

AWE and WONDER

Science, mathematics

and

the outdoors.

ECEY 5005

Student number: 2007412

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1. Choose a photo relevant to children's outdoor play which supports science and mathematics learning.



(Source: White, no date)

2. Discuss three features in the image which are relevant to mathematical and scientific learning.

Feature 1. Uneven terrain.

The uneven ground with dips, slopes and mounds visible in the picture above offers many possibilities for mathematical and physics concepts to be learned. Children could be encouraged to roll various balls of different sizes onto the slope and observe which one goes the farthest or the fastest. Here, they could learn about how gravity pulls the objects down the slope with various speeds, or how the speed of the ball is affected by the push force or its own weight. The task design meets the new curriculum for Wales principles regarding exploration of physical systems, of forces and energy through which children can understand the laws

governing the Universe (Welsh Government, 2020). The activity itself renders children to use their knowledge to anticipate, communicate and explore certain effects specific forces have on the motion of objects.

Moreover, at the top-centre of the image there is another visible hole, which has a spade across it. It is possible to assume children have been using it as a bridge, maybe even going across and over the pit. In this situation, children would learn about equilibrium in relation to the gravitational pull of the earth, consistent with the learning outcome discussed above; alternatively, they can also identify the pit as a risk and act accordingly so that themselves or others are safe from any potential harm, in line with the second progression step of understanding and predicting phenomena in the 'Science and Technology' area of learning (Welsh Government, 2020).

Feature 2. Soil as a natural element.

Children can experience digging in the soil, using materials which can vary from natural loose parts found on the terrain, such as sticks or pointed rocks, to provided man-made materials, such as a spade, hand trowel or hand fork. The children could be asked if they are finding it easy or hard to dig, thus enabling opportunities to discuss force and motion, mentioned above, in feature one. Moreover, considering the fact that digging can reveal evidence of animal life, it is possible to ask children to pay attention and to identify the types of insects and worms they might find. This activity promotes learning and exploration about the relationship between living creatures, their habitat and life cycles, in line with progression step two of understanding how living things are interdependent for survival purposes (Welsh Government, 2020).

Planting seeds is another potential activity suited for the environment pictured above. It could help children learn about compaction – where the soil is heavily compacted, with poor drainage and therefore in need for aeration – when digging allows oxygen to flow through soil particles, therefore providing a better terrain for plants to grow in. Planting seeds offers opportunities to learn about photosynthesis and the life of plants and about the harmonious interaction between natural elements like soil, sunlight, and water. This activity enables children to learn about mutually dependent organisms in ecosystems and how their survival is affected by changes occurring in that environment, as per progression step four of the section mentioned previously (WG, 2020). Moreover, adding gardening tools such as shovels, spades, rakes, forks, hoes would complete the gardening experience for children.

Natural materials which can be found on the ground such as pebbles, stones or twigs can be sorted by shape or size, matched, counted, compared or weighted; for instance, children might find that a fistful of rocks and pebbles feels heavier than a fistful of grass and twigs. The activity meets new curriculum's mathematics and numeracy learning by experiencing and exploring numbers in a rich outdoor and multi-sensory environment, by using mathematical vocabulary to describe quantities and compare weights or measures, by describing the position of natural materials in relation to other materials in their environment (WG, 2020).

The holes in the ground can also help form puddles when the weather changes, thus giving opportunities to learn about weather characteristics and temperatures. Furthermore, as children are directly exposed to different types of weather, they can assess how it impacts the environment; for instance, the sunny or windy weather can dry the soil which was wet and damp due to rain from previous days. In this directed task, children could learn to recognise patterns in nature and communicate their findings as well as using their acquired knowledge to anticipate certain effects in their scientific exploration, as described by progression step two of the 'Science and Technology' area of learning of the new welsh curriculum (WG, 2020).

In puddles, children can stomp, thus stirring up the mud at the bottom of the puddle and making big splashes of water. Using the puddle as a mirror, opportunities for learning about reflection and light arise; moreover, discussions about limits and boundaries could take place, as children might conclude that the surface of the puddle only reflects images within certain bounds. Furthermore, the adult could scaffold the discussion by asking whether the puddle would still reflect children's image at night. The indicated task reflects the new curriculum 'Science and Technology' learning by enabling children to explore and discuss different properties and then interaction between water and light (WG, 2020).

Children can also test the depth of the water in the puddles against their boots, thus learning about getting wet or staying dry. In this scenario, children's estimation and approximation skills can be stimulated, while also measuring the depth of the puddle using appropriate measuring tools. This task meets a second progression step of the 'Mathematics and Numeracy' new curriculum's area of learning, through which children can approximate and measure utilising non-standard units of measurement, a precursor to learning and using standard units (WG, 2020).

Feature 3. Outdoor wooden stand.

The outside counter can act as a mud kitchen, where, with the provision of other materials, such as containers, scoops, pots, wooden spoons and so on, children can use soil they previously dug out to make mud pies. Alternatively, adding different types of soil as loose parts, such as sand, compost, clay, they can form their own mixtures while observing and acknowledging the differences in textures, weight or density of the materials. Using practical measuring equipment, such as spoons, jugs, cups or buckets enables children to use mathematical vocabulary. This activity meets 'Mathematics and Numeracy' area of learning by utilising different measuring devices, estimating and measuring capacity or mass with the appropriate standard units and the appropriate mathematical language (WG, 2020).

3. Risk assessment

Location / Activity:	School's backyard play garden	Date:	20/03/2022
Assessor:	Diana Cune	Review date:	21/09/2022

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.

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
Walking on a flat grassed area mixed with uneven terrain.	Children develop their sense of equilibrium, which is managed by the vestibular system. Children have space to use and build their gross motor skills as the body is challenged to maintain balance, they will build core and muscle strength, practice spatial awareness coordination, flexibility and agility.	Trips, slips, falls or bruises.	Adults and children	Plan a 'Let's get Muddy Safe' set up before each activity, which teaches children to be aware of the natural environment, take care when walking and be aware of slippery surfaces. Ensure suitable footwear and outerwear for all children and adults, weather appropriate. Remove any tools left on the ground, before any activity.	L
Planting seeds into pots or in the ground, with the help of man-made tools.	Hands-on learning about nature. Developing a connection to the world. Identifying that plants are living things which grow in specific conditions, and using that newly acquired knowledge to predict certain effects the outdoors can have on the plants (weather, light etc.). Offers children chances for mathematical exploration when comparing, measuring seeds. Digging in the soil is basic engineering. It is a multi-sensorial experience, as children experience the textures of the soil or compost. Handling tiny seeds helps with children's fine motor skills.	Cuts, bruises due to misuse of the resources provided by the adults: rakes, shovels, hoes, trowels etc.	Children and adults.	Checking all equipment for any damages before each use. Demonstrating the safe methods of handling the props, and making sure all children know how to use everything correctly. Children are to use the tools only under supervision.	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
Using the mud kitchen.	Children are expressing their creativity while enhancing their fine motor skills using measuring scoops, cups and other containers. Children have opportunities to use rich mathematical language describing measurements and quantities or textures. Squishing and patting mud develops tactile sense, providing a rich sensory play. Children taking an interest in mixing potions and the changes that occur when different materials are mixed together could indicate early chemistry aptness.	Bruises from improper use of tools such as pans or other containers provided.	Children.	Checking containers for any damages before each use. Children need to know the 'golden rules' of not putting mud or their muddy fingers in their mouths, nose and ears, and also, not to throw mud at each other.	L
Gathering rocks, twigs or other natural materials.	Exploring shapes, sizes and textures. Children can start experiencing with cardinal or ordinal numbers: plotting them on a grid-squared paper or a map, comparing shapes or areas of rocks or leaves, identifying the largest or the thickest. Enhances creativity as children are handling open-ended natural resources which can be attributed limitless purposes and uses.	Prickles, cuts or bruises.	Children and adults	Instruct children to avoid prickles and to safe handle any resource they might select from the ground. First aid kit available by the exit door.	L
Handling mini-beasts found on or in the ground.	Children are observing and exploring the environment and are beginning to understand and appreciate nature. Children have the opportunity to learn and explore the relationship between living things, their habitat and life cycles.	Bites, stings, allergies to the bites of insects, ingestion of mini-beasts.	Children and adults	Children to be instructed of the 'golden rule' of not putting anything, not even their fingers, in their mouths, ears or nose. Ensuring children's hands are properly washed after activity. Where appropriately, adults to have allergic medication or treatment available. Stings-relief are available in the first aid kit.	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
Stomping/ exploring in puddles.	Children are developing their proprioception sense - sensing their body parts without actually looking at them, as well as they vestibular sense as the action improves balance. Developing gross motor skills through jumping and stomping. Exploring the cause and effect of jumping in the water - the splashes and the ripples, and learning about properties of water. Experiencing and learning about floating and sinking. Opportunities to use non-standard units of measurement for depth and width.	Slips, falls.	Children	Instruct children on 'Let's get Muddy Safe' set up discussed above. Ensure children are wearing appropriate overalls and wellies.	L
Playing outside in different weather conditions.	Children experience and learn about seasons, the changing of the weather, about temperatures, using scientific language related: cold, hot, windy, wet, dry. Children are offered the opportunity to experience and compare nature when dry or nature when it's wet, or even snowed in. It provides new sensory stimulation as nature offers new sights, smells (such as 'petrichor' - the word which describes the smell of wet soil after a long period of warm, dry weather) and sounds. A slippery or snowy world brings about a different set of physical challenges from a dry world: children's gross motor skills, sense of coordination and balance are stimulated.	High-winds can fly in debris from neighbour areas which cause eye or head injuries. High temperatures can cause irritability, dehydration, sun-burns and in serious cases, heat stroke. Low temperatures can be uncomfortable, especially if paired with wet clothes; serious cases lead to hypothermia.	Children and adults.	Check weather prognosis before activity. Ensuring appropriate footwear and clothing at all times: - on hot weather, install water fountain, or have a designated space outside for regular hydration; also, adults to ensure application of sunscreen and appropriate headwear for children and themselves such as sun hats. - on cold days ensure children are dressed warmly. - on rainy days, children to wear waterproof clothing and boots.	L

