

A Portfolio of Evidence to Outline the Use of a Specific Outdoor Area to Promote and Support Children's Scientific and Mathematical Thinking

Part One – The Outdoor Area



(Source: Trip Advisor, 2020)

Part Two – The Features of the Outdoor Area

Feature One – Uneven Ground

Travelling over uneven ground allows children to practise their balance and sense of movement, known as the Vestibular sense. The system which controls this sense, the Vestibular system, is stimulated by varied movement such as up and down, around and over, promoted by travelling over the uneven ground (The Motor Story, no date a). Another sense linked to this is the Proprioception sense which is the concept of the child having awareness of where their body is in a space and developing the ability to safely manoeuvre around in this space. The uneven ground develops this

sense as the child is not just travelling in a straight line, but in a varied direction and camber (The Motor Story, no date).

Furthermore, travelling over the uneven ground provides children with concrete experiences of mathematical and scientific concepts, providing deep understanding and quality of learning of scientific and mathematical concepts as outlined in the Curriculum for Wales (Welsh Government, 2021). Children begin to understand cause and effect and trial and error as they travel over the uneven ground using their own bodies, as they could fall or become unsteady on their feet having to correct themselves and pick themselves up. In turn the children begin to understand how their bodies effect the world round them. This supports progression steps one and two in the description of learning 'Being Curious and Searching for Answers is Essential to Understanding and Predicting Phenomena' as the children evidence curiosity and explore the outside environment (Welsh Government, 2020).

Adding loose parts such as balls and hoops into this environment can enrich this learning and provide additional concrete learning experiences linked to forces, energy and friction as the children feel the forces, energy and friction when the balls and hoops are rolled over the ground. This supports progression step two of the above description of learning because the children are establishing the ability to investigate the different forms of energy and how it can be transferred (Welsh Government, 2020).

Intrinsically linked to these are a range of mathematical concepts. Children can travel shorter and longer distances over the uneven ground, they can think about the different heights of the ground and use estimating skills supporting progression step one of the description of learning 'Geometry Focusses on Relationships Involving Space, Shape and Position and Measurement Focusses on Quantifying Phenomena in the Physical World' (Welsh Government, 2020a).

Both scientific and mathematical concepts of learning can be enhanced when the practitioner implements metacognitive talk and sustained shared thinking to support and recognise children's understanding whilst they explore the uneven ground. For example, 'what do you think will happen this time?', 'why is the ball moving faster this time?' and 'why do you think the hoop is falling over when it starts stopping?'.

Feature Two – Trees

In the Mathematics and Numeracy Area of Learning and Experience (AoLE), one of the descriptions of learning is 'Algebra Uses Symbol Systems to Express the Structure of Mathematical Relationships' (Welsh Government, 2020a). Children can use their hands to feel the patterns of the bark on the trees. Practitioners can extend this by adding paper and crayons to the environment so children can make rubbings of the bark patterns indicating that they are beginning to recognise and copy the patterns around them, providing a concrete experience which is also holistic.

This links to the scientific idea in the description of learning 'The World Around Us is Full of Living Things Which Depend on Each Other for Survival' (Welsh Government, 2020), signifying that children are beginning to recognise that plants and animals are living things which grow for progression step one. Additionally, as children are exploring the properties of a material and choosing it for a specific use, trees can be linked to the description of learning 'Matter and the Way it Behaves Defines Our Universe and Shapes Our Lives' for progression step one (Welsh Government, 2020).

Practitioners can extend children's learning by encouraging them to count the trees, facilitating the use of cardinal numbers thus supporting progression step one in the description of learning 'The Number System is Used to Represent and Compare Relationships Between Numbers and Quantities' (Welsh Language, 2020a). Also involving mathematical concepts, through extended language using sustained shared thinking and metacognitive thought, when discussing the arrangements of the trees children are demonstrating the ability to describe and quantify the position of objects in relation to other objects whilst using mathematical language, as explained in progression steps one and two in the description of learning 'Geometry Focusses on Relationships Involving Space, Shape and Position, and Measurement Focusses on Quantifying Phenomena in the Physical World' (Welsh Government, 2020a).

