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Outdoor Environments to Promote and Support Children's Scientific and Mathematical Thinking

Section 1 – The chosen environment, the riverbank.



(Source: Walters, 2021)

Section 2 – Three features of the chosen environment.

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Feature 1, pebbles –

Pebbles can be used to enhance children's mathematical and scientific learning by allowing the children to make stone structures, patterns, compare sizes and weights, throwing them into the water to make a splash or to create a dam to redirect the river water. These activities will help the children to understand scientific concepts such as forces including gravity, balance and energy and mathematical concepts such as weights, patterns and shapes. This links to the new curriculum science and technology descriptions of learning, Welsh government, (2020). As children will be actively exploring the environment and making observations based on what they find. Throwing stones into the water or creating dams will help children understand their actions have an impact on the environment around them, as the river water will be redirected by their dam, Welsh Government, (2020). Creating a dam would also afford the children opportunity to design and create a structure, choosing what materials would be best, the children may wish to incorporate mud into the dam providing more links to progression where they understand ways in which materials change when mixed together e.g. sand and water to make a mud Welsh Government, (2020). Playing close to the water's edge has risk so allows the children opportunity to assess their environment and identify possible risks to them and others Welsh Government, (2020). It also allows for children to experiment with counting objects and estimation of size Welsh Government, (2020) and cross curricula activities such as art and design by painting rocks.



(Source: Stærk, 2020)

Feature 2, Leaves, sticks, branches and foliage –

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(Source: Whitehouse, no date)



(Source: Whitehouse, no date)

Children can use the natural materials to enhance scientific and mathematical learning creating many different things such as using large branches for den structures, identification of textures or patterns in natural materials and imaginative play - the purpose of a stick can be limitless. The added element of being by the riverbank is that bark, sticks, leaves and pine cones all share the ability to float. Children can use these materials to create natural boats to float in the river providing understanding not only about the river and the direction and speed of its flow but also opportunity to learn about boats and their many different parts such as masts, sails etc Whitehouse, (no date).

This links into the new curriculum science and technology descriptions of learning, Welsh government, (2020). Children will be exploring different types of energy and how it can be transferred by the boats being propelled forwards by the water, using design skills to identify materials needed for their boats. They will also be using predictions of what will float or sink and testing these predictions in the water, Welsh Government, (2020). This could be progressed further by the children identifying which of their prototypes float best and using this knowledge to design further boats with better properties for floating. Welsh Government, (2020). It also allows for learning of mathematical concepts such as grouping objects and estimation of size and weight Welsh Government (2020). Cross curricula activities could include bringing books about boats and ships to the riverbank for the children to study or paints and crayons for leaf printing or rubbings.

Feature 3 – The living world of plants and animals.

The riverbank is home to a wealth of animal and plant life for children to observe and study, plants such as blackberries grow along its edge which provides children with opportunities for plant life cycle study, art and cooking. Many animals and insects also make their home at the riverbank, ducks often nest along its shore to have their ducklings providing children with more opportunity for lifecycle study and opportunity to collect items such as feathers and egg shells. This links into the new curriculum science and technology descriptions of learning, Welsh government, (2020). Children will learn to recognise that plants and animals are living by observing them change over

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time, children can observe the ducks eggs becoming ducklings and eventually becoming adult ducks and compare parallels to their own lives as they were once smaller and are growing over time Welsh Government, (2020). The children can gain understanding of why the ducks choose the riverbank to nest on, observing the ducks using natural materials like sticks and moss to make nests and could use similar materials to try and construct their own nests Welsh Government, (2020). Cross curricula activities could include singing nursery rhymes involving animals that they may find such as two little ducks or 3 little speckled frogs.



