

Awe and Wonder: Mathematics, Science and the Outdoors.



Part 1.

Feature 1 – Trees.

The leaves and twigs from the trees provide children an opportunity to explore mathematical concepts such as patterns, numbers and size. Supplying baskets or bucket allows the children to collect the different leaves and compare the different patterns and sizes by matching and sorting them into groups for example spiky leaves/wavy leaves and big twigs/small twigs. This will allow children to begin to understand how to categorise objects according to their properties. Games could be played where each child is given a leaf and they have to find their matching pair or challenge them by giving them a leaf that they have to find in the wooded area. Showing children, a stick and asking them to find a shorter/longer/heavier/lighter stick will also allow the children to develop their mathematical ideas and a broader mathematical vocabulary. Counting the leaves and twigs that have been collected will increase the children confidence with numbers. Trees and leaves also provide opportunities for children to explore science. By visiting the area in different seasons children build their knowledge of how the

weather effect the colours they will see and how seasons create cause and effect. For example, during the summer months trees will have green leaves as the sun feeds them while during the autumn months leaves begin to change colour and fall off to allow the tree to survive long term and prepare for new leaves to grow. The wooded area also allows the children to investigate light and dark. Where there are less trees children will be able to see shadows forming on the ground while the further, they travel into the forest area the darker it becomes, causing shadows to be less visible. A discussion about how the weather allows us to see shadows such as on sunny days when the sun is low, shadows are easier to see than on cloudier day. The children can create their own shadows by providing chalk. The children can draw around their friends' shadow on an even ground helping them to understand how shadows work in a fun way.

Feature 2 – living things and their habitats.

The area chosen in the picture allows children to recognise that the world around them is full of living things from the trees and plants to the bugs, chickens and birds they will see. Here relationships between living things, their habitats and their life cycles can be explored. The life cycle of the chicken can be discussed as well as how a chicken provides eggs for people to eat. The life cycle of plants and trees – discussing how a plants and trees start as a seed and grow taller over time. Discussing how trees and other living things need food and water to survive making links to people and how we need water and food to grow and remain healthy in order to stay alive. Children could plant seeds and revisit the area to watch the progress. Comparing the different habitats such as where a bird likes to live – in tall trees to build their nest is different to where a worm likes to live – underground in darkness. Children can also begin to understand that living things depend on each other to survive for example a bird likes to eat worms, while worms need to eat leaves fallen from the trees to stay healthy. Offering children magnifiers to look closer at the different bugs and animals can also provide a chance to discuss and compare the different body part of the bugs and animals such as legs, arms and head. There are also many opportunities to incorporate mathematics, the children can look and collect the different bugs, counting how many they find, counting their legs, what bug is faster/slower, biggest/smallest as well as comparing their sizes and if they have any patterns such as a snail's spiral shell or a ladybird's circular spots. The children can work together to group the bugs for example with legs, without legs.

Feature 3 – Climbing and Jumping.

Tree climbing allows children to develop their spatial awareness for instance can they reach a branch or will they be able to fit through the gaps in the trees. Climbing trees also allows children to understand height. Can they go higher in one tree than the other, are they halfway up the tree and can they go further than their friends. In addition to height children can learn about scale, in particular when they look down from their vantage point. Jumping from the logs also allows children to explore measurement. A game could be played where the children see who can jump the furthest by marking their position with a stick. They can make predictions such as is the next persons jump going to be shorter or further than the last person measuring the length using non-standard measures such as stones, bark or twigs as a result

strengthening their number knowledge and counting skills. Children will be able to use mathematical language when measuring such as three stones long. Children can also investigate forces and energy while jumping from the log in addition learning about balance and coordination whilst walking along the log. Will their jump be further off the log or from a standing position? If they run and jump will that make their jump longer? Can they walk along the log from one end to the other without falling off? Jumping and climbing offers an opportunity to discuss kinetic energy and how gravity will pull them back down to land on their feet.