As described above, movement supports the development of the Vestibular and Proprioception sense. In the trees children will move by climbing over and under them creating the concrete opportunity for children to think about height, width, area and volume. These are important mathematical concepts highlighted in progression steps one and two of the description of learning, Geometry Focusses on Relationships Involving Space, Shape and Position, and Measurement Focusses on

Quantifying Phenomena in the Physical World' (Welsh Government, 2020a). Moreover, the scientific concepts of trial and error are also entwined in this because children learn trial and error and cause and effect as highlighted in the description of learning 'Being Curious and Searching for Answers is Essential to Understanding and Predicting Phenomena' (Welsh Government, 2020).

Feature Three – Light

In the environment shown in the above image there are areas of shadows caused by the sunlight shining through the trees. The Science and Technology AoLE explains that children need to understand that 'Forces and Energy Provide a Foundation for Understanding Our Universe' (Welsh Government, 2020). When children look at the shadows, experiment with them and discuss them, they are showing that they can explore one of the basic properties of light, thus understanding that description of learning (Welsh Government, 2020). Therefore, the light is providing a concrete experience of a scientific concept.

Moving through the light, chasing their own shadows further enhances this. It is also provides children with an enjoyable and active game that helps them to understand their bodies and how they move in the world around them fostering the description of learning 'Being Curious and Searching for Answers is Essential to Understanding and Predicting Phenomena' in the Science and Technology AoLE (Welsh Government, 2020). Furthermore, it underpins the deep learning that the world around us is full of living things and conversations with practitioners can extend into the knowledge of the natural world exploring the relationship between living things and life cycles as explained in the description of learning 'Being Curious and Searching for Answers is Essential to Understanding and Predicting Phenomena' (Welsh Government, 2020).

Additionally, there are links to the Mathematical and Numeracy AoLE (Welsh Government, 2020a) if children use mathematical language describing and comparing the size and position of the shadows as outlined in progression step one and two of the description of learning, 'Geometry Focusses on Relationships Involving Space, Shape and Position and Measurement Focusses on Quantifying Phenomena in the Physical World' (Welsh Government, 2020a). To facilitate an extended learning experience, practitioners can bring paper and pencils to the

environment to enable children to experiment with shadows using natural loose parts found in the area.

Section Three

RISK BENEFIT ASSESSMENT

Location / Activity:	Woodland	Date:	05/04/2022
Assessor:	Alison Goodridge	Review date:	05/10/2022

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.

ACTIVITY	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
Travelling on uneven ground	Children will practise their balance, in turn supporting the development of their vestibular systems. Children will use their bodies and become aware of them and what they are capable of, developing gross motor skills. Develops understanding of forces and energy as per the curriculum.	When travelling on uneven ground falls may occur leading to cuts, bruises, grazes and sprains.	Children and adults.	Adults to explain to the children what the ground is like how this will affect them and their balance. Explain how to walk safely and how to help yourself to balance. Wear long sleeves and trousers to protect limbs from injuries. Wear sturdy closed toe shoes for grip and support when walking.	L

ACTIVITY	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 area	Supports the understanding of science concepts such as life cycles, mini beasts, understanding the natural world and how it works. Developing independence. Becoming ethical citizens whilst respecting the areas they explore. Develop fine motor skills when touching and holding things. Develop gross motor skills when moving around.	Plants that could be hazardous or poisonous causing illness. Cuts from thorns and branches. Children can become lost. There may be rubbish. Bites or stings can occur from plants and insects. Children may act unsafely whilst climbing.	Children and adults.	Adults to create clear boundaries, explain the boundaries and show the children where they are. Adults to be aware of any allergies children may have. Adults closely monitor children if they want to climb, crawl, etc and demonstrate how to do this safely. Check area for hazardous or poisonous plants and insects before children visit and during the visit. Do a litter pick prior to the visit and explain what the children should do if they find litter. Ensure that adults watch children closely and do regular head counts. Explain 'stranger danger' to the children. Ensure you have a fully stocked first aid kit and water with you.	L