(Source: 123RF, no date)

Section 3 – Risk benefit assessment

Location / Activity:	Riverbank of river Afan	Date:	19/09/2021
Assessor:	Sarah Walters	Review date:	19/03/2022

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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
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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
Walking on pebbles and inclines along the riverbank	Children will benefit from an increased awareness of their own bodies and balance. Children will have opportunity to develop balance and co ordination using their vestibular system. Children will learn cause and effect of forces such as gravity when walking or rolling down sloping surfaces. Children will develop gross motor skills walking up and down gradients and balancing on rocks.	Children may trip over or loose balance causing a fall resulting in injury such as grazes, sprains or broken bones. Children could scrape themselves on rough or jagged rocks. Children could underestimate speeds on sloped surfaces and run into other children or fall over causing injury.	Children and adults	Children will be made aware of the different surfaces and adults will talk with the children to create ideas about how the children think they can keep themselves safe. Children will be provided with appropriate footwear such as trainers, boots or wellies. Clothes will be suitable for the season and may include all in one suits for wet days. Children will be made aware of the boundaries and how far they may explore.	L

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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
Children may wish to collect natural items found by the riverbank such as rocks, sticks, leaves, plants, feathers, egg shells, blackberries or insects.	Children can develop a connection to the natural world around them becoming eco warriors learning how to care for the environment. Children have physical opportunity to compare weights and textures of different items. Children have opportunity to study plants, animals and insects lifecycles. Children have opportunity to use natural items to create patterns and structures.	Children could be stung by plants such as stingy nettles or thorn bearing plants. Children could eat plants or berries that are harmful and poisonous. Children could collect rubbish or other dangerous items left by other people. Children may be bitten or stung by insects or animals. Children may disturb animal nests. and	Children, adults and animals.	Adults will discuss with children ways in which to stay safe such as not putting anything in their mouths. Children will be made aware of items that they must not touch such as birds nests or human rubbish and aware that anything they are unsure about must be discussed with an adult. Children will be shown plants that may sting them and aware of the dangers. Adults will bring a first aid kit.	L

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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
Exploring the waters edge and entering the water.	Children will have opportunity to study the flow of the river and use rocks or other items to create dams to change the course of the water. Children will have opportunity to use natural items in the water to discover what floats and sinks. Children can collect water to change the viscosity of sand or earth along the riverbank by mixing and making mud pies. Children can study animals that live in the water such as fish or ducks.	Children may slip on wet rocks and hurt themselves. Children could be swept away by strong water currents and drown. Children could enter an area that was too deep and drown.	Children and adults	Children will not enter the water without an adult supporting them. Children will have appropriate footwear to enter the water. Adults will discuss with children water safety and areas of the river that are not safe to walk in. Adults will assess water levels/ speeds and decide if the river is safe to enter.	M

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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
Climbing large rocks or trees	Children will use gross motor movements to climb large rock or trees. Children will gain an understanding of their bodies and an awareness of the world from different heights. Children will gain confidence and problem solving skills when climbing objects. Children will develop balance and co ordination.	Children may fall and hurt themselves, causing scrapes or broken bones. Children may climb to high for their own ability and get stuck. Branches may snap causing injury or falls.	Children and adults	Children will be taught how to assess the strength of branches and suitable rocks to climb on. Adults will be aware of the children's abilities and scaffold their learning choosing suitable climbing challenges for them. Children will be aware not to climb higher than they feel comfortable. Children will be supervised while climbing.	L

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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
Exploring the area in different seasons.	Children will gain an understanding of the changes that plants and animals go through in different seasons. Children can experience different temperatures and weather conditions such as snow and frozen water. Children can experience changes in light during the winter and summer. Children can see the changes that happen to the river in summer and winter.	Very hot weather could cause sunburn or sun stroke. Very cold weather could cause hypothermia. Stormy weather may cause trees to fall causing serious injury. Heavy rain could cause the river to swell making the riverbank unsafe. Children may be too hot or cold.	Children and adults	Children will wear appropriate clothes for the weather, sun cream and sunhats for hot weather. Warm clothes and all in one waterproof suits for cold or wet weather, hats gloves etc. Children will not visit the site during extreme weather conditions. Adults will assess the river levels during periods of wet weather to determine its safety.	L

Section 4 – The role of the adult.

The photo in section 1 is an environment rich in loose parts such as pebbles, sticks, leaves etc. According to Nicholson, (1971) children need the opportunity to experiment and play with loose parts, which can be defined as materials that can be manipulated or transformed during play. Gull et al, (2019), Rahardjo, (2019) and Scotlands play strategy, (no date) who all explore Nicholson's theory of loose parts ascertain that loose parts offer opportunities for cross curricula learning, allowing children to experiment

