

Carved

BY NATURE

The Forces of Weather and Erosion on Landscapes

SCIENCE YEAR 5



Carved by Nature: The Forces of Weather and Erosion on Landscapes

First Edition

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By Michelle Morrow

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Introduction

At My Homeschool, we study a variety of scientific disciplines, such as biology, Earth science, space science, physics, and chemistry. We use the scope and sequence laid out in the Australian Curriculum and the NSW syllabus. We also use Charlotte Mason's ideas when preparing the framework for our courses.

A lesson is to be completed once a week. There are two parts to this resource:

- An introductory Science narrative to read.
- Earth Science Links: A complimentary video to explore the topic further. These links are found online in your Virtual Cupboard.

After reading the introductory Science narrative you can then watch the *Earth Science Links* and write some of the interesting facts you have learnt in your Science Notebook. Include illustrations if it will add to the lesson.

Our science resources combine the ideas of Charlotte Mason and modern teaching methods. The melding of these two approaches gives children the delight of learning about science through a range of literary and digital mediums. It also utilises a core idea in the Charlotte Mason method where children make connections between all the knowledge they are acquiring across all subjects – she calls this the science of relations.

This year we read the novel *Ash Road* by Ivan Southall to follow how extreme weather changes a landscape. We also see the changing landscape of Australia as we read *Our Sunburnt Country. Carved By Nature* and our *Earth Science Links* continue to build on that foundation.

Melding these two methods allows you to give your child a modern Charlotte Mason science curriculum that will consolidate and reinforce their science understanding and the science of relations.

I trust you will find this resource useful, and your child will be eager to learn more about the topics covered.

Michelle Morrow

Lesson 1: Weather and Erosion

Weathering, erosion, transportation, and deposition are like nature's tools that change and shape the Earth, making new landscapes over time. Imagine these processes as a team of artists, each doing different things to make the world's beautiful scenes.

Weathering is like the first artist, working on a big, strong rock. Even though the rock looks tough, weathering slowly breaks it down. There are two types: physical and chemical. Physical weathering works like a hammer and chisel. When it gets really hot or cold, the rock expands or shrinks. Over time, this makes cracks and breaks. Chemical weathering is more like painting with acid than paint. The rain, sometimes a bit acidic, reacts with the rock, making it weaker and sometimes even dissolving parts of it. This is really clear with rocks like limestone.

After the rock is broken down, those bits have to go somewhere. Here comes erosion, the sculptor, moving these pieces around. Erosion is all about moving broken-down bits like rock, soil, and tiny particles from one place to another. It can happen through water, wind, ice, and even gravity. Think of a river with muddy water after it rains – that's erosion, carrying away all that mud and sand.

Next, transportation is like the journey of these bits. Streams and rivers can carry all sorts of things like tiny clay particles, bigger stones, and even huge rocks, depending on how fast the water is moving. Glaciers, big slow-moving ice masses, can also carry loads of stuff far away. Wind is important too, especially in deserts where it can blow around lots of sand and dust.

Then we have deposition. This is like the end of the journey, where all the moved stuff settles down. It happens when things like water or wind can't hold the bits anymore, so they drop them. This can make new places, like deltas at the end of rivers where the water slows and drops all the stuff it's been carrying. In deserts, sand dunes are made from sand dropped by the wind.

Weathering, erosion, transportation, and deposition usually happen slowly but sometimes can be really quick, especially in tropical storms (cyclones, typhoons and hurricanes)¹ or in floods and landslides. These sculptors of nature work together all the time, changing how the Earth looks, creating the amazing landscapes we see. The story of how our planet's surface changes is always ongoing, with nature writing and rewriting the scenes around us.

Science Notebooking

Watch the *Earth Science Links* and write some of the interesting facts you have learnt this lesson.

¹ Tropical storms in the southern hemisphere are called cyclones and rotate in a clockwise direction, while in the northern hemisphere they are called hurricanes or typhoons and rotate in an anti-clockwise direction.

