to the meeting place, we gathered all the children together and instructed them to form a line. We proceeded to the designated meeting point, where two staff members from the forest school awaited us. In order to explain the regulations of forest school and the possibilities for exploration in the forest, the children were requested to take a seat.

Afterwards, we went over with the children the various stations at the forest school and what to expect there.

Where they see the ropes, and are they allowed crossing that area? Was one of the questions asked to the children as they waited to go explore.

They shouted NO! Following that, they were asked if they are allowed to pick up any strange objects they observed on the ground.

No, they answered, we will run and get an adult.

Following that, the staff and parents dispersed to have a discussion on what was expected of each adult, including their responsibility to let children play and explore without interfering. Moreover, a first aid kit should be close by for every employee.

11:00 A.M:

The children were helped to put on their wellies and waterproof shoes before they went an explore the forest.

The children were left to explore the forest.

Each child took a different path.

Some children rushed to play in the mud while others went swinging, some went collecting sticks, others went using the magnifying glass to investigate bugs and insects, and some went collecting leaves from the ground.

One child was curious about bug and was in awe as they took up pieces of leaves and found worms while using her magnifying glasses to study the bugs and insects in the forest environment.

She used the containers that were offered to them in the section of bugs and insects to put her worms in.

Miss, have a look at what we found, she said.

What did you find, I asked?

She emphasised I discovered a worm.

Where did you find the worm? She said that we discovered them under leaves.

Well, that's interesting, I exclaimed.

Uh yeah, she responded, but miss why his worm short and this worm long? I replied why do you think your woman is longer?

She responded that her worm consumes more food. I smiled and replied, "Well, certainly, I think so."

Progression step 2 I can explore living things and their habitats (Welsh Government, 2022).



(Source: Amazon, n.d)



(Source: Bing, n.d)



(Source: Ebay, n.d)

One child was amazed by the swing.
About how high she can swing until she can touch the sky.
She said, "Miss," what would happen if I pushed her a little harder.
I said that is an interesting idea! Let's see what would happen.
I think she would go higher, she said.
I asked if you wanted to try gently but firmly pushing her.
She exclaimed, "YES!"
I told her to try, and when she did, she jumped in excitement. She said miss we tried to push her harder, she reached this height.
I observed how happy she was that they had succeeded.
Progression step 2 I can communicate the effect forces (Welsh Government, 2022).

As they accomplish this, the children learnt about gravity and height.



(Source: Bing, n.d)

The children' enthusiasm for the outdoors and for playing outside absolutely amazes me.

I approached some children who were collecting mud.

They educated me that they opened a cake business so that they could bake cakes for me to purchase.

Absolutely, I replied, I'd love to buy a cake.

To begin their experiment, the children went to the mud kitchen.

What kind of cake would you prefer, miss they asked?

I responded, "Well, I would love one of those delicious chocolate cakes because it is my favourite."



(Source: St Nicholas School Canterbury, n.d)



(Source: Bing, n.d)

We arranged buckets of water close to this activity area so children can play with water while exploring and experimenting.

The children mixed their mud cake with water and stirred it with a stick.

Miss, I think this has too much water in it, one child said.

I asked I wonder what might happen if we put more flour in it.

He took the lead and instructed the children to add extra flour to the cake because they had put too much water.

In this, children were picking up knowledge from more knowledgeable children.

The children learned about measurements while making mud cakes.

Progression step 2 I can observe and describe ways in which materials change when they are mixed together (Welsh Government, 2022).



The next group of children I saw were busy gathering sticks and leaves off the ground. They looked at the stick and leaves' various patterns, shapes, and sizes. They then made the decision to use the materials they had gathered to construct a den. The den was initially constructed, but it kept collapsing.

(Source: Bing, n.d)

I asked them why they think the den continued to collapse. If they have tried pushing the sticks deeper into the ground. Let's try again. If I push the sticks deeper in the ground if the den would stay up. They were curious to try pushing the stick deeper in the ground and excited it work when they did. They wanted to experiment more in den building by add more sticks and leaves. Progression step 1 I can show curiosity (Welsh Government, 2022).

1:15 P.M:

The staff kept track of the children' activities while they were exploring the forest by keeping notes and taking pictures of everything they did. As departing time drew near, we assembled all the children for circle time. The next step was to have the children paint or draw something related to what they had been learning about today. Some chose to paint on paper, while some wanted to paint sticks and leaves. Everyone discussed their findings, and I was thrilled to observe and participate in the various scientific and mathematical concepts the children were curious to learn, explore, and investigate.

Children were given wonderful opportunities to engage, ask questions, and come up with solutions in this forest environment full of awe and wonder. Goodbye they said to the forest school staff as they left. Thank you.



(Source: Bing, n.d)



(Source: Bing, n.d)

RISK BENEFIT ASSESSMENT

Location / Activity:	Exploring the outdoors on a cool day: Forest School (Possibility of light rain)	Date:	22 nd March 2023
Assessor:	Temara Glynn	Review date:	20 th June 2023

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 risks	Who is at risk?	PRECAUTIONS in place to reduce the risk of injury	Overall risk RATING: L/M/H
Exploring the environment Uneven terrain, tree roots, and broken branches on the surface. Branches at eye level	Encouraging the development of movement and environmental awareness. Educating children on self-awareness and peer support learning about nature firsthand Development of motor skills Improved balance	bruises from trips, slips or falls	Adults and Children	Using the appropriate footwear to minimize the likelihood of slipping or tripping for both staff and children. Using appropriate clothes to minimize bruises Children are given precise guidelines on the area they can explore. Routine inspection of trails and paths for obstructions or potential hazards, such as falling branches A designated staff member will carry a first aid kit. Use caution and group briefing about hazard of overhead trees and low branches	M

Experience exploring outdoor space in photograph	How will young people BENEFIT from this activity?	Hazards and risks	Who is at risk?	PRECAUTIONS in place to reduce the risk of injury	Overall risk RATING: L/M/H
Building dens or other activities using sticks and branches	Possibilities to communicate openly, solve problems, and scaffold one another. Opportunities to practice knots, develop motor skills, and improve social skills Promotes maths and science concepts such weight, height, measurements, volume and size Enhances creativity and imagination	being struck by sticks bruises and cuts eye or head injury	Children	Practitioners should alert children that they should be mindful of their surroundings and carry or hold sticks safely. Accidents and injuries are to be handled promptly.	L

Experience exploring outdoor space in photograph	How will young people BENEFIT from this activity?	Hazards and risks	Who is at risk?	PRECAUTIONS in place to reduce the risk of injury	Overall risk RATING: L/M/H
Children making mud pies and water play	Promotes creativity and imagination Offers a variety of opportunities for movement Promotes mathematical and scientific experiences such as measurements, volume, weight Builds problem- solving skills (Cognitive development) Development communication skills	Water spills, trips and falls caused by slippery surfaces, and children having difficulty lifting heavy water containers	Children	Children to wear appropriate clothing or change of clothes if needed First aid kit on hand if needed Ensuring children know they are to walk carefully on slippery ground	L

Experience exploring outdoor space in photograph	How will young people BENEFIT from this activity?	Hazards and risks	Who is at risk?	PRECAUTIONS in place to reduce the risk of injury	Overall risk RATING: L/M/H
Exploring beyond the ropes or cones	Help children understand the value of collaborating with others and following the rules. Establishing relationships and built on trust.	Child can become terrified Child might get lost	Children	Golden rule- children told and asked to repeat boundaries and Forest school rules such as shouting and staying put where you are Regular headcount No access out of forest ground –staff will place ropes and cones along the line children should not pass Create a buddy system. Where children are to stay in group of at least 2 persons Explaining to children to not speak to strangers outside of the group	M

Experience exploring outdoor space in photograph	How will young people BENEFIT from this activity?	Hazards and risks	Who is at risk?	PRECAUTIONS in place to reduce the risk of injury	Overall risk RATING: L/M/H
Swinging	Increases spatial awareness Strengthens a child's core muscles and supports with balance development Teaching body awareness Improves motor skills and coordination Improves sensory skills Improves critical thinking skills	Falls which can lead to broken ankle or hand Children can get blisters or burns from rope	Children	Practitioners to always have observation children while on swings Checking the swing is in good condition Ensure children know not to push each other too high in the air	L
Collecting Natural Materials	Gaining knowledge and confidence in the local forest Physical strength and movement development Hands on learning about nature	injuries sustained while lifting objects, strains, trips, falls, poisoning, wounds, grazes, thorns, splinters, and stings,	Child	Prior to the activity, safety instructions would be provided. Encouraging children to learn how to lift safely Children under adult supervision the entire time the activity is taking place and the site is frequently checked for the presence of natural compounds. Children are informed of what they may and may not collect.	L