ACTIVITY	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
Changeable weather conditions.	Developing the knowledge of different weather types, temperature changes and how they affect the water/soil/living things. Developing understanding of the changing seasons. Beginning to learn how to look after themselves and each other when thinking about what they and their friends might need – eg. Hat and suncream for hot days.	Excessive exposure to the sun/heat causing, sunstroke, dehydration and burns. Excessive exposure to cold temperature leading to hypothermia. Getting too wet and becoming uncomfortable or cold. Injury from falling trees and debris during high winds.	Children and adults.	Monitor the Met Office weather forecasts for the area and act appropriately if weather warnings are put in place. Ensure children have suitable clothing and equipment – sun cream and sunhats/wet weather gear and wellingtons. Ensure there is access to drinks and changes of clothes. Bring a fully stocked first aid kit.	L
Climbing the trees, logs, branches.	Developing gross motor skills and the vestibular system. Children will become aware of themselves and their surroundings. Children will learn trial and error/cause and effect if they fall or wobble. Children will be encouraged to become ethical and to appreciate the natural environment. Children will develop risk taking when making decisions about going higher, jumping down.	Injuries such as bumped heads, sprains, bruises, grazes and cuts can happen when children are climbing. Some children may be nervous and become scared or upset. Eye level branches can cause injuries to eyes. Children can fall when climbing.	Children	Ensure you have a fully stocked first aid kit. Explain where children can climb and where they must not - create a boundary. Explain the consequences and what to do if something happens. Reassure children and provide help and support in a patient manner. Encourage children when they are taking healthy risks.	L/M

Section Four

The outdoor environment offers holistic opportunities for a range of concrete mathematical and scientific learning experiences. Practitioners can enrich this environment using a variety of methods and resources to create deeper educational learning (White, 2012 and Robertson, 2017).

Numerous educational theories and pedagogies advocate the importance of the outdoor environment to early years education. Froebel established this when he created the Kindergarten – the children's garden – underpinning that the outdoor environment is essential to early years education (Aubrey and Riley, 2019). He stated that children having a direct experience with the natural world of the Kindergarten everyday is essential for them to begin to appreciate nature and understand the relationships between all living things (Tovey, 2013). Moreover, the Kindergarten is a rich learning environment that offers learning experiences for all areas of learning (Bruce, 2012).

In addition to this, Froebel developed a set of learning materials called 'Gifts'. These had no fixed purpose and were designed to enhance the senses of early years children to enrich the learning experience (Aubrey and Riley, 2019). Froebel advocated creative expression and imagination, stating it is a vehicle for learning (Tovey, 2012).

The 'Gifts' are wooden blocks which provide a tactile sensory experience of open-ended play leading to concrete mathematical learning of mathematical concepts such as geometry, symmetry and measurement (Whinnet, 2017). This links to progression steps within the Mathematics and Numeracy area of learning and experience (Welsh Government, 2020a). Practitioners facilitate this learning providing the 'Gifts' and space to play with them freely. The Kindergarten provides children with the space to play freely and learn with their whole bodies holistically and meaningfully whilst provoking wonder and curiosity (Tovey, 2021). Furthermore, practitioners can extend learning by supporting the children, asking questions and introducing mathematical language into conversation (Whinnet, 2017 and Robertson, 2017).

According to Nicholson (1971), this concept can be extended with his theory of 'loose parts' where variables in the environment extend the play opportunities within

it and the greater the number of these 'loose parts', the greater the possibility of play opportunities. His theory focussed on adding 'loose parts' to outdoor areas such as public parks to supplement environmental education whilst also supplementing artistic and scientific exploration (Nicholson, 1971). As such, this theory can be facilitated by practitioners providing the variety of 'loose parts' into the learning environment.

