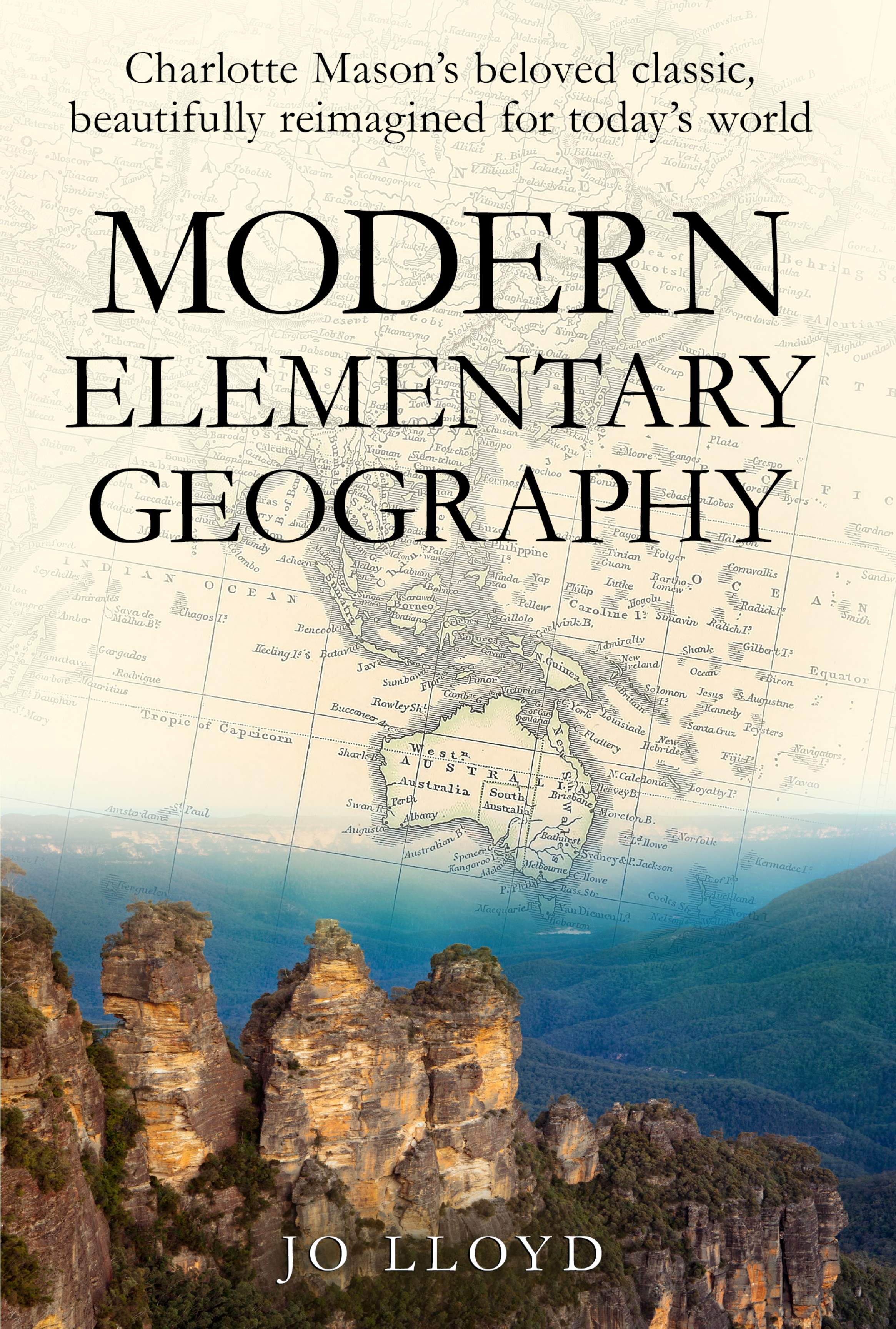
Charlotte Mason's beloved classic, beautifully reimagined for today's world

MODERN ELEMENTARY GEOGRAPHY



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Modern Elementary Geography

by

Jo Lloyd

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Introduction

It was almost 150 years ago that English educator Charlotte Mason wrote *Elementary Geography.* The first book in a series of geography titles for use in school rooms and homeschools across England and the British Empire, the focus of this book was physical geography. It served to teach readers about topics such as the form and motion of the Earth, directions, and the meaning, purpose, and use of maps. Grounded in fundamental geographical concepts, part of its value was that it taught children about place, encouraging them to look around their own local neighbourhood through a geographer's lens.