Lesson 2: Mechanical Erosion

Imagine Earth as a living canvas, constantly being shaped and reshaped by various forces. Among these, weathering plays a crucial role, breaking down rocks and landscapes. Weathering can be caused by mechanical means like wind abrasion, extreme temperature cycles, and frost wedging, or by biological agents such as plants and tree roots. These natural sculptors work tirelessly, often unnoticed, gradually transforming the environment around us.

Starting with mechanical weathering, think of it as nature's toolkit for carving and shaping landscapes without changing the rock's natural composition. One vivid example is wind abrasion. Picture the arid, sweeping deserts of Australia. Here, the wind acts like a relentless artist, using sand and small particles as its tools. Over centuries, these particles, carried at great speeds, bombard rock surfaces. The wind shapes unique landforms, like the remarkable rock formations found in the Australian Outback. These structures, smoothed and sculpted by the relentless desert winds, show the power of wind abrasion.

Another mechanical weathering process is driven by extreme temperature changes. In many parts of Oceania², rocks experience daily and seasonal temperature fluctuations. In regions with high daytime temperature ranges, like the Australian Outback, rocks heat up considerably under the hot sun during the day and cool down rapidly at night. This expansion and contraction cycle can cause the rock to crack and eventually break apart. Over time, these cracks fragment the rock, resulting in the gradual disintegration of once-massive rock formations.

Frost wedging, though more common in colder climates, also occurs in higher elevations within this region. This process starts when water seeps into cracks during warmer times. When the temperature falls quickly, the water freezes and expands, prying the rock apart. Think of it like a wedge of ice forcing its way through rock crevices. The repeated freezing and thawing cycle slowly widens these cracks, eventually causing chunks of rock to split off. In the mountainous regions of New Zealand, such frost action is common, leading to the gradual breakdown of mountain ranges.

Moving onto biological weathering, this is where living things cause a reshaping of the Earth. One significant living thing that does this is plant life, especially tree roots. Consider the mighty rainforests of Queensland, Australia. Here, tree roots snake their way into tiny fractures in rocks. As the roots grow, they put pressure on the rock, gradually prying it apart. It's a subtle yet powerful force, with roots capable of splitting even large boulders over time.

Additionally, smaller organisms like lichens and mosses also contribute to biological weathering. These organisms can grow on rock surfaces in both Australian and Oceanic environments. As they grow and expand, they chemically react with the rock, helping to break it down and sometimes even absorbing minerals from the rock itself.

Weathering, whether mechanical or biological, might not be as quick and intense as other geological processes like volcanic eruptions or earthquakes. However, its quiet, persistent work is essential in sculpting the landscapes of Australia and Oceania. From the majestic, wind-sculpted deserts to the quietly expanding rainforest trees, these processes remind us of the slow but constant power of nature in shaping our world.

Science Notebooking

Watch the *Earth Science Links* and write some of the interesting facts you have learnt this lesson.

² Oceania is a region of the South Pacific Ocean, made up of four sub-regions: Australia and New Zealand, Melanesia, Micronesia, and Polynesia.

Lesson 3: Erosion Through Water

Erosion by moving water is like a story about how rivers, rain, and the sea can slowly wear away the ground and move things like dirt and rocks to new places. This is how some of the coolest landscapes in Australia and Oceania were made.

Think of a river flowing along. It's not just water in the river; there's also stuff like tiny bits of rock and dirt mixed in. When the river flows really fast, especially if it rains a lot or floods, it can pick up loads of these bits and carry them along. The river can even change its shape, making its banks and the bottom look different after a while.

In Australia, there's this place called the Twelve Apostles along the Victorian coast. These are big towers of rock standing in the sea. They were made by waves hitting the rock for thousands of years. The waves made caves in the cliffs that turned into arches and then, when the arches broke down, they left these big rock towers. Even though they're called the Twelve Apostles, there aren't twelve anymore, there are eight, because the waves are still breaking them down, showing just how powerful water can be.