As Nicholson (1971) documented, 'loose parts' can promote artistic and scientific exploration (Rahardjo, 2019). As established by historical figures, there is no discernible difference between science, mathematics and art. To gain a well-rounded understanding of the world, one must understand that everything connects intrinsically (Da Vinci in Kemp, 2007 and Einstein, 1954). This supports the cross-curricula construction of the new curriculum for Wales (Welsh Government, 2021).

Loose parts can include natural materials such as shells, leaves and sticks; man made materials such as tyres, rope and buckets and states of matter such as water, sand, soil and light (Nicholson, 1971 and Play Scotland, no date). Loose parts have a high level of affordability in children's play – they can become whatever the children's imaginations allow (MA Education, 2016 and Casey and Robertson, 2017).

When the practitioner considers the value of matter as a loose part the value of loose parts to scientific learning becomes explicit (Rahardjo, 2019). When this is added to the outdoor environment the benefits extend. As Einstein (1964) stated, 'play is the highest form of research'. As children play with light they can gain concrete experience of shadows, as they make 'mud pies' in the soil they gain deep learning experiences of matter and when children play with water they observe real-life examples of the water cycle, forces and movement (Rahardjo, 2019). Practitioners can extend and enrich these tangible opportunities with metacognitive talk and sustained shared thinking (Waite, 2011 and Ernst and Tomabene, 2012).

Bruner and Vygotsky are constructivists whose theories involve adults supporting children to reach their full potentials (Aubrey and Riley, 2019). Pertinent to scientific and mathematical learning, Vygotsky (1978) stated that it is not what the children create that should be assessed, but how the children create it. In his Zone of Proximal Development, Vygotsky explained that children require a 'more knowledgeable other' to assist them on achieving the next step in their learning

(Verenikina, 2010 and Aubrey and Riley, 2019). Bruner adds to this theory with his idea of scaffolding where the adult supports the children to learn and discover using his Spiral Curriculum (Bruner, 1964 and Drew, 2021).

Enabling practitioners are required to assist and facilitate this learning (Whinnet, 2017). The role of the practitioner is to believe that children can learn anything through the process of education. No scientific or mathematical topic is too complex for young minds when practitioners teach effectively in an honest form (Bruner, 1964). Practitioners can facilitate rich learning opportunities as they demonstrate sustained shared thinking to extend conversations and consolidate learning (Bruner, 1964, Siraj-Blatchford, 2009 and Purdon, 2014).

Sustained shared thinking is a pedagogical method which requires practitioners to use high order skills and work together with the children to extend the narrative of conversations evaluating and creating solutions to solve problems (Siraj-Blatchford, 2009 and Purdon, 2014). Consequently, as children play with the loose parts, these high-quality interactions lead to deeper understanding of mathematical and scientific concepts during play (White, no date). This allows children to engage curiously in activities and deepen their learning with the support of a facilitating practitioner (White, no date and Casey and Robertson, 2016).

However, there can be barriers to this practice. The outdoors can be risky, and some practitioners may not believe that the risk outweighs the benefits (Gill, 2010). Perceptions of risk are influenced by broader social and cultural impacts which will be different for each practitioner. Therefore, each practitioner will hold a different perception of risk (Kerner, 2010). Additionally, as modern society increasingly chooses to mitigate risks to children, it may be argued that several practitioners choose to eradicate the chance of risk completely in order to keep children safe. (Gill, 2010, Little and Eager, 2010 and Little, 2015).

Risks associated with the outdoor environment are often perceived as situations in which the child could become harmed or injured (Little, 2015, Bilton, 2020). In fact, with a comprehensive risk benefit assessment completed, the risks can often be mitigated into the low or medium category with the benefits of the outdoor activity far outweighing the risks (Little and Eager, 2010 and Gill, 2010). With support from practitioners who understand this, children can be encouraged to challenge

themselves and enter new situations fostering curiosity and independence (Little, 2015, Gill, 2010 and Bilton, 2020). Such skills lend themselves to the ideas of Da Vinci (in Kemp, 2007) who stated, 'to develop a complete mind: study the science of art; study the art of science. Learn how to see. Realise that everything connects to everything else'.

Moreover, the thought of teaching science and mathematics to early years children can prove challenging to many practitioners. When based upon personal early experiences, practitioners can hold the opinion of these subjects being far reaching of their own abilities and that they should be taught in a traditional manner inside the classroom (Costa, *et al.*, 2021 and Gealy, *et al.*, 2022). Implementation of training programmes can improve the confidence of the practitioner's knowledge, in turn, improving their confidence in delivering these subjects (Gealy, *et al.*, 2022). Furthermore, institutions can provide educational opportunities to practitioners which inform them how mathematics and science concepts can be seen in everyday routines without complication (Costa, *et al.*, 2021).

Not unlike a risk benefit analysis, considering the barriers against the advantages of practitioners facilitating holistic scientific and mathematical learning opportunities in the outdoor environment, it can be considered that the benefits to early years children prevail over any negative factors.

Reference List

Aubrey, K. and Riley, A. (2019). *Understand and Using Educational Theories*. 2nd Ed. Los Angeles: SAGE Publications Ltd.

Bilton, H. (2020) 'Values stop play? Teachers' attitudes to the early years outdoor environment'. *Early Child Development and Care*, 190(1). pp.12-20. DOI: <https://doi.org/10.1080/03004430.2019.1653548> [Accessed: 25 March 2022].

Bruce, T. (2012) *Early Childhood Practice: Froebel Today*. London: SAGE.

Bruner, J.S. (1964) 'The course of cognitive growth'. *American psychologist*, 19(1), p1.

Casey, T. and Robertson, J. (2017) *Loose Parts Play*. [PDF Document] Available at: <https://www.inspiringscotland.org.uk/wp-content/uploads/2017/03/Loose-Parts-Play-web.pdf> [Accessed: 25 March 2022].

Costa, H. M., Outhwaite, L. A. and Van Herwegen, J. (2021) *Preschool Teachers' training, beliefs and practices concerning mathematics in pre-schools in the UK: implication for education and practice*. DOI: 10.31234/osf.io/rdx6c. [Accessed: 25 March 2022].

Drew, C. (2021) *Bruner's Spiral Curriculum. The Three Key Principals*. Available at: <https://helpfulprofessor.com/spiral-curriculum/> [Accessed: 25 March 2022].

Einstein, A. (1954). *Ideas and Opinions* (p. 384). New York: Wings Books.

Ernst, J and Tornabene, L. (2012): 'Preservice early childhood educators' perceptions of outdoor settings as learning environments', *Environmental Education Research*. DOI:10.1080/13504622.2011.640749. [Accessed: 25 March 2022].

Gealy, A.M., Tinney, G., Macdonald, N. & Waters, J. (2022) 'A socio-constructivist approach to developing a professional learning intervention for early childhood education and care practitioners in Wales', *Professional Development in Education*, 48(2), pp.298-314, DOI: 10.1080/19415257.2020.1742187 [Accessed: 25 March 2022].

Kemp, M. (2007) *Leonardo da Vinci: the Marvellous Works of Nature and Man*. Oxford: Oxford University Press.

Kernan, M. (2010) 'Outdoor Affordances in Early Childhood Education and Care Settings: Adults' and Children's Perspectives'. *Children, Youth and Environments* 20(1) pp.152-177.

Little, H. (2015) 'Mothers' beliefs about risk and risk-taking in children's outdoor play', *Journal of Adventure Education and Outdoor Learning*, 15(1), pp.24-39, DOI:10.1080/14729679.2013.842178 [Accessed: 25 March 2022].

Little, H. and Eager, D. (2010) 'Risk, challenge and safety: implications for play quality and playground design', *European Early Childhood Education Research Journal*, 18(4), pp. 497 — 513.

MA Education (2016) *Possibilities on Offer*. Available at: <https://www.earlyyearseducator.co.uk/features/article/possibilities-on-offer> [Accessed: 25 March 2022].