With the sustained interest in her philosophy and method of education, while first printed in the 1880's, this book continues to be popular today. However, even with the revised edition published in 1925, there are many aspects of contemporary geography, discoveries, and research that is simply not reflected in Charlotte's original text. While some components of her book are still applicable today, there is so much more that can, and should, be included in a modern course of geography.

A lot has changed since *Elementary Geography* was first published. At that time only 39 states were officially admitted to the union of the United States and large parts of the interior of Africa were unknown. The Greenwich Meridian had just been selected for 0° longitude and the National Geographic Society was newly founded. The world map of Charlotte's time was dominated by empires, not smaller independent nations, and World War I and II were yet to shape the world, let alone other significant events of the 20th and 21st Centuries.

There have been significant developments in science and technology, including changes and innovations that have altered the way geography is understood and taught. During Charlotte's era the approach was to describe places and people. Today we seek to analyse and understand these spatial processes and patterns, using some powerful insights from extensive data. Charlotte's original text cannot account for our expanding view of the universe, man landing on the moon, space technology and the advent of Global Positioning Systems, or the evolution of digital maps.

Charlotte Mason was interested in new research and encouraged fresh approaches to knowledge and teaching, qualities I also embrace. With many years of experience in homeschooling and a degree in geography, I am pleased to support students and parents in learning about geography. This book stays true to Charlotte's original vision of engaging learners but highlights contemporary knowledge and advances in physical and social geography.

While bringing Charlotte's work into the modern era, the original framework of her 41 chapters has been retained, allowing readers to exchange the old for new with ease. Likewise, I've kept Charlotte's approach of including poetry within the lessons. However, these are now folded into the lessons and the poems reflect the diversity of people worldwide, showcasing a range of voices and perspectives.

The hallmarks of Charlotte's approach to progressive assessment and map work have been preserved in this book. The original format of questions for students makes it easy to check on their progress and all the answers are provided too. Given geography is learned chiefly from maps, map questions are given. This includes modern approaches to mapping, such as online map options, satellite imagery, and bathymetry.

Those embracing the Charlotte Mason method can expect the same engaging approach with written text that draws the reader in and is suitable for narrations. This isn't a dry textbook. It has a literary quality to teach children foundational geography. As a home educator, I know how important it is to harness the attention of little ones. I know how we long to make these lessons and topics come alive in our children's hearts and minds. We want the goodness and beauty that comes from a Charlotte Mason education, but need the truth evident from modern research.

I hope you find joy in exploring the countless wonders of our world. It is my delight to offer this book and share my wisdom and knowledge so you can teach this subject with confidence and flair. May this be just the beginning of a lifelong journey of reading, learning, discovering, and experiencing the people and places of the world around us.

A Warm Welcome to the Children

As you open this book, you may wonder what geography is all about.

Geographers study places and people. It is a subject perfect for people who are naturally curious. It is for anyone who ever looked down a road or river and wondered where it goes. Geography is for those people who sit on the train or bus watching houses and shops pass by and ponder who lives in those houses and what they buy from those shops. This is a subject that helps us understand our world.

So, to study geography is to be an explorer of the world, and geography is a subject that we all live every day.

Modern Elementary Geography showcases a range of places in our beautiful world. Some places you may have seen with your own eyes. They may be a part of where you live. For example, you might live within a mountainous area and when you read the chapters about hills, mountains, and valleys you can look out your window and see these in the landscape around you. Others you may not have seen just yet; so, you might read about fjords and glaciers, imagining what they look like, and want to explore them in the future.

I enjoy learning about our world and exploring it. I have studied geography extensively and have learned from some enthusiastic teachers. I've read many books, articles, research papers, pored over maps and statistical data, and trekked through landscapes doing fieldwork to explore and understand our world. I understand that reading good books about this topic is exciting and I am thrilled to share this book with you. Perhaps it will capture your imagination and help you to see the world around you in new ways.

This book is a starting point for studying geography. It will help you understand parts of our world including oceans, continents, landscapes, and the places people live. My hope is that this book will be just one of many geography books you enjoy in your life as you become an intrepid explorer.