Up in tropical Queensland, lots of rain can cause erosion too. When it rains really hard, the water doesn't just stay on the surface; it carries away a lot of soil. This can be a problem for places where crops are grown because they need the soil to stay in place.

Over in New Zealand's South Island, the water's erosion is really obvious too. The island has mountains called the Southern Alps and many fast rivers. These rivers, like the Clutha and Rakaia, take bits of the mountains with them, making valleys and fjords (which are like long, narrow sea inlets between high cliffs). The rivers keep changing the land, which can make things hard for people who farm or build things there. These rivers show just how much nature can change the landscape.

In Oceania, with islands like Fiji and Samoa, there's a different problem with erosion. The sea levels are rising, and big storms make the waves hit the land harder. This washes away beaches and sometimes even threatens people's homes. The rivers here, swollen with lots of rain, can change the land a lot too, affecting where people live and the nature around them.

Erosion by water in places like Australia and Oceania is always happening and always changing how the land looks. From the coastlines being shaped by the sea to river valleys getting deeper and wider, erosion shows us how nature can build new things but also break things down. It's important for us to understand how water shapes the land so we can look after our homes and the natural world around us.

Science Notebooking

Watch the *Earth Science Links* and write some of the interesting facts you have learnt this lesson.

Lesson 4: Monsoon Season

Monsoon season, a time of heavy rains and sometimes strong winds, plays a significant role in shaping landscapes in the Oceania and Asian Pacific regions. During these months, usually from May to September, the changes to the landscape can be both beautiful and destructive.

The monsoon season is driven by a shift in winds and air pressure, bringing moist winds from the oceans. In countries like India, Thailand, and the Philippines, these winds lead to torrential rains. This great amount of water can cause rivers to swell, lakes to expand, and floods to occur—dramatically affecting the landscape.

One of the most noticeable changes is erosion. When a lot of rain hits the ground, especially in hilly or mountainous areas, it can wash away the soil. This process, known as soil erosion, can change the shape of hillsides and riverbanks. For example, in the mountainous regions of Nepal and northern India, monsoon rains often cause landslides, where the soil and rock get so wet that they slide down the slopes, reshaping the landscape and sometimes blocking rivers to form new lakes.

In flatter, agricultural regions, such as the vast rice fields of Vietnam and Bangladesh, the monsoon rains are essential for crops. However, too much rain can flood fields and damage crops. The overflowing of rivers, particularly the mighty Ganges in India and Bangladesh, can lead to extensive flooding, affecting millions of people and altering the landscape. The deposited sediments (small particles like sand, mud or tiny rocks) from these floods, though, can also enrich the soil, making it more fertile for the next planting season.

The Oceania region, including islands like Fiji, Samoa, and Papua New Guinea, also experiences significant changes during the monsoon season³. Here, the heavy rains can lead to rapid growth of vegetation in some areas, while causing soil erosion and landslides in others. Small islands can be particularly exposed to erosion and flooding, which sometimes reshape the island's coastline and can even affect the coral reefs surrounding them. The increased runoff from the land can carry sediments and pollutants to the reefs, harming these delicate ecosystems.

Another fascinating aspect of the monsoon's impact is on river deltas, such as the Mekong Delta in Vietnam or the Irrawaddy Delta in Myanmar. These areas receive vast amounts of sediment carried by the rivers overflowing with monsoon rains. Over time, this process has created fertile, flat delta regions which are important for agriculture but can be reshaped during intense monsoon seasons.

Understanding the effects of the monsoon season in the Oceania and Asian Pacific regions helps us appreciate the power of nature and the resilience of the people who live there. It demonstrates the constant interaction between the Earth's natural systems and human communities, highlighting the importance of preparing for and adapting to these seasonal changes.

Science Notebooking

Watch the *Earth Science Links* and write some of the interesting facts you have learnt this lesson.