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with various cognitive and social and emotional skills. Specifically opportunities for STEAM learning, STEAM or Science, Technology, Engineering, Arts and Mathematics provides opportunity for children to experiment with materials such as loose parts during self-guided play. When provided with an environment rich in opportunities for loose parts play such as the one pictured in section 1 children will begin to lead their own inquiry into problem solving, creativity, concentration, language, gross/fine motor skills and scientific and mathematical thinking. The role of the adult is central to how much meaningful learning the children will acquire during this exploration Gull et al, (2019), Rahardjo, (2019) and Scotland's play strategy (no date) all agree that adults will need to be open to providing children with opportunities for outdoor exploration and have excellent observation skills drawing children's attention to textures, shapes and patterns and selecting appropriate tools and methods to enhance this. For example Scotland's play strategy, (no date) suggests adults may want to read a story whilst outdoors that will spark children's imaginations and curiosity, Stick man for example may lead the children to hunt for a stick to be stick man, search for an appropriate family tree or make their own nest for the swans. However this adult role is where Early Years Outdoors (2017) believes that Nicolson's theory is flawed, they believe that the theory lacks emphasis on the role of the adult in facilitating children's play, which as discussed previously can widely influence the experience that the children will have, Early years outdoors (2017) offer the playwork principles as a solution to this.

Play Wales (no date) offer clear guidelines for the role of the adult in facilitating children's play, with emphasis on the child's choice. Adults should be available to support children in the creation of a space to play which balances risk with developmental benefit and the well-being of the children. This adult role is explored in more detail by White, (2021) who speaks about her own personal experience of observing children's play in both a sterile play space and an allotment leading her to transform the sterile play space into a natural playground. The new play space gave children opportunity to discover life cycles and decomposition of plants in the compost heap and find living creatures such as hedgehogs and worms with adults further facilitating learning by providing the addition of resources such as a wormery and gardening equipment to care for the garden. This shows that adults who have the observation skills to recognize and act on children's needs can influence their development positively, the new garden offered higher risk to the children however this was outweighed by the greater affordance for exploration and learning. This can be further supported by Duglan (2015) who found that when adults valued children's ideas and interests such as climbing, swinging and being high up by introducing a tree swing to the garden the children took ownership of the swing and the risks involved and developed self-regulation skills to manage the challenges they faced. However this was not without its challenges as at first the adult practitioners were nervous of the risks involved, this hindered their ability to scaffold the children's learning as over managing the risk would not allow the child their own opportunity to problem solve. Cremin et al (2015) supports this thinking citing that the attention a child gives to problem solving during play is directly linked to the teachers ability to scaffold the learning, adults who are able to observe and offer constructive advice at appropriate times foster children's independence and confidence in their own ability to problem solve, inquire and develop their own metacognitive strategies such as but not limited to asking themselves questions or thinking out loud whilst problem solving. This is further supported by Tovey (no date) who explores the work of Froebel and the Froebelian approach and offers tree climbing as an example of the benefits of risk stating that it allows children to experience many opportunities to learn about height, perspective and their own strength and limitations. It also

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offers opportunity for risk and affords small mistakes which help the children foster resilience, Tovey suggests that adults who do not allow for risk or are anxious of it convey this anxiety onto the child, undermining the possibilities for the child to experience small failures and develop resilience. Adults with a love of nature and a positive approach to play are according to Tovey (no date) invaluable in teaching children to risk assess situations for themselves.

This adversity to risk is not limited to practitioners, Little (2013) believes that over protective parenting has had an impact on the experiences that children have outdoors. Little (2013) States that parents although aware of the benefits of outdoor play find difficulties in overcoming their own anxieties about risk, creating a culture of fear that has greatly reduced children's opportunity for unstructured outdoor play. Gill, (no date) supports this view stating that children and young people live in a world with increasing adult anxiety over their safety, this can lead them to underestimate their own abilities. Parental anxieties can be a barrier that practitioners face when trying to create effective outdoor settings, often fears of legal action over injury's can lead to a watering down of outdoor experiences for children. Maynard, Waters and Clement (2013) believe that adults respond differently to children in an outdoor environment, children are able to push boundaries without worry about noise or mess, however Arlemalm-Hagser (2010) proposes that this outdoor environment does not eliminate adult gender bias. Although the adults studied perceived the outdoor classroom as gender neutral space there were still hidden gender cues such as an upset boy being offered football to calm him when he preferred the sandpit, an area practitioners associated more with girls. This is particularly important to remember when encouraging mathematical and scientific exploration outdoors as according to Cassidy et al (2018) these disciplines tend to have a low female presence for study at A level.

Similarly adult's knowledge and love of the outdoors and nature will have an influence on the experiences they afford to children, Skarstein and Skarstien (2020) explore the importance of children's time in nature for their understanding of biodiversity, the impact humans have on ecosystems and to foster a relationship and appreciation of nature. They ascertain that simply being in nature is not enough and children require the company of adults who can model appreciative attention to plants and animals, whilst also being able to recognise children's questions and curiosities. However Skerstien and Skarstien (2020) state that a high percentage of teacher's current knowledge of common species of plants and animals is poor and adults with a low knowledge and confidence about nature are not best placed to facilitate outdoor learning. Ernst and Tornabene (2012) expand upon this stating that early years educators need an appreciation and awareness of the natural world, citing teachers beliefs as a major influence in how they perceive the benefits of the outdoor classroom and the opportunities it affords. The work of McCree, Cutting and Sherwin (2018) supports this view and demonstrates what can be achieved when children have prolonged access to outdoor learning with knowledgeable, skilled practitioners. The study shows that when disadvantaged children were given this opportunity they were able to foster a relationship and ownership of the outdoor space whilst improving their resilience and self-regulation skills. Working at slower pace with patient, knowledgeable practitioners whilst being allowed to follow their own interests allowed them to improve their general attainment in school.

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The picture in section one offers high affordance for children's play and discovery, due to its wildness, complexity and abundance of loose parts. According to Campbell and Speldewinde (2020) knowledgeable, playful adults can encourage children to see the limitless affordance of the environment around them. They consider outdoor environments to have the highest affordance for play and learning for children and state that the properties of learning will be dependent on the person's view of the environment around them with the adults' interaction with the child and the environment being central to this. MA Education (2016) explores Gibson's affordance theory, Gibson believed that the potential use of an object or element of the environment is immediate and perceived by the person's sensory input. Environments therefore will present different affordances depending on how the person is feeling at the time, a cold child may only seek out shelter in the environment but if the adult meets that need by providing appropriate clothing or a warm drink then the child's natural desire to seek out play affordances can flourish. This can be supported by McCree, Cutting and Sherwin (2018) who noted that at the start of their study the children would actively seek out the hot chocolate drinks before moving on to other areas of discovery. Early years outdoors (2017) believe that materials that are fun and stimulating often are also items with high play affordance to children, the picture in section one has many aspects that offer this including large boulders to the right that could be climbed, sat on, used as a table or coloured with chalks the possibilities are endless.

These concepts of affordance, connection with nature and loose parts play can all be supported by the work of Froebel, according to Maynard, Waters and Clement (2013) who explore the work of Froebel it was Froebel's belief that children should be given the opportunity to grow in harmony with nature, what grew from this idea were kindergartens and forest schools that focus on child centered outdoor play that allows the child to develop a sense of local identity and environmentalism. This Froebelian approach is explored further by Tovey (no date) who believes that learning through nature gives children opportunity to understand the natural world with the freedom to explore, experiment and use whole body movement to experience concepts such as gravity, gradient, speed and energy whilst also experiencing adventure, risk and challenge. Froebel also believed in the potential of loose parts play, which he referred to as forms of knowledge, life or beauty. He believed that play with these simple open ended materials afforded learning for children over many aspects including science and mathematics. Tovey (no date) also believes that the role of the adult is crucial stating that the way in which adults respond and interact with children's interests and ideas can lead to meaningful conversations that can either spark or crush children's curiosities'. Froebelian educators according to Tovey (no date) will have high expectations of children's abilities and know how to effectively support the children to achieve and extend learning. The key to this is effective observation of the children's interests and play ideas which informs the adults of what resources they can incorporate to extend the children's learning.

These concepts and benefits of learning in the outdoors also link in with the new curriculum for Wales four principles, Welsh Government (2020) believes the new curriculum will support children to be adults who enjoy taking measured risks and think in a creative way to provide solutions to problems. Children will grow to be adults who enjoy challenges, take part in physical activity and understand the impact of their own actions on the world. They will be actively involved in the sustainability of the

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planet and have developed strong skills of resilience and empathy. All of these targets of the four principles can be achieved and developed during outdoor play and exploration, it is therefore a crucial aspect of how the new curriculum must be delivered.

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