

Awe and Wonder: Mathematics, Science and the Outdoors

Part 1



Part 2 – Reflective Account - WC 1134

Exploring on a Snowy Day.

Each week a group of approximately 6 children from the Early Years explore their local community with 2 members of staff. This can be visiting the shops, the park, community interest buildings, etc. This is in line with the Curriculum in Wales (2020) four purposes and with a view to provide holistic learning and cross curricular skill development opportunities as well as endorse a sense of belonging for the children in their local area in turn boosting the visibility of the school. The curriculum links are based on a general assessment of the children's collective explorations; however, these will be looked at more closely with the video and photographic evidence that the children and staff use to record their outings being used to identify individual children's progression.

On this particularly cold and snowy day, the group of children were from the year 1 class. We walked from the school up the hill towards our local church and child A noticed how slippery the floor was. When trying to walk on a patch of black ice their feet couldn't find purchase and they began to slide as if roller skating. Child B exclaimed that Child A was ice skating with Child C looking for a patch of ice to also explore the slippery



nature of the floor. I stood back to observe, and Child C seemed confused that they were unable to skate like Child A, pushing their feet back and fore making a scraping sound with their shoes catching on the pavement. I asked what sound Child A was making while doing the same movement and Child B stated they were making a swooshing sound. Together the children explored the sounds they were making with their feet and chatted about why they were different. Child A stated that Jack Frost hadn't been to the patch that Child C was on and so it wasn't slippery. To extend the learning, I asked if the children had any ideas why Jack Frost hadn't visited that area. They were unsure as to why but took notice of where the icy patch was (next to a wall) in relation to the non-icy patch situated in the centre of the pavement. The children then took turns skating on the patch of slippery ground. I praised their enquiring natures and teamwork to work out the differences regarding the icy and non-icy floor and the reasoning for this.

Curriculum links - Science and Technology (Welsh Government, 2019)

- Being curious about the world around us

Curriculum Links – Mathematics (Welsh Government, 2020)

- Geometry focuses on relationships involving shape, space and position, and measurement focuses on quantifying phenomena in the physical world.



Once we got to St Barrwgs Church, Child D noticed the snow falling from parts of a tree and excitedly went over to have the snow fall on them. Children B, C and E followed, and they were all laughing at the bits of snow falling all around them and tried to count the flakes. Child F was looking at the tree and their friends and noticed a patch of grass which was still green as was the tree. Child F openly wondered why this tree and the patch of grass were still green as the trees we noticed on the way had no leaves. Child A watched where the snow from the tree was falling and told a story of them and their dad getting caught in the rain when on a walk and taking shelter under a tree. We walked over to the patch of grass and Child F stated that maybe the tree was like an umbrella for the grass and kept most of the snow off. It started to snow, and the wind picked up slightly. The snow started to swirl, and I asked the children if there was something that could affect where the snow landed apart from the 'umbrella'. The children returned from under the tree when they noticed it was snowing again in time to hear my question. Child D started to twirl in the swirling snow, pretending

they were a snowflake and landed on the grassy patch stating the wind sent them there. To extend the learning I reminded the children of the question of why the tree was still green. Child D excitedly shouted, 'because it's a Christmas tree'. To support and promote literacy and scientific development, I introduced the words evergreen and deciduous trees to differentiate between green trees and bare trees in the winter with the children going on to discuss the seasons and their differences.

Curriculum links - Science and Technology (Welsh Government, 2019)

- Being curious about the world around us

- Understanding that living things incorporate the world around us and how they depend on each other for survival
- Forces and energy provide foundation for understanding our universe.

Curriculum links – Mathematics (Welsh Government, 2020)

- The number system is used to represent and compare relationships between numbers and qualities.
- Geometry focuses on relationships involving shape, space and position, and measurement focuses on quantifying phenomena in the physical world.



Once we had been outside for a while, the children started to say they were getting cold. We made our way towards the church where the staff opened the building to allow us use of the toilet facilities and kindly offered warm drinks and snacks. On our way to warm up, Child F exclaimed that the picture was shining, pointing to the stained-glass window. All of the children stood and looked in awe of the window and I wondered out loud why the picture was shining. Child D shouted 'the sun'. We all looked around to see where the sun was, and Child E argued that there was no sun 'just clouds and snow'. I rephrased my question to ask where the light was coming from. The children were unsure, so we decided to go inside and warm up. Once inside, the children were seated on

the front pew, when Child A stated, 'look, there's the picture again, it's not shining!'. Child A started looking around the church and noticed the lights were on and wondered if they made the picture shine. We chatted about the light shining through the window and I asked if the light shone through it all and if it didn't why not. The children couldn't remember but we agreed to walk past again on the way back to school.

On the return to school, we walked past the window and the children shared that only part of the window was shining. I again asked where the light was coming from and Child B stated, 'in the church'. To extend the learning, we looked at the window from different areas of the churchyard to see if the same parts of the window were shining. Child C kept going from one tree to another and saying that the picture looks different at each tree. The

other children joined in and excitedly found the image changed depending on where they stood. To extend their learning, I stated that what they have found is that depending on where they stood the part of the window shining change and asked why this would be. They were unsure but Child F stated they were the only thing moving. I praised all of their ideas and introduced the word angle into their vocabulary and surmised that what they have found is that as we change where we are stood, the angle in which we see the window changes, changing how we see the light shining through the window.

Curriculum links - Science and Technology (Welsh Government, 2019)

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Part 3 - WC - 700

RISK BENEFIT ASSESSMENT

Location / Activity:	Journey to St Barrwgs Church, Bedwas and exploring the grounds.	Date:	20/02/24
Assessor:	Sheridan Hyde	Review date:	27/02/24

The journey and the photograph	How will young people BENEFIT from this activity?	Hazards and associated risks	Who is at risk?	PRECAUTIONS in place to mitigate any risk of injury	Overall risk after precautions RATING: L/M/H
Frost, Ice Snow and Cold	Looking at the textures and temperatures for different states of water. Learning about the weather and seasons. Language development.	Slipping/falling Cold Icicles falling Wet Chilblains Snow Ingestion	Staff and children	Appropriate clothing and footwear for the weather (waterproofs provided for children). Discussions prior to leaving to ensure the children are aware of the hazards. Rules in place to view icicles from afar, not stand underneath. Set amount of time to be outside before warming up. First Aid kit and First Aider to accompany the outing. Full change of clothes to be supplied by parents in case of accidents.	L
Toileting and hand washing facilities	Feeling engaged with the local community and understanding the world around them. Reinforcement of the importance of personal hygiene.	Toileting accidents. Risk of infection due to lack hand washing facilities.	Children	Antibacterial gel to be in the First Aid Kit for the journey. Ensure privacy in the bathroom and establish a routine of order to access. School staff to supervise queuing and handwashing. The Church volunteers agreeing to open their facilities.	L

The journey and the photograph	How will young people BENEFIT from this activity?	Hazards and associated risks	Who is at risk?	PRECAUTIONS in place to mitigate any risk of injury	Overall risk after precautions RATING: L/M/H
Warm drinks and snacks provided by the church	Feeling engaged with the local community and understanding the world around them.	Allergies and intolerances, burning due to hot liquids, choking.	Children and Staff	Check children's individual risk assessments for any allergies or intolerances. Ensure cups have lids and children are sat and supervised while drinking. Pour drinks and allow to cool to ensure appropriate temperature to avoid scolding. Food thermometer taken to ensure drinks are sufficiently cooled.	L
Roads and traffic including cyclists and pedestrians	Continued road safety and awareness. Language development	Collisions or crashes resulting in injury or death	Staff, children and general public	Staff to ensure it is safe to accompany children across roads reminding of Kerb craft training and principles both before outing and during. Zebra/pelican crossings to be used. Everyone grouped together before being crossing the road. Reminders to the children about walking safely.	L
Uneven ground and concealed holes/hazards	Understanding of balance. Develop hazard perception. Supports physical development and challenge.	Slips, trips and falls Concealed hazards	Staff and children	Appropriate footwear to be worn. First Aid kit and First Aider to accompany the outing. Rules for children to think and assess before jumping or running in.	L

The journey and the photograph	How will young people BENEFIT from this activity?	Hazards and associated risks	Who is at risk?	PRECAUTIONS in place to mitigate any risk of injury	Overall risk after precautions RATING: L/M/H
Leaning headstones	Understanding of gravity. Promoting historical interests. Language development. Numeracy development (dates)	Headstones falling. Trips and Falls	Staff and children	Discussion prior to outing to promote respect for the graves. Viewing from afar and not climbing on them. First Aid kit and First Aider to accompany the outing. Appropriate footwear to be worn	L
Natural loose parts (sticks, stones, etc.)	Promotes physical development (fine and gross motor skills). Supports curiosity and creativity.	Cuts, scrapes and bruises.	Staff and children	First Aid kit and First Aider to accompany the outing. Safe removal and disposal of sharps (needles, etc.) and rubbish. Encouragement of good hand hygiene with handwashing facilities provided.	L
General Public, pets and other animals (rats, cats, etc.)	Understanding of stranger danger. Engagement with local community. Understanding of urban habitats	Children seeing people they know and going to/with them. Risk of Infection from animal faeces, allergies, sickness	Children	Staff to be vigilant and ensure children and parents understand the need for children to stay with the staff until released from school as usual. Staff to check and clear area of animal faeces or potentially harmful debris (sharps, etc.) using appropriate PPE. Encouragement of good hand hygiene with handwashing facilities provided. Reminders not to touch face or mouth prior to handwashing.	L

The journey and the photograph	How will young people BENEFIT from this activity?	Hazards and associated risks	Who is at risk?	PRECAUTIONS in place to mitigate any risk of injury	Overall risk after precautions RATING: L/M/H
Trees	Understanding of plant life cycles. Invokes curiosity about the natural World. Understanding of different types of trees and their role within the environment / relationship with different animals.	Falling branches, snow and icicles. Uneven ground (concealed roots). Climbing and falling. Extreme weather conditions (lightening, heavy snow). Sharp branches (scrapes, cuts, bruises).	Staff and children	First Aid kit and First Aider to accompany the outing. Ongoing assessment of tree state, including low branches. Ensure children are aware of personal space to avoid accidents with sticks. Ongoing reminders of uneven ground. Appropriate footwear and clothing.	L

Part 4. – WC - 1809

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

How adults support children in the early years to develop their learning and encourage engagement with mathematics and science depends on the curriculum, legislation and the agreed way of learning and assessment. Within the Curriculum for Wales (2022), literacy, numeracy and digital competence are all 'mandatory cross-curricular skills' with the role of the adult being to ensure this learning is across all subjects and delivered in a variety of ways and environments. Legislation and guidance often inform the way in which outdoor learning is perceived by the adult. However, there are many outdoor learning approaches with the role of the adult differing depending on the setting or country. In the United Kingdom outdoor learning and approaches are often being informed by guidance with targets and evidence needed to assess the children as well as risk benefit assessments being completed to ensure the activity is of benefit to the child while mitigating any risk of injury. This will be explored with regard to the children's mathematic and scientific development and understanding including any detriment and benefits.

Play Wales endorses a child's right to play as per article 31 of the United Nations Convention on the Rights of the Child (UNCRC) (UNICEF, 2022). They argue that, within their ethos, the role of the adult is to facilitate and observe the play in order to enhance the learning and development of the child. They state, 'Most children, given free choice, will play away from adults, and will generally only go to them for food or if a serious problem occurs such as an injury or bullying.' (Play Wales, 2024, p.6). They go on to suggest that adults should only become involved in children's play when they are invited to do so by the child. This ethos of facilitated play in a Playworks setting to reinforce self-directed learning is supported by Sim and Zu (2015) where they conclude that a child's facilitated free play is a collaboration with the facilitator whereby the child learns about the task at hand as well as develop skills to direct or facilitate their own free play and learning in the future. Kolbs experiential learning theory (1974) also reinforces the Playworks ethos as it argues that children learn through experiencing, reflecting, thinking and acting. This is also known as The Experiential Learning Cycle and can be applied to children and adults alike. It can be seen as the 'ideal process of learning, [it] invites you to understand yourself as a learner, and empowers you to take

charge of your own learning and development.’ (Institute of Experiential Learning, 2024) Kontra et al (2015) supports the experiential learning theory in science with their findings stating that the learning significantly improves a child’s understanding of scientific concepts when learners are exposed to and take part in the physical experimentation as well as given opportunity to question, explore and reason.

Freud highlighted the importance of the early years and how the mind is shaped by an individual’s experiences. Piaget expanded on this thinking by introducing the idea that children are able to think and reason. (Harris Helm, J. and Katz, L.G. and Wilson, R., 2023) Welsh Government (2020) has designed the curriculum with experiences, knowledge and skill development in mind to support children to make links and build connections across the learning areas which they argue will deepen understanding and enhance the learner’s confidence in their own learning development. Within the Early Years, Welsh Government have highlighted the importance of children’s wellbeing and development with these being at the forefront of the Play, Learning and Care sector. This has been set using their non-maintained curriculum guidance. They have defined five developmental pathways which include belonging, communication, exploration, physical development and wellbeing. The aims of the new curriculum for both maintained and non-maintained settings are to ensure the holistic development of children and young people in a range of environments to build on essential skills with the view of them becoming ethical, knowledgeable and informed citizens who seek evidence to evaluate in order to form their own views. (Waunfawr Primary School, 2020). The role of the adult in these settings is to individualise the learning for each child also known as providing equity. This includes providing learning opportunities for confident and able children to further explore and for children who require more guided learning, always looking at what would support the individual child and allowing them to proceed at their own pace.

One way to individualise learning for children is to allow free play, allowing children to explore within their own interests. Campbell, et al (2018) agree with this statement and go on to argue that this is true for mathematics and science, in particular. With children who were exposed to STEM (science, technology, engineering, and mathematics) subjects from an early age and within their own interests foster a belief in their ability to learn within these subjects and adopt an appreciation for the subjects in everyday life. In order to

encourage more free flowing, imaginative play, Campbell, et al (2018) argue that the outdoor setup plays a part in how the children interact with the environment with, they argue, loose parts provided to children in an enclosed area can encourage exploration and creativity in what interests them but will often include preconceived ideas on how to play with the equipment provided. These, they argue, can include STEM concepts but often don't extend the natural learning and require the adult to support the links. However, in a larger, unrestricted outdoor environment, children will interact with the world around them and often learn risk assessment through risky play such as climbing trees, for example. They also learn how natural outside influences, such as rain or wind can affect how they climb the same tree. When children are encouraged to explore their natural environment without the introduction of additional resources, they can extend their learning in a very natural and holistic way. This can be seen in brain development whereby the neural connections form strong bonds by consistent and repetitive reinforcement to create networks. These interactions based on experiences can inform and reinforce connections when a similar situation arises such as a slide being slippery in the rain may allow for a connection for other things to become slippery when wet. (Harris Helm, Katz and Wilson, 2023)

Children often play in a way that adults would never think of. Affordance is the opportunity or potential that items or environments can provide children and how they are perceived. Franchak (2019) argues that affordances continually change due to growth, development of skills, the environment and perception. They found that younger children are more likely to take risks, however as children age, they learn risk assessment and 'recalibrate' to changing environments or self through their experiences thus as adults are able to judge what they are able to do and refrain rather than experiment. Gibsons Ecological Theory (1979) supports this and states that experiences develop with senses to support the sense of self. For example, a child may misconstrue the height of a table and try to walk under it, hitting their head. The next time, they may duck their head, however, as they grow their perception also needs to change. This experience driven learning is also known as sense data (Gibson, 2015). What has been found is that calibration can inform similar actions, but additional experiences and learning is needed for dissimilar experiences. For example, a child who crawls will have perception for walking but not for kicking a ball with additional experiences for kicking being needed to gain this knowledge and perception. The

environment also plays a part with the perception for walking on the flat or walking on a slope differing where additional experience may be needed to avoid accident or injury. (Franchak, 2017). The role of the adult would be to support this learning by offering a range of experiences to aid development and risk assessing as necessary to mitigate any possibility of injury.

When thinking of STEM subjects being explored in the outdoors, natural environments are often thought about for providing a rich and varied experience. However, children who reside in more urban areas can also access rich and varied learning environments. In Wales, the Children and Families (Wales) Measure 2010 provided a basis for the Play Sufficiency Assessment (Wales) Regulations 2012 whereby local authorities are required to provide information on the play opportunities for children which include both indoor and outdoor opportunities with all development having to complete an assessment to ensure that there are play opportunities and thus the role of the adult being to support ensure these opportunities are available to children. Many of these play areas are set up as outdoor parks with perceived set agendas and not necessarily open space. However, Ahmadi, et al (2018) state that it is not the environment that provides the affordances but how the children perceive and use these. In other words, a child brought up in an urban area, given the opportunity will play, create, learn and develop in a similar way to children who have access to open green space. 'Independent mobility and the possibility to actualize environmental affordances are fundamental characteristics of child-friendly setting.' Ahmadi, et al (2018). Taking into account the STEM subjects, urban environments allow for learning and development in a different way from more rural areas. Shapes and sizes of buildings alongside angles of light will be perceived differently than those in urban areas, for example. However, the principles of the subjects being taught will be the same with adults needing to understand how their local community can support their teaching in a variety of subjects and ways. (Welsh Government, 2020)

Allowing children the freedom to explore and experience mathematics and science through natural play, according to Grey (2024) provides better outcomes for children than them learning by rote. He states that 'academic training in pre-K and K has long-term damaging effects on children's social, emotional, intellectual, and academic development.' Durkin, et al. state that there is a detriment to children's development when, at age 4, they attend a

setting with twenty or so other children where the role of the adult is to ensure ‘behavioural control’ has an impact on the child’s ability to develop and manage self-control and their emotions which in turn can have a negative effect on the future learning and development.

It can be surmised from the information presented that children who are allowed to experience, experiment and question the world around them will develop an appreciation for the STEM subjects as well as the knowledge they gain without necessarily understanding the underlying principles. The role of the adult would be to facilitate the learning by providing suitable learning environments, allowing for freedom of expression and experiences while extending the learning to support knowledge development, reinforcing connections and the cross curricular links.

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