Nicholson, S. (1971) 'How Not to Cheat Children. The Theory of Loose Parts'. *Landscape Architecture*. 62(October) pp. 30-34.

Play Scotland (no date) *Loose Parts*. [PDF document] Available at: https://www.playscotland.org/resources/print/Play-Scotland-Loose-Parts-Leaflet.pdf?plsctl_id=10934 [Accessed: 25 March 2022].

Purdon, A. (2014) 'Sustained shared thinking in an early childhood setting: an exploration of practitioners' perspectives'. *Education* 3(13) pp.1-14. DOI:10.1080/03004279.2014.907819. [Accessed: 25 March 2022].

Rahardjo, M. M. (2019) 'How to use Loose-Parts in STEAM? Early Childhood Educators Focus Group discussion in Indonesia', *Journal Pendidikan Usia Dini*, 13(2), pp. 310 - 326. DOI: 10.21009/JPUD.132.08. [Accessed: 15 March 2022].

Robertson, J. (2017) *Messy Maths: A playful, outdoor approach for early years*. Carmarthen: Crown House Publishing. Available at: ProQuest Ebook Central. [Accessed: 25 March 2022].

Siraj-Blatchford, I. (2009) 'Conceptualising progression in the pedagogy of play and

sustained shared thinking in early childhood education: A Vygotskian perspective', *Educational and Child Psychology*, 26(2).

The Motor Story (no date a) *Proprioception*. Available at: <http://themotorstory.org/sensory-processing/proprioception/> [Accessed: 23 March 2022].

The Motor Story (no date) *The Vestibular System*. Available at: <http://themotorstory.org/sensory-processing/the-vestibular-system/> [Accessed: 23 March 2022].

Tovey, H. (2013) *Bringing the Froebel Approach to Your Early Years Practice*. London: Routledge/Taylor & Francis Group.

Verenikina, I (2010) 'Vygotsky', *Twenty-First-Century research*, pp.16-25. Available at: <https://ro.uow.edu.au/edupapers/1022> [Accessed: 25 March 2022].

Vygotsky, L. S. (1978). *Mind in Society*. Cambridge: Harvard University Press.

Waite, S. (2011) *Children Learning Outside the Classroom: From Birth to Eleven*, London: SAGE Publications.

Welsh Government (2020) *Area of Learning and Experience Science and Technology. Descriptions of Learning*. Available at: <https://hwb.gov.wales/curriculum-for-wales/science-and-technology/descriptions-of-learning/> [Accessed: 23 March 2022].

Welsh Government (2020a) *Area of Learning and Experience Mathematics and Numeracy. Descriptions of Learning*. Available at: <https://hwb.gov.wales/curriculum-for-wales/mathematics-and-numeracy/descriptions-of-learning/> [Accessed: 23 March 2022].

Welsh Government (2021) *Introduction to Curriculum for Wales Guidance*. Available at: <https://hwb.gov.wales/curriculum-for-wales/introduction/> [Accessed: 23 March 2022].

Whinnet, J. (2017). *Froebel's Gifts and Block Play Today*. [PDF Pamphlet]. Available at: <https://www.froebel.org.uk/uploads/documents/Froebels-gifts-and-block-play-today.pdf> [Accessed: 25 March 2022].

White, J. (no date) *Early Years Outdoors. Visions and Values for Outdoor Play*. Available at: <https://janwhitenaturalplay.wordpress.com/vision-and-values/> [Accessed: 25 March 2022].

Wilson, R. A. (2012) *Nature and Young Children: Encouraging Creative Play and Learning in Natural Environments*. Abingdon, Oxon: Routledge. Available at: <https://search-ebscohost-com.ezproxy.uwtsd.ac.uk/login.aspx?direct=true&db=nlebk&AN=466198&site=ehost-live> [Accessed: 25 March 2022].

Trip Advisor (2020) *Woodland Walk*. Available at: <https://www.tripadvisor.co.uk/Profile/muddlemayhem?fid=4ef5a333-4721-4ffb-8c97-cf25f04b9dde> [Accessed: 23 March 2022].