Experience exploring outdoor space in photograph	How will young people BENEFIT from this activity?	Hazards and risks	Who is at risk?	PRECAUTIONS in place to reduce the risk of injury	Overall risk RATING: L/M/H
Climbing trees or on structures at site	Confidence, physical strength and ability enhancement Personal , social and emotional development Improved motor skills as to handholds and wrapping their fingers in order to climb upwards, as well as hand-eye coordination It increases imagination enhanced speed, flexibility, awareness, and balance It encourages an increase in self-confidence. It promote curiosity and discovery It develops critical thinking skills – child would develop to know where to place his hands and feet	Slips, trips, falls, collisions, strains	Children	Weather check in line with weather risk (in terms of wind and rain) Safety check of structure to be used for climbing – ensure it is not wet and slippery and is not rotten. All climbing activities to be closely supervised Children will not climb wearing articles that could become entangled in the branches Ribbons of other visual signals could be used to mark where safe climbing limit is Limit numbers of children in any one tree	M

Experience exploring outdoor space in photograph	How will young people BENEFIT from this activity?	Hazards and risks	Who is at risk?	PRECAUTIONS in place to reduce the risk of injury	Overall risk RATING: L/M/H
Loose Parts	enhancing inquisitive creates curiosity and exploration Enhance mathematical and scientific concepts such as children making mud pie or cake or using magnifying glass to look for bugs and insects leads to measurement, height, gravity, life cycles	Cuts, bruises, burns	Children	Practitioners ensuring all loose parts are in good condition Practitioners to supervise children while using loose parts Practitioners to ensure children understand how to use the different loose parts	L

Experience exploring outdoor space in photograph	How will young people BENEFIT from this activity?	Hazards and risks	Who is at risk?	PRECAUTIONS in place to reduce the risk of injury	Overall risk RATING: L/M/H
Exploring insects, bug and plants	Learning about habitats Learning about insect, bugs and plants life cycle Nurtures children curiosity and exploratory drive Children can count the insects or bug they have found or the different plants or number of leaves on the ground	Potential suffocation, poisoning, or allergic reaction	Children and Adults	Learn about any allergies that have been reported in the group Inform children about bee wasps Talk about hazardous plants and fungus. Instruct children not to consume anything or put their fingers in their mouths The golden rule - everyone should wash their hands before eating lunch or avoid touching their faces after exploring something Have antiseptic wipes, inhalers or medicine on hand	H

Outdoor experiences foster a child's cognitive, emotional, and physical development in particular ways that are different from, or greatly extend the experiences accessible indoors, even though the synthetic materials found in the indoor environment are evidently rich in learning opportunities (Welsh Government, n.d). Young children should have the chance to explore more features of nature while they are outdoors, as nature stimulates all their senses. Comenius (cited in Joyce, 2012) believes that without the utilization of nature and a variety of sensory experiences, one could not have a proper knowledge of the world.

Many factors affect the availability of outdoor learning opportunities in schools, including health and safety issues, teacher self-efficacy and confidence, a lack of time, money, and support (Rickinson *et al.*, 2004 cited in Moffett, 2022). Department for Children, Education, Lifelong Learning and Skills (2009) states that to provide and manage outdoor learning, practitioners must give children the freedom to take calculated risks. That does not suggest that the outdoor learning space should be risk-free, rather it means that the risks that children may encounter outdoor would have been considered and assessed (Pizzolongo, 2021). Tovey (2007 cited in Sandseter, 2014) discovered that while some teachers encouraged children to take risks, others expressed fear about the children's risk-taking due to what they think might happen during risky play. However, teachers may provide children with 'yes environments' (Gonsoski, 2016). These environments would encourage children to explore outdoors which may allow teachers to take an open-minded approach to supervision and allow children to take risks. For example, a child in a forest school wants to climb a very tall tree but the teachers are afraid that the child might fall and break a part of his or her body. While this might be true, the child can benefit from learning about height, gravity and balance during his or her climbing experience. However, it involves practitioners considering how risky play can provide learning possibilities for the child (Bahrenscheer and Sederberg, 2019).

It is therefore essential that adults who are interested in nature and appreciate outdoor learning, support children by being observant, engaged, and attentive to their surroundings (White, 2011). Practitioners who understand the benefits of being outdoors, see the value it provides for young children's development. As a result, they spend time outdoors with children so that the children's development can occur. The natural environment should be familiar to children and feel like a place to which they belong (Davis *et al.*, 2006 cited in Waite, 2011). With a long and intertwined history, mathematics and science are becoming increasingly important in children's learning

development (Wright and Chorin, 1999). The aforementioned quote conjures up the notion that the extensive history shared between Mathematics and Science means that children reap the collective benefits.

Practitioners working with young children need to provide environments for children to be curious and they need to be engaged as conversation partners with children (Grindheim, Sorensen and Rekers, 2021) to support the development and learning of mathematics and science. In relation to the outdoor areas, children are afforded improved teaching conditions that encourage both sensory and cognitive exploration. This view is supported by Issacs (cited in Maynard, 2014) who states that the outdoor environment is source for children curiosity and can be supported and extended by adults. These explorations help them to discover and comprehend scientific and mathematical concepts. These include concepts like gravity, weight, height, balance, texture, shape, size, and patterns which are discovered and understood through play while making mud cakes, building dens, swinging, rolling down slopes and learning about different life cycles. Therefore, nature is referred to as one setting where children's curiosity is encouraged. It is further looked at as being rich and varied in relation to the environments where children's play, learning, and cultural development are encouraged. Opportunities for children to engage in collaborative, curiosity-based play in the natural environment also influence the foundations for curiosity (Cohen and Waite-Stupiansky, 2019).

According to Wilson (2018) in the early years of children's lives, adults may provide them with rich sensory- environments that help to stimulate their mathematical and scientific curiosity and create awe and wonder opportunities. Maynard, Waters and Clement (2013) state that practitioners may provide children with the opportunity to take part in child-initiated activities in a natural setting, which will give them the chance to ask and respond to their own questions. Richardson (2013) and Warden (2007) believes that every child has the right to experience and appreciate the unique and important aspects of being outside. The points put forward by the aforementioned authors therefore mean that the outdoor setting plays a pivotal role in children's overall development. When young children have unrestricted access to stimulating outdoor settings for learning through play and hands-on experiences, they thrive, and their bodies and minds develop at their best. Unlocking the potential of the outdoors requires knowledgeable and enthusiastic adults (Edgington, 2014 and Bilton and James, 2008). To properly understand children, practitioners need to closely observe and engage with the children on a regular

basis. After gathering this knowledge, the adult then uses activities, dialogues, resources, and questions to encourage children to explore and learn more about math and science in their environment (Brenneman, 2011).

Malaguzzi provided support for this through his participation in the development of the Reggio Emilia Approach. This approach suggests that practitioners follow the children's interests while becoming updated about their current knowledge and the difficulties they are facing (Moss, 2018). By doing this, they construct their work and the environment to fit the specific child's needs and encourage shared thinking among children, other practitioners, and families (Hall *et al.*, 2010). This approach sees everything as being interconnected which enhances Math and Science concepts when they are thoroughly exploring outdoors. He suggests that the practitioners serve as their researchers, the environment serves as their teacher, parents as partners and children as communicators (Pound, 2006).

However, Dewey believed that children may engage with others and work independently and collaboratively with their peers and adults. He also believed that learning should be a lifelong process. Instead of only instructing children, practitioners may direct their learning, engage their minds, and collaborate with them. Additionally, children's critical thinking and problem-solving skills should be encouraged by practitioners (Bilton, 2002). For example, a child who is building a rocket but cannot get the parts together would then be encouraged to ask the practitioner for help. The practitioner helps the child but ask the child what does the child want the practitioner to do? The practitioner does not take away the rocket from the child and does it himself or herself, rather he or she works along with the child to complete the project.

Practitioners can create environments where all children's mathematical and scientific ideas are appreciated and where children are encouraged to experiment and discover for themselves (Johnson, 2018). For example, a practitioner can support children's mathematical and scientific development outdoors by providing children with loose parts so they can explore. Children can be provided with cups and pans to make mud cake in their environments. While doing these things, children are learning about measurements and volume. These include how much water is needed to make the cake moister or is there too much water so next time less water will be used? With this process, practitioners are also introducing children to trial and error.