³ The South Pacific islands do not experience a traditional monsoon season like parts of Asia and Africa do. However, they do have a distinct wet season, which is somewhat like a monsoon. While this wet season shares some characteristics with a monsoon, such as increased rainfall, it doesn't involve the same large-scale wind shifts that define a true monsoon. Instead, the weather patterns are more influenced by local oceanic and atmospheric conditions.

Lesson 5: Wave Rock and Acid Rain

Weather and acid rain are two forces of nature that have a remarkable ability to shape and erode landscapes. To understand how they work, let's look at some specific examples, including the famous Wave Rock in Western Australia and two other places where these forces have left their mark.

First, let's talk about Wave Rock. Found in Western Australia, this massive, wave-shaped rock formation stands about 15 metres high and is around 110 metres long. It's a perfect example of how weather, especially chemical weathering, can shape the Earth. Over many thousands of years, rainwater has reacted with minerals in the rock, slowly dissolving and altering them. This chemical reaction, combined with the physical forces of wind and rain, has sculpted the rock into the shape of a breaking wave. The patterns and colours on Wave Rock are due to the minerals in the rainwater, which stain the rock as they flow down its surface.

Another example is the Grand Canyon in the United States. This immense canyon showcases the power of weather, specifically the erosion caused by the Colorado River and its tributaries. Over thousands of years, the river has cut deeply into the landscape, carving out a canyon that's over 1.6 kilometres deep in places. Rain and snowmelt add more water to the river, increasing its erosive power. Besides, the extreme temperature changes in the canyon cause physical weathering, breaking the rock apart and making it easier for the river to erode.

Acid rain, which is rain that has become acidic due to pollution in the air, also plays a role in weathering and erosion. The pollutants, often from factories, cars, and power plants, mix with water vapour in the atmosphere and fall as acid rain. This type of rain can be particularly damaging to buildings and statues made of limestone and marble. A clear example is seen in the statues and monuments across many European cities. Over time, acid rain has eroded intricate details from these stone structures, smoothing out sharp lines and wearing away faces and inscriptions. This happens because the acid in the rain reacts with the minerals in the stone, slowly dissolving them.

In the Black Forest of Germany, acid rain has had a great impact on both man-made and natural environments. The acidic precipitation, primarily from industrial regions of Europe, has damaged vast areas of forest. It's not just the trees that suffer; the soil can become too acidic for many plants to survive, changing entire ecosystems. The acid rain speeds up the natural weathering processes, breaking down rocks and soils more quickly than usual.

These examples – Wave Rock, the Grand Canyon, and the eroded European monuments and damaged forests of the Black Forest – show how weather and acid rain can shape and erode the Earth. While these processes can create stunning natural landscapes, they can also cause significant damage and change to both natural and human-made environments. Understanding these processes helps us appreciate the incredible power of nature and the importance of protecting our environment from pollution and other harms.

Science Notebooking

Watch the *Earth Science Links* and write some of the interesting facts you have learnt this lesson.

Lesson 6: Stockton Beach

Coastline erosion is a big problem for many coastal areas around the world, including places like Stockton Beach in New South Wales (NSW), Australia. The beach has been facing severe erosion issues, with the sea gradually eating away the land. To tackle this, various projects and methods have been employed, aiming to protect the beach and the nearby communities. Understanding these can give us a clear idea of how we can protect other coastlines facing similar issues.

One of the main ways to combat coastline erosion is through something called "beach nourishment." This involves taking sand from other areas and adding it to the eroding beach. At Stockton Beach, this method has been used to replace the sand that's been washed away by the waves and tides. By doing this, the beach becomes wider and higher, providing a buffer against the sea and helping to protect the land behind it. However, beach nourishment needs to be done repeatedly because the newly added sand can also get eroded over time.