RISK BENEFIT ASSESSMENT

Location / Activity:	Forest area	Date:	20 TH September 2021
Assessor:	Rhianne Stephens	Review date:	20 th March 2021

ACTIVITY	How will young people BENEFIT from this activity?	Possible hazards	Who is at risk?	PRECAUTIONS in place to reduce the risk of injury	Overall risk RATING: L/M/H
Investigating Leaves and trees	Exploring different shapes, patterns and sizes. Learning about the different seasons, how the leaves change throughout the year. Colour exploration Classification. Observing the different wildlife that live on and around the trees. Sensory benefits through touching the different leaves, bark and sticks. Introduced to new vocabulary. Learning to respect nature. Understanding trees and plants are living things.	Low level branches catching children's eyes or causing cuts. Allergies caused by the different plant or pollen. Children falling and cutting themselves. Stings from nettles and plants. Bites from insects.	Adult/ Child	A discussion about the possible hazard before going out to the forest area. Adults to inspect the area for sharp objects such as glass to ensure the area is safe for the children to explore. Meeting the ratio requirement for the number of children. Observe and guide the children when in the forest. Washing hands. First aid box to be taken with any medication needed for children with asthma and allergies. Ensure suitable clothing and footwear.	L

Climbing trees and jumping	Gives children the opportunity to explore and gain an understanding of height. Allows children to investigate scale and measurement. Children begin to understand forces, energy and gravity. Climbing and jumping is physically challenging for children. Builds confidence and self-esteem and develops resilience. Provides a sensory experience. Children become problem solvers. Improves their balance and coordination. Children can learn to manage their own risk. Supports children's gross motor skill as they are using their large muscle groups to be able to climb and jump.	Children may fall from height or slip causing cuts and grazes. Possibility of falling on something hard or sharp. Falling on someone from above. This could cause head injuries Low level branches going into eyes. Weather conditions making tress slippery.	Adult/Child	An adult to supervise the children when climbing. Adults to inspect trees for broken branches. Weather conditions to be considered such as high winds, heavy rain. Inspect the ground below for sharp object such as glass. First aid box to be taken. Appropriate footwear and clothing such as wellingtons, trainers and long sleeve jumpers.	L
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Walking/ jumping from logs.	Supports children's balance and coordination. Supports body awareness - what the body can do. Physically challenging. Improves posture. Children gain confidence and build resilience. Supports children's knowledge of energy and forces.	Falling causing cuts and bruises.	Adult/ Child	Wearing appropriate clothing and footwear. Discuss that they might need to walk across slowly at first until they become more confident with the height/surface. Try walking in a straight line beforehand with one foot in front of the other to allow the children to gain an understanding of how balance works. First aid box to be taken.	L
Collecting the different materials	Children have the opportunity to collect different item to use for in a variety of different ways. Collecting different materials supports different schemas. Improves children's hand eye coordination when bending and picking up the different materials. Enhances children's sensory development.	Collecting different items such as sticks, or pieces of wood could cause splinters. Carrying different items could cause cuts. Children could pick up sharp object that lay underneath the materials	Adults/ Child	Discuss what children can and cannot collect. Discuss the boundaries and when children can and cannot go. Adults to check the area for obvious item that are dangerous such as glass. First aid box to be taken.	L

Outdoor in various weather conditions.	Children experience the different weather temperatures. Enhance their knowledge of the different seasons. Children learn how to manage their own risk such as wearing layers when cold and sun cream when hot. Different weather conditions offer a sensory experience for children such as wind, rain and snow. Children expand their vocabulary using words such as cold, wet, dry, windy.	Sun exposure can cause sun burn and/or heat stroke. When children are too hot or wet, they may become upset and distressed. High winds cause tree branches to fall causing head injuries, cut and bruises. When raining this will make the leaves to be wet and slippery cause trips and falls resulting in cuts and bruises. On sunny/hot days children may become dehydrated.	Adult/ Child	Appropriate clothing to be worn. Waterproofs, wellingtons and extra layers on cold days. Sunhats, sun cream on sunny days. Keep track of the weather forecast and ensure it is safe to venture out. If winds are in excess of 30mph to stay indoors. First aid box to be taken. On sunny days sun cream to be applied and taken to reapply when necessary. On sunny/hot days water to be taken to ensure hydration.	L
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Part 4

Mechler (2015) states mathematics and science are regularly thought of as separate subject however maths and science are related, both encompassing our everyday lives. According to Early Years Careers (2015) adults often reflect on their own learning of mathematics and science as a negative experience and therefore early years practitioners should include maths and science in their outdoor provision within an engaging environment to help support early mathematical and science development. In addition, Ernst and Tornabene (2012) believe that children who engage in early outdoor experiences in nature increases a child's curiosity, creates lifelong positive attitudes, enhances their knowledge of nature while creating scientific and mathematical thinkers. Thus, linking Froebel's theory (1850) that children were active and curious learners who learnt best through rich first-hand experiences. Froebel believed that the outdoor environment gave children the opportunity to understand how everything linked together, autonomy, space and time for exploration within nature and opportunities for meaningful learning across the curriculum supporting children's scientific discovery and mathematical development in a holistic approach (Tovey, no date). Early Years HQ (no date) suggests forest schools as a popular long-term approach to outdoor learning. Forest schools' intentions are to inspire and encourage children through positive outdoor experiences that supports children's free play learning. Moreover, Learning Through Landscapes (2021) describes forest schools as a specialised approach aimed to develop