4. The role of the adult

The use of the outdoors for early years education has become an important focus in many areas of the world, with a visible need to arrive at a better understanding, achievable by challenging its role in this area (Waller, et al., 2010). Many outdoor learning research studies indicate that teacher attitude is one of the most important aspects of challenging and shifting from the traditional indoors learning methods, to outdoors. Bilton's (2020) findings after interviewing early years educators about outdoor learning show that only those who had rich and positive outdoor childhood memories and are still inclined for the outdoors have an somewhat enthusiastic approach to teaching in a natural environment. Moreover, the teachers indicated a lack of knowledge and training in articulating the lessons presented outside. In the same way, Waller (2011) emphasises that practitioners's views, understanding and attitude towards outdoor learning is of crucial importance for outdoor play and learning provision, seen as the second most important resource for a holistic experience, apart from the natural environment. Furthermore, Rodger (2016) states that the outdoors is the ideal environment for children to express their exhilaration and explore, observe and experience the materials available while the educator can observe children's play and plan encouraging ways to extend their learning and understanding. The answer for how educators can support children this way comes from Schärer (2018) who states that practitioners need to actually pay attention to children's cues and to respond accordingly, highlighting that in this process, the professionals need to practice critical reflection.

Pratt (2011) talks about a mathematising model for teaching, where on a horizontal plane, the students are acknowledging mathematical ideas and use them to problem solve real situations, and on a vertical plane the teacher takes the conversation to a higher level and adds new concepts and knowledge to the pupils, thus maintaining a certain level of control over the mathematical learning happening outdoors. The pattern can extend as further as possible to support children's interest in the ideas discussed. The similarity between this pattern of the mathematising model and sustained shared thinking is clearly visible here. The EPPE project has highlighted the positive impact quality education has on children's learning, arguing that maintaining a balance between teacher-led activities and free play leads to successful learning (Siraj-Blatchford et al., 2008). The educators are to find opportunities to extend children's interests and thinking, using modelling techniques, sustained shared thinking or actively engaging in conversations and play. The two ideas discussed above come as an extension to