Another method used is the construction of sea walls, rock revetments, and groynes. A sea wall is a solid barrier built along the coastline, designed to absorb and reflect the energy of the waves. While effective, sea walls can sometimes lead to increased erosion further down the coast and can be quite expensive to build and maintain. Rock revetments are similar but consist of large rocks placed along the beach to absorb wave energy and reduce erosion. Groynes, on the other hand, are structures built out into the sea from the coast. They trap sand moving along the coast due to the longshore drift (the process by which sand and sediment move along the coastline), helping to build up the beach.

At Stockton Beach, various structures like these have been used to try and slow down the erosion. They're particularly important because the erosion is not just a natural process but has been made worse by human activities. For example, the building of breakwaters at the nearby Newcastle Harbour has changed the natural flow of sand along the coast, contributing to the erosion problem at Stockton Beach.

There's also been an emphasis on monitoring and research. Scientists and engineers keep a close eye on how the beach is changing, using things like aerial photographs, drones, and underwater mapping. This helps them understand the erosion patterns and decide the best ways to tackle the problem.

Coastline protection projects like those at Stockton Beach are really important. Not only do they help to save the beach itself, but they also protect homes, businesses, and habitats for wildlife. It's a challenging task because the forces of nature are powerful and can be unpredictable. However, by combining different methods and continuously researching and monitoring, we can find effective ways to protect our precious coastlines.

Science Notebooking

Watch the *Earth Science Links* and write some of the interesting facts you have learnt this lesson.

Lesson 7: Mangrove Swamps

Mangrove swamps, vital coastal ecosystems found at the intersection of land and sea, are among the most productive and biologically complex ecosystems on Earth. They provide a natural buffer against coastal erosion, storm surges, and tsunamis. In Australia, Indigenous landcare groups have been actively involved in the conservation and restoration of these swamps, recognising their role in both environmental health and cultural heritage.

One specific example of such an initiative can be found in the work being done in Northern Australia's mangrove swamps where Indigenous communities have been working hard to protect and restore these areas. For instance, after seeing increasing erosion and degradation, partly due to weather and industrial impacts, these groups have been introducing traditional land management practices. They use controlled burns in surrounding areas to prevent wildfires that can severely damage the delicate balance of these ecosystems. Additionally, they plant new mangroves to replace those mangroves that have been lost due to erosion or other environmental pressures.

The roots of mangrove trees are essential in the fight against erosion. They help to stabilise the shoreline and reduce the impact of waves and storm surges, which can wash away soil and other materials. By binding the soil together, these roots help to maintain the structure and integrity of the coastline, protecting inland areas from saltwater coming in. This is especially crucial for the preservation of freshwater habitats and the species that rely on them.

The Indigenous landcare groups' work in more than just physical restoration. They also keep records on the health of the mangroves, noting changes in the environment that might warn them of emerging threats or the need for new conservation strategies. Additionally, these groups often collaborate with scientists and environmental organisations to blend traditional knowledge with scientific research, improving the effectiveness of their conservation efforts.

Education and community involvement are central to these projects. By involving young people and sharing knowledge about the importance of mangroves and traditional methods for their care, Indigenous landcare initiatives make sure these important skills and knowledge are passed on. This not only creates a connection with the land but also provides future generations with the tools they need to keep up the important work of protecting the environment.

These Indigenous-led efforts in mangrove swamp conservation represents the powerful impact of combining traditional knowledge with contemporary environmental science. By nurturing their connection to the land and applying both respect for its cultural significance and a commitment to practical conservation, these initiatives play a crucial role in fighting coastal erosion, preserving biodiversity, and maintaining the health of vital ecosystems like mangrove swamps.

Science Notebooking

Watch the *Earth Science Links* and write some of the interesting facts you have learnt this lesson.

Lesson 8: Man Made Erosion

Erosion is a natural thing that happens over a long time. But sometimes, people can speed it up with things they do, and this is called man-made erosion. It's interesting to see how our actions can affect the Earth, and not always in good ways.

One way man-made erosion happens is when too many trees are cut down. Trees are great because their roots hold the soil together like a big hug. Without them, when it rains, the water can wash the soil away. Also, if it's windy, the soil can just blow away because there's nothing to protect it. When all the top soil goes away, it's tough for plants to grow there again.