children's confidence and increase self-esteem via hands on learning within a woodland environment. Kostic (2016) state forest schools offer a holistic approach to encourage and promote children's mathematical learning with endless possibilities. Furthermore, Forestry Commission England (no date) suggests forest schools offer opportunities to cover many aspects of the maths curriculum that includes measuring, shape, number and symmetry. Similarly, Campbell and Speldwinde (2020) state forest school locations provide affordances and opportunities for children's scientific exploration. Aside from conceptual learning in science, forest schools give children opportunities for skill-based learning. Forest schools offers loose and fixed resources enabling children to investigate science in a fun way through play. While Froebel's theory supported children's learning in the outdoors Gibson (1977) affordance theory describes the way in which children perceive different possibilities within their environment. Different resources within the environment offers a child alternative learning opportunities that is within the child's ability. For example, for one child a log may be seen as an object to jump over while another may walk along it. When the child interacts and investigates their environment new affordances develop (Early Years Educator, 2016). According to Early Years careers (2016) a stimulating outdoor environment supports children's physical development and their imaginative skills. Piaget (1936) believed a stimulating environment developed a child's curiosity and children became 'Little scientist' through exploring and interacting with the world around them to gain an understanding of people, objects and concepts (Kandola, 2019). Cherry (no date) also describes Piaget as a pioneer of the constructivist theory. Piaget suggested that a child's understanding of the world is constructed from their interactions between the child's ideas and experiences. Furthermore, Piaget's schema theory (1923) aids children's understanding of science and mathematical concepts. Through schemas such as trajectory, rotational and transporting helps develop children's science and mathematical development through repeating their actions to gain an understanding of how things work, move and problem solve (Education Scotland, no date). Robertson (2017) describe how Nicholson's loose part theory (1971) provides a stimulating environment when a number of loose parts are available for children to investigate and explore. Nicholson described loose parts as providing open ended materials for children to explore phenomena such as gravity, forces, concepts and ideas throughout the curriculum. Clarke (no date) suggests that loose parts and open-ended materials enables children to challenge themselves, take risks, children can extend their own play whilst becoming active participants in their learning. Furthermore, Play Scotland (no date) suggests that loose parts promote and develop children's curiosity, exploration and learning. In addition, when loose parts are incorporated, they create a rich holistic learning environment where children can learn about the world in which they live, supports experimental and discovery as well as mathematical and science concepts. According to Ranheim (2020) loose parts provide an enjoyable way for children to explore maths. Loose parts provoke children's interest in mathematics as children are attracted to item that are real. Loose parts can be used in a variety of different ways for children to investigate concepts such as symmetry, weight and size. Wilding (2020) describes how loose parts such as stones, sticks, pinecones and leaves all support children's understanding of mathematical concepts such as patterns, comparing, shapes and counting. According to First Discoverers (2020) children are naturally inquisitive and curious about the world around them. Therefore, introducing scientific discovery at an early age can ignite their enthusiasm for science. Child Care (2019) explain how the natural environment supports children's scientific understanding by stimulating

children's curiosity, building their vocabulary and using their senses. By exploring and manipulating natural objects children can investigate the cause and effect that happens when children add water to mud or sand, exploring the properties of water and ice as well as mixing colours. Furthermore, Daly and Beloglovsky (2015) explain how loose parts supports children's scientific explanations about physical properties of the non-living world. Children increase their knowledge of how things work when experimenting with stacking logs, tyres and tubes while also investigating many theories involving height, distance, force and gravity. Loose parts that stop, start and change their direction allows children to learn that different items move in numerous ways while hills allow them to investigate incline and gravity. Similarly, Williams (2021) believes loose parts play a central role in children's scientific discovery and naturally occurs through play. Children use loose parts to investigate floating and sinking with bottles that act as boats and explore gravity through rolling stones, conkers and pinecones down slopes or various inclines. Through these types of activities children are exploring, investigating, creating and testing hypotheses while connecting with the world around them. According to Semling (2018) open ended resources allows children to explore numerous possibilities enabling children to make their own decisions. Through open ended resources children learn leadership, decision making skills and problem solve independently. Dancer (2021) suggests the role of the adult is to participate as a co-player with children to extend their learning and knowledge while modelling and reinforcing specific vocabulary. Thus, reinforcing Vygotsky's Zone of Proximal Development theory (1934) suggesting that children's interactions with more knowledgeable adult or peers enabled the child to learn higher order functioning and reach their potential allowing children to develop new skills (First Discoverers, 2020). Vygotsky highlighted the importance of language development as this was how adults presented children with information. In addition, he believed language was the way in which children engaged in thinking to further their understanding (Discover Early, 2021). According to Wheeler (no date) Brunner's scaffolding theory (1976) is also used as a tool to support children's learning. When children work with a more knowledgeable adult this allows children to understand and make links between different concepts and prior learning. Children start by needing the support of an adult, however when they become more confident and independent in their thinking and newly acquired knowledge and skills the adult support is no longer needed. Thus, only allowing the child to gain the skills and knowledge they require. The Effective Pre-school, Primary and Secondary Education Project (EPPSE) suggested that children made the greatest progress when shared sustained thinking took place. Shared sustained thinking occurs on a 1:1 basis or in a group and requires individuals to work together to problem solve, explore ideas and extend their understanding of concepts with children making connections to their learning (Department of Education, 2015). Brodie (no date) believes that shared sustained thinking is an active and creative process that promotes a child's 'deep level learning'. When children are 'deep level learning' they are not only learning information, but they are also thinking critically supporting a positive learning disposition. In addition, Brodie suggests practitioners to model their thinking through metacognitive talk. Sword (2021) describes metacognitive talk as talking out loud what you are thinking as you perform a task. This enables them to understand and learn new strategies while directing their own learning through improving their cognitive process, memory attention and activate past knowledge allowing for effective and efficient learning. Primary Science Teaching Trust PSTT (2020) say that effective questioning during shared sustained thinking should be open ended when

exploring science in the early years. Questions such as I wonder why, what, how and what do you think will happen next? will help develop children's early scientific talk and understanding while answering their own questions. In addition, PSTT state the outdoors is an important way of contextualising science in the early years as well as when learning is taken outdoors a positive relationship between practitioner and child form supporting scientific learning. Furthermore, Teacher Line (no date) suggest to develop mathematical thinkers, practitioners need to ask questions such as what happened? What if? and why? These question will help support shared sustained thinking between practitioner and learner. However, Chalke (no date), Burkhart (2019) and Best (2019) suggest that many practitioners are not confident teaching maths and science. Practitioners with a negative experience of mathematics and science lack confident and are likely to transfer their own negative experiences, doubts, anxiety and attitudes on to children, impeding their learning. With this in mind the intervention 'Talking Science' was introduced to 64 practitioners in Early Childhood Education and Care (ECEC). The intervention was delivered via a collaborative and socio constructive model. The aim of the intervention is to deconstruct their past experiences and concerns followed by reconstruction through actions and knowledge in a collaborative approach with peers'. Thus, increasing their confident to deliver science within their ECEC setting (Gealy *et al.* 2020). Another factor outlined by Cowper (2019) suggests practitioners are reluctant to take learning outdoors due the risks. Stating practitioners were not confident enough and suggest that risk should be rebranded as 'adventure' to eliminate their fears. Stanza (2015) supports Cowper and also identifies other reasons for practitioners' reluctance such as weather and the setting not having the appropriate clothing such as wellingtons and waterproofs. In addition, practitioner find following the curriculum requirements for maths and science difficult to follow in the outdoor environment. While Knight (2017) states settings are not utilising their outdoor space environment due to settings focusing on academic achievement and remaining inside in a 'structured' classroom as opposed to considering the outdoors as a learning environment. However, the Welsh Government (no date) state the means in which children are taught will be different. Learning will incorporate children's skills, experiences and knowledge and practitioners will gain more flexibility in the way they teach to ensure the best possible outcomes for their learners. In addition, the new curriculum for Wales 2022 supports collaboration and cross-disciplinary through planning, learning and teaching within an area and across the different areas. This collaboration and cross-disciplinary will help facilitate learners to make associations between their learning by combining experiences, knowledge and skills. (Welsh Government, 2020). Mathematics and Science are two of the area of learning and experience within the new curriculum for Wales 2022. Within each area there are principles of progression. The principles of progression will be central to the curriculum and will inform the practitioners approach to progressing their learners (Welsh Government, 2020).

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