Vygotsky's scaffolding method of supporting children's current knowledge and deepening it by adding more complex information, and his view on the zone of proximal development where children can become knowledgeable in mathematics and science with the help of well-informed, experienced adults (Pound, 2006). Consequently, in order to offer children valuable mathematical and scientific insight in an outdoor play area such as the one depicted in the image above, it is of great importance for the adults to be enthusiastic and committed to outdoor learning through child-led, open-ended play. Moreover, there is a need for educators to be intentional in their teaching and their methods of doing so, constantly developing their knowledge and approach to pedagogy (Chigeza and Sorin, 2016). The same idea is presented by Waller (2011), who agrees that practitioners should continuously observe, reflect and review the outdoor provision for the children in their setting, adapting the environment according to children's interests. The importance of reflective practice for the practitioners is also recognised by Bazley (2018) who considers it to be a continuous process of learning from mistakes as well as successes, and making the relevant improvements over time.

Waller (2011) thinks that practitioners are therefore subjected to certain roles while outdoors: they should develop relationships with the children and engage in conversations, thus facilitating communication; adults should be genuinely invested in children's curiosities, interests and pursuits, using scaffolding and sustained shared thinking techniques to deepen their insights; moreover, they should work at maintaining play while using modelling strategies, they should challenge and support risky play, teach children about caring for the natural environment and provide chances for the children to experience different outdoor spaces, with diverse natural play variables. This idea of offering children open access to resources stems from several pedagogic approaches which nowadays are regarded as progressive in terms of early education, such as Mallaguzzi's Reggio Emilia or the Froebelian ethos, which are discussed throughout this section.

It has been shown that providing children with natural variables used as resources for play helps them actively learn. In this way, Nicholson (1971) has developed his theory of 'loose parts' through which he explains how children's creativity and imagination are closely linked to the number of variables in an environment and their quality, highlighting the rich opportunities for learning nature provides. The same idea is promoted by Play Scotland - that natural spaces offer a wide range of materials as loose parts, otherwise missing from indoor or artificial play settings, therefore providing richer opportunities for play and subsequently, learning (Casey and Robertson, 2019). The importance of allowing children free access to resources was recognised by the founder of Reggio Emilia pedagogic approach; Malaguzzi

viewed children as competent and unique individuals who need to play and learn in a resource-rich space through which they will express their feelings, their ideas and come to understand different aspects of the world (Smidt, 2015). The same idea is put forward by Archer and Siraj (2015), that a fundamental role of the educator is to offer children rich, stimulating play spaces, with dynamic and adventurous characteristics, where there are opportunities to take risks and explore, all whilst learning.

Applying the above ideas to the play space shown in the image above, it could be argued that the outdoor area does not offer sufficient natural variables, as a wild natural environment would offer. However, not all educational settings have access to a woodland area, or the means to organise regular trips in nature. This is where the challenge lays, when educators must plan and transform the available space into an interesting environment which offers children spontaneous opportunities for authentic learning (Waller, 2011). That can be achieved in a number of ways: from adding natural resources to the ones already present in the picture, to planning and introducing specifically designed group activities which spark children's scientific and mathematical interest, to arrange for the extension of the play area, or even to involve the local authorities which can provide transportation means to the nearest forests school or woodland area. From here another challenging aspect arises - that of inclusion. Moser and Martinsen (2010) draw attention to the fact that practitioners need to regularly reflect whether the outdoor environment where they are planning new activities or the familiar school's back yard, are suitable for all children, without regard to their age, gender, ethnic, social or cultural background. The authors found that Norwegian preschool kindergartens offer children well-designed, resource-rich outdoor spaces quite suitable for all children, claiming that allowing free access to different materials and tools in a natural space helps children make sense of their purpose, thus understanding the world around them. But then again, Scandinavian countries have a rich history and culture regarding the outdoors.

Froebel also thought children should be afforded opportunities to play and experience the natural, open-ended materials which promote unity thorough diversity as well as learning about the connections between all things. He promoted the use of the outdoors for both exploration and learning, being invested in giving children opportunities for hands-on learning such as planting seeds and growing a garden (Tovey, n.d.). It seems as the image pictured at the beginning of this paper and the planting and gardening activities mentioned in section two are in accordance with Froebel's idea of early education. Then again, merely engaging in such activities might not sufficiently stimulate children's cognitive development. Cremin et al. (2015) point out that there is a debate whether scaffolding children's curiosity and inquiries

facilitates or inhibits their desire to learn. The researchers also prove in their study that young children benefit the most when teachers give support not by leading the way, but by being respectful of children's inquiries and setting up open-ended child-centred activities where young ones employ all resources available, they ask questions and are enthusiastic and motivated in their play, they cooperate and use their problem-solving skills together, to reach solve scientific tasks. Thus, the need for a balanced approach of outdoor early years education arises, where educators employ unstructured and teacher-led nature activities, recognising teachers' essential role in developing, implementing and facilitating outdoor learning experiences (Ernst and Tornabene, 2012). In relation to the outdoor play space shown in the selected picture, there is real potential to re-design the space having the needs of the child in focus, although attention is required to preserve the natural occurring features, resources and free play opportunities which stimulate children's creativity. Adults could plan for different activities which meet the new curriculum's learning outcomes, like the ones mentioned in section two, add the relevant resources which enrich both children's experience and learning and carry out the activities on a regular basis, if possible.

Considering what young children need, Steed (2019) states that their development and success is inextricably linked with their learning space, arguing that early years education must be a safe space for children to interact, play and explore with freedom and trust. In our contemporary world most children are deprived of nature and its natural play resources. In this sense, Louv (2009) talks about the 'nature deficit disorder', a concerning disadvantage of not taking children to explore nature which causes their senses to diminish, they develop attention issues and are susceptible to more physical and emotional illnesses when compared with children who do experience the outdoors regularly. Consequently, educators must include outdoors opportunities for children to maximise their holistic development, but doing it while offering a secure space where risk is allowed within limits, in line with the Health and Safety Executive, who recognises and promotes a balanced approach towards exposure to risk and danger (HSE, 2012). Therefore the need for practitioners to evaluate the outdoors space and complete a risk only, or a risk-benefit assessment as the one in section three of this paper. From here, a key issue arises, that of the practitioners' personal opinions and preferences towards outdoor play and learning. Depending mainly on the cultural background and upbringing but other factors too, practitioners can discourage or enable children's inherent predilection towards risk and exploration of the unknown. Research has emphasised the fine line adults have to walk daily to ensure children's protection without inhibiting their learning and to assess their attitudes while engaging with children (Brown, 2014; Bilton, 2020; McInnes et al. 2011).

The Scandinavian approach to outdoor early education and care represents a positive model for practice. Obee et. al. (2020) discuss the liberal attitudes of Norwegian adults towards forest schools and the risky play children are subjected to on a daily basis. They concluded that educators and parents alike consider children as competent and capable humans, further encouraging young ones to develop their own risk assessing skills; adults were aware of the possible outcomes but also recognised its value and were knowledgeable of the benefits of risk-taking in the outdoors - which represents the balance all practitioners must practice, discussed above.

All of the ideas discussed in this section, point out that the practitioner holds an integral role in early outdoors mathematical and scientific learning. From establishing nurturing and trusting relationships with children, to creating emotionally and physically safe environments for them to express themselves as they desire and regulate their feelings and behaviours, adults should model an attractive learning process, a child-centred space where curiosity is understood, encouraged and scaffolded so that it transforms itself into teaching and learning. The adults role is to offer as many hands-on, authentic experiences, rooted in reality as well as chances to revisit the activities and add to their previous knowledge acquired there. Moreover, adults should afford effective environments with access to a wide variety of resources and equipment children can handle, carry and use accordingly, action which helps children develop awareness of themselves and others, of things and the world around them, while navigating and managing risks and make decisions. Children should also be offered multi-sensory activities in natural environments, where they can experience open-ended materials and resources and can observe natural phenomena. All learning should be delivered in an effective and stimulating manner for children, with the need for consistent reflection upon both the environment and of the pedagogic techniques employed by educators.

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