Another way people cause erosion is through farming. When farmers plough their fields, it can make the soil loose. So again, if there's a lot of rain or wind, that loose soil can easily get washed or blown away. And if farmers use lots of water for their crops, it can sometimes wash away the soil too, which isn't great for the farm or the nearby rivers and streams that can get all muddy.

In Australia, especially near the Great Barrier Reef, when farmers clear land to grow crops, they take away plants that normally protect the ground from washing away when it rains. This means the soil can easily get carried off into rivers and seas. Also, if farmers use too many chemicals like fertilisers, it can make the soil weaker and more likely to erode. This loose soil then washes into rivers and seas, making the water dirty, which can hurt sea life like the beautiful corals in the Great Barrier Reef.

Building roads, houses, and big buildings can also lead to man-made erosion. When these things are built, the land around them can get disturbed or uncovered. So, like before, when it rains or the wind is strong, this bare land can be eroded. The soil can end up in waterways and other places it shouldn't be, which can harm the environment.

In the United States, in a place called the Midwest, people have built big walls called dams across rivers to make lakes and get electricity. These dams change how the river flows. Above the dam, the water moves slowly, and lots of dirt can pile up, which sometimes leads to flooding. Below the dam, because there's less dirt and the water moves faster, it can wash away more of the riverbanks. Changing how the river flows can be tough on the plants and animals that used to live there.

Also, in places where people go for mining - which is when they dig up the earth to find metals and minerals - huge amounts of soil and rock are moved. This can lead to a big mess with lots of erosion, because the land is left bare and often very damaged. After mining, the landscape might look completely different, and it can take a long time for it to heal and for plants to grow back.

In Australia, there's a famous mining town called Mount Isa, located in Queensland. Mount Isa is known for being one of the largest mining areas in the world, especially for minerals like copper, lead, zinc, and silver. Mining is a big part of the town's history and economy, but it also brings some environmental challenges, like erosion.

Mining in Mount Isa, much like other mining operations, involves digging up huge amounts of earth and rock to get to the minerals buried deep underground. This digging can change the landscape a lot. For example, creating big open pits or heaps of waste rock can leave the land around the mining area bare and more likely to erode. When it rains, the water can easily wash away this loose soil and rock. This not only changes the shape of the land but can also carry soil and chemicals into nearby

waterways, affecting plants, animals, and even the quality of water people use. Plus, the dust from these mining areas can blow away, covering nearby areas and affecting air quality.

In Mount Isa, managing the waste from mining activities has been a concern. Over the years, people have noticed changes in the local environment because of the mining. The land where the mines are can get damaged, and it takes a long time to recover. The area around the mines can become more like a desert, with less plant life and more erosion.

That's why it's really important for mining companies to think about the environment and try to fix any damage they cause. They can do things like planting trees and grasses to help stabilise the soil and using better ways to manage waste and water. By doing these things, they can help reduce erosion and take care of the environment around places like Mount Isa, making sure the land stays healthy and good for all the living things that depend on it.

So, why should we care about all this erosion caused by humans? Well, when soil gets washed or blown away, it affects everything: plants can't grow properly, animals might lose their homes, and our beautiful natural landscapes can change. Plus, when all that soil ends up in rivers, lakes, and seas, it can pollute the water and harm the fish and other creatures living there.

What's good though, is that people are finding ways to slow down man-made erosion. This includes planting more trees, farming in ways that protect the soil, and taking care when building things or mining. By being careful with how we treat our environment, we can help keep our planet healthy and happy for everyone!

Science Notebooking

Watch the *Earth Science Links* and write some of the interesting facts you have learnt this lesson.

Week 9: Revision or Examination Questions

Choose one or two of these suggested questions and write the answer in your notebook:

1. What is the difference between weathering and erosion?
2. Give one example of how nature can cause erosion.