The grandeur of the stars (left)

CHAPTER 1

Our Solar System

To begin a study of geography it is useful to consider our place in the universe. When we ponder the wonders of our world we can sometimes forget that our planet is just one of many. A good way to remember just how big our universe is, is simply to look up. Have you ever looked up at the stars and just gazed at the night sky? If you live in the city it can be hard to notice many stars; but stand outside in a nature reserve, national park, or out on a farm, where there is little artificial light, you can look up at night and see a whole sky full of stars. There are so many stars in our universe it is impossible to count them all and many children are taught the popular nursery rhyme about stars in the sky:

Twinkle, twinkle, little star; how I wonder what you are!

Enjoying the night sky, a stargazer will notice that some lights do seem to be bigger and brighter than the rest; they don't seem to twinkle like other stars do, or how it is described in the song. Rather, their light stays constant. This is because they are not twinkling stars at all. They are distant planets of our solar system. While stars generate their own light, making them twinkle, planets do not produce light. Instead, they reflect the light from the sun. This is why they look different to the stars when you gaze up at them at night.

In our solar system there are eight planets. These are Mercury, Venus, Earth, Mars, Jupiter, Saturn, Uranus, and Neptune. Mercury is the planet closest to the sun while Neptune is the furthest away. We live on planet Earth. It is the third planet from the sun. Venus is the second planet from the sun, sitting between Earth and Mercury. Moving away from the sun, the fourth planet is Mars. The first four planets – Mercury, Venus, Earth, and Mars – are all terrestrial planets. They are all relatively small and solid, with rocky surfaces.

Each of the eight planets in our solar system orbit around the sun, as do asteroids and comets. Some planets orbit the sun much quicker than others given the distance they need to travel. It takes Earth 365 ¼ days – one year – to make a trip around the sun. The shape the planets travel in is called an ellipse, which is like a flattened circle or oval shape. To complete the orbit within this time, Earth travels at nearly 30 kilometres (18.5 miles) per second. In comparison, it only takes Mercury 88 days to orbit the sun. It has a shorter path because it is so close to the sun and the sun's gravity pulls on it, making it move faster. However, Neptune is the planet furthest away from the sun and so takes a lot longer to make its orbit: 164.8 years!

Beyond the four inner terrestrial planets lies the main asteroid belt. This is a part of our solar system where asteroids revolve around the sun. There are millions of asteroids, ranging in size from small to over 1 kilometre (0.6 miles) in length. Scientists monitor the movement of asteroids, using telescopes and radar to watch for any coming close to Earth's orbit and presenting possible danger. Past the main asteroid belt are the four other planets of our solar system: Jupiter, Saturn, Uranus, and Neptune. Jupiter and Saturn are giant ice planets, while Uranus and Neptune are gas giants.

No matter how far away, what the planet is made of, or how quickly it moves, all the planets are centred around the sun. It is the heart of our solar system. The sun is a massive star and the only one in our solar system. The sun is so big that one million planets the size of Earth could fit inside it. Gravity from the sun keeps all the planets, asteroids, and even the smallest piece of space debris, in its orbit. Energy from the sun is what enables us to have life as we know it here on Earth. The connection between the sun and Earth is what creates our seasons, ocean currents, weather, climate, and the beautiful, coloured lights in the night sky, auroras. Yet, while it is the centre of our solar system, it is only one of billions of such massive stars that are dispersed across the Milky Way galaxy.

We see the sun in our sky during the day and enjoy the light and heat it provides. The way the Earth orbits around it defines our years, and the rotation of the Earth is what creates day and night. To visualise this, it can be useful to think about Earth as having a "day side" and a "night side". This is because, while our sun is massive, it still only illuminates half of our Earth at any time: the "day side". The "night side" is in the dark, away from the light of the sun. Likely, it is daytime while you are reading this. This means you are in the "day side" of Earth that is facing towards the light of the sun. You experience the sunlight and enjoy the daytime. However, the other side – the "night side" – is facing away from it, making it dark there. This means it is night-time and people are sleeping and resting. When the Earth rotates to face the sun their day will begin and yours will turn to night.