Nicholson's concepts were created in the framework of design theory and how one could promote engagement and creativity in an individual's environment. When used in the context of an outdoor empty space, the idea is to add moveable objects, such as old milk crates, nets, tyres, twigs, pallets, sticks, and board to play areas, so that children can benefit from the creative and exploratory possibilities they provide (Gibson, Cornell and Gill, 2017).

Play Scotland (n.d) says that loose parts encourage creativity, curiosity, exploration, immigration and discovery in children's outdoor mathematics and science environments. This concept is linked to Bruner who spoke about the importance of imagination and how children may use everyday objects to represent other things (Pound, 2006). Albert Einstein says that "Imagination is more important than knowledge. For knowledge is limited to all we now know and understand, while imagination embraces the entire world, and all there ever will be to know and understand". Imagination is seen when a child uses a twig as a spoon to stir a cake batter or uses an empty box as a rocket ship. These resources support both learning and open-ended play. In open-ended play, children have the freedom to lead the play and choose what they wish to create or build. For open-ended play or any other forms of play to achieve any real success, adults can provide children with access to engaging environments. They can engage in setting up these environments or supplement them with resources, while observing and documenting the children as they interact in these environments.

Moffet (2022) states that children can have the chance to deepen their knowledge of mathematics and science in their foundation stage by engaging with "the world around them" through experiences. They may have the ability to able to "explore and talk about shapes in the environment," "investigate movement through space during outdoor play activities," and "explore and discuss about pattern in the environment'. According to Pugh (2010 cited in Joyce, 2012) there is an urgent need to improve outcomes for all children by equipping all teachers and practitioners with the skills that are required to use in the outdoors. Ernst (2014) states that this can be done with training on the use of the outdoors. Froebel (cited in Tovey, n.d) saw children as active, curious, creative learners. Froebel (cited in Clark, 2023) argued that if young children had the chance for unstructured, uninterrupted play, then they would connect what they already understand to what they are trying to learn while the child is doing this the practitioner would observe and support the child. For example, a child who

is making a mud pie will be able to complete the task if allowed to do so in an unstructured, uninterrupted way. The ability to complete the task will see the child tapping into both math and science concepts.

Vygotsky (cited in Waller, 2017) argued that learning occurs in the social environment when children and adults play and learn together. His work demonstrated how social and cognitive development interact together and build upon one another. He believed that language plays a central role in cognitive development. Cremin *et al.* (2015) claimed that when children are "scaffolded" it fosters children independence as inquirers and problem solvers. This is based on careful observation of what the children can do and designing a curriculum that pushes them beyond that. Communication is a key component of social interactions; hence Vygotsky emphasized the importance of language in a child's cognitive development (Daly, Byers and Taylor, 2006).

A mathematical and scientific illustration of this may be a child who is walking on an uneven ground and is scaffolded by an adult. The child realizes his or her limitations and asks an adult for assistance. By holding the child's hand while they walk, explaining the idea of balance and counting their steps while verbally encouraging the child's efforts, the adult ends up assisting the child. After a few times of doing this balance exercise, the practitioner can let go of the child's hand while still verbally encouraging him or her and standing back when it is believed it is safe to do so. The child will be able to do this task without any physical or verbal assistance once this phase is finished. A supportive, scaffolding, enabling adult is what is needed to support children's mathematical and scientific development.

Children are making discoveries of and inventions in relation to math and science concepts as they investigate and explore every day in their environments. Practitioners may use the outdoors as a tool to support and encourage the advancement of scientific and mathematical concepts. It is important to recognize that both science and math are interconnected so practitioners may use them collaboratively to support children's outdoor experiences. During outdoor experiences, children benefit from learning about weight, height, balance, life cycle, measurements, force, gravity, communication and teamwork. Furthermore, children also benefit from holistic development during outdoor experiences. However, it is believed that practitioners' confidence, time and support may be a barrier to children's mathematical and scientific learning opportunities in an outdoor environment. These barriers can be eliminated through teacher

training so that said teachers can provide support to children during outdoor learning. Practitioners can encourage math and science activities during outdoor exploration to promote awe and wonder experiences in children's learning.

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