Along with the sun, the other main light in our skies is the moon. Unlike the sun, the moon can be seen both at night and during the day. Most planets have a moon and some asteroids even have moons. Saturn and Jupiter have many moons, with Saturn having 146! Here on Earth, we have only one moon. That one moon orbits our planet, just as the Earth orbits around the sun. Like planets, the moon doesn't generate its own light. The light the moon gives is light reflected from the sun. It is reflected off the surface of the moon, creating the moonlight we see. Over the course of a month, you will notice that the shape of the moon changes. Depending on what phase of its orbit the moon is in, you may see the whole moon, called "the full moon", and it might be quite bright in the sky, reflecting the light from the sun from its full surface. Other times you may just see part of our moon, or barely be able to see much of it at all. At times it is like a small crescent hanging in the sky.

Just as Earth has a "day side" and "night side", the moon has a "near side" and a "far side". Both sides experience day and night, but the far side is always looking away from Earth. From Earth we always see the near side of the moon, no matter where you live in the world. Whether you are in Australia or North America, everyone sees the same side of the moon: the near side. While we cannot see the far side of the moon from Earth, it still experiences night and day depending on whether the sun is shining on it or not.

You may have heard someone refer to a "dark side" of the moon and wonder how this relates to having "near" and "far" sides. The idea of having a dark side comes from the fact that the moon doesn't generate its own light but also from a time when space communications equipment wouldn't work beyond a certain point. It was called the "dark side" because communications would be lost, leaving spacecraft in the dark. There isn't really a dark side of the moon as such, but years ago people associated it with the far side. Because we cannot see it from Earth it was shrouded in mystery and darkness.

Many scientists devote their skills to helping us understand more about the moon, planets, stars, and other aspects of our solar system. There is much to learn and space science is a really exciting area. But it isn't just scientists that are captivated by what we can see in our skies. Artists have created beautiful paintings celebrating the beauty and wonder of our vast solar system. Explorers would navigate their journeys using the night sky, following the alignment of planets and stars to plot and track their journey, and the Bible tells how a bright star appeared in the sky to herald the birth of Jesus Christ. Poets and lyricists capture the wonder of the night sky or the glory of the bright sun. Some even give clues about spotting the planets among the stars, such as in the beginning two stanzas of this poem by Henry Wadsworth Longfellow:

The Light of Stars

The night is come, but not too soon;
And sinking silently,
All silently, the little moon
Drops down behind the sky.

There is no light in earth or heaven
But the cold light of stars;
And the first watch of night is given
To the red planet Mars.

by Henry Wadsworth Longfellow

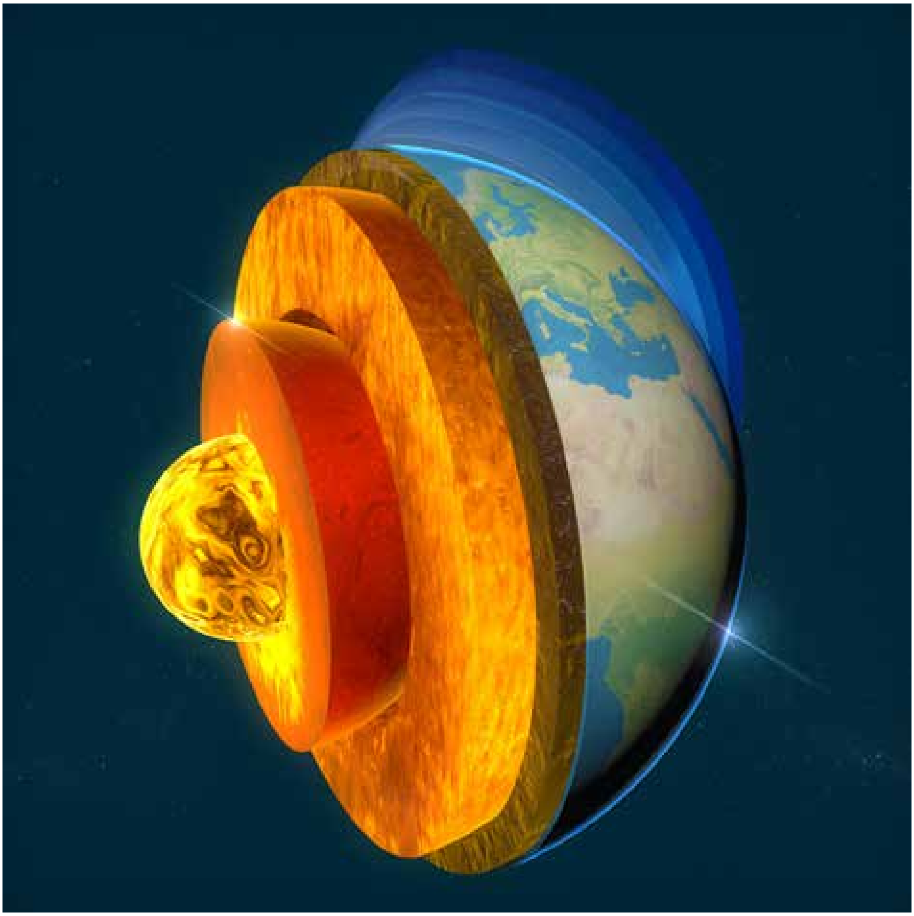
CHAPTER 2

Planet Earth

Earth is the fifth largest planet in our solar system and the only planet where there is life and liquid water. Earth has incredible biodiversity, one key feature that distinguishes it from other planets. It has teeming coral reefs swimming with fish, vast grasslands, and rainforests vibrant with many different plants and animals. Space scientists are yet to find another planet that has the array of species of life that Earth holds. Being one of four terrestrial planets, Earth is made up of rocks and metals. These form five major layers, three of which are solid, one is liquid, and one is quite mysterious.

Our Earth is dynamic, which can be hard to capture in diagrams. Cross-sections usually show four rather distinct layers of our planet, but this suggests they are quite separate and doesn't show all the layers. The depths of each layer aren't as strict and uniform as the simple lines of a picture can show. Just as space scientists research aspects of astronomy and planets, geologists are the scientists who study our planet Earth. Geologists examine the history of our physical planet and the materials that make up our world, like rocks and minerals. They make new discoveries about how our planet works. The work of space scientists and geologists inform geographers. Geography looks at where things are on Earth, why they are there, and how they are changing over time. This means that geographers need to understand the geology of our physical planet.

Back in 1864 novelist Jules Verne imagined the centre of the Earth as holding a sprawling subterranean sea, giant crystals, and even a lost cavern of dinosaurs. However, the truth is quite different to his book, *Journey to the Center of the Earth*. Rather than being a place where dinosaurs roam, it is almost like a different planet within our own. The inner



The layers of the earth

core of planet Earth is solid iron and nickel and nearly 2,500 kilometres (1,500 miles) thick. It is also extraordinarily hot. It is a scorching ball which is almost as big as Earth's moon, yet, still today we know more about other planets in our solar system than we do about this part of the Earth. While many older books show the inner core as just one layer, scientists now believe it is made up of two. In the innermost depths of the inner core a smaller core exists, much like a tiny pip can be found inside an apple core. While somewhat elusive, making it difficult to map, scientists using supercomputers have pieced together elements of data to get a picture of this innermost core.

The second layer, called the outer core, surrounds the inner core with iron, nickel, and sulphur. Like the inner core, this has exceedingly high temperatures. However, different to the inner core – which stays as a solid, dense iron ball due to the intense pressure – this is a fiery liquid layer. Given we are so used to seeing rocks as thick, solid parts of our world, it can be hard to think of rocks so hot that they are molten. However, for the rocks in this layer of our planet, the heat and pressure are just so intense that the rocks cannot stay in their solid state. This outer core is around 2,300 kilometres (1,400 miles) thick. By way of comparison, this is about the same distance between Perth and Adelaide in Australia, New York City and Houston, Texas in America, and a little further than travelling between Beijing and Guangzhou in China. It is this outer core that creates Earth's magnetic field. The magnetic field is vital for life. Its strength helps to maintain water in liquid form, making our planet habitable. Without it, plants, animals, and humans would not survive on Earth.

The third layer of our planet is called the mantle. This layer is around 2,900 kilometres (1,800 miles) thick and is the largest of the four layers. Being so thick, it varies in temperature. Some parts can be very hot, around 3,700°C (6692°F), while others are around 700°C (1300°F). Overall, compared with the blazing inner layers of the planet, this one is relatively cooler. This is a large part of the planet, with the Earth's mantle making up 84% of the Earth's total volume. It is made up mostly of dense rock. Iron, potassium, sodium, calcium, and aluminium are just some of the elements found in the mantle. The materials and heat within the mantle help shape the landscapes we see on Earth.

The uppermost part of the mantle is called the lithosphere. This is a solid part of the planet and is a part of the outer two layers. Spanning the top 100 kilometres (62 miles) of Earth, the lithosphere is in the upper part of the mantle and within the fifth and final layer, the crust. This is where the tectonic plates lie. The countries of the Earth lie on these massive, rigid slabs of rock, called tectonic plates, and these move within the mantle. When you read about earthquakes, volcanic eruptions, and the formation of mountains you are learning about geological activity caused by tectonic plates moving and interacting in the lithosphere.

It is the fifth, and final, layer of Earth that is the thinnest. Called the crust, just like the crust on a loaf of baked bread, it is the outermost layer of the planet. The crust represents just 1% of the total volume of our planet but sustains the diversity of life that we see in the world around us. The crust is only about 5 kilometres (3 miles) thick under parts of the ocean and around 70 kilometres (43 miles) under the continents. The distance from the crust to the centre of the Earth is 6,000 kilometres (miles), through solid and molten rock.

Scientists divide Earth's crust into two types:

the continental crust, which forms the continents; and

the oceanic crust, which makes up the ocean floors.

Both are shaped by plate tectonics and are composed of different rocks and minerals. Of the two, the continental crust is thicker, extending from 30 to 70 kilometres thick (19-44 miles), deep into the mantle. The oceanic crust is thinner but can reach great depths, this dark volcanic rock plunging into deep, cold ocean trenches. However, this part of our planet isn't just rock and scientists are making new discoveries about life hundreds of metres within the crust.

The thin and light layer of Earth's crust is a crucial zone. It is here that coal and clay, diamonds and dirt, and other precious resources and valuable minerals are found. Powerful geological forces continually shape this part of our planet. It is in the crust that features like the Mariana Trench and Mount Everest were created. The Earth's crust is where mining activities take place. Its rich resources are extracted for human use. For instance, South Africa's gold mines, some of the deepest in the world, go as far as 4 kilometres (2.4 miles) tapping into the lucrative shallow parts of the crust. However, there is a hole in Russia that is believed to be the deepest anyone has ever drilled. Thought to be welded shut now, it was constructed during the Cold War when scientists thought they would take a "shortcut" to the mantle by drilling into the ocean floor, because this is where the crust is thinnest. Here the crust is only about 6 kilometres deep (nearly 4 miles) and this tunnel leads halfway to the boundary of the mantle, over 12 kilometres (7 miles) underground.

From the Earth's thin crust to its scorching core, understanding the structure of our unique planet and its position in the solar system is vital for beginning a study of geography. While it is fanciful to think of journeying to the centre of the Earth, the reality is that scientists use computers and data to gain a better understanding of what is actually within the Earth's core. This is work that is important to geography because geography is all about place. Knowing where our planet's place in space, along with its composition, provides the foundation for physical geography. The work of geologists, astronomers, and other scientists plays a key role in shaping the research conducted by geographers. Geographers explore the physical aspects of our world to try to solve problems affecting both people and places which means they must first understand the structure of our physical world.

Earth, the blue marble

Questions on Chapters 1 and 2

For answers see page 199

1. Which planet is closest to the sun?
2. Which planet is furthest from the sun?
3. How many planets are there in our solar system?
4. Why do planets shine rather than twinkling like stars?
5. What is the name of the path that planets take around the sun?
6. How many days does it take Earth to orbit the sun?
7. What are the five layers of the Earth called?
8. Is the inner core solid or liquid?
9. What is the study of rocks and the form of our Earth called?

An open coal mine

CHAPTER 3

Earth's Atmosphere — Part 1

Inscription for a Garden Wall

Winds blow the open grassy places bleak;
But where this old wall burns a sunny cheek,
Then eddy over it too toppling weak
To blow the earth or anything self-clear;
Moisture and color and odor thicken here.
The hours of daylight gather atmosphere.
By Robert Frost

Surrounding Earth are layers of gases which act like a protective blanket for the planet. Just as you might snuggle under a blanket on a cool night to keep warm, this layer of gases provides a covering over our planet. The curtain of gases that wrap around Earth are called the atmosphere. Gases are substances which have no fixed shape or volume. They aren't like water that freezes solid into ice, or liquid you see when you pour milk or juice into a glass. Instead, gases will expand to fill any available space and, in most cases, are invisible.

To understand gases better, it is useful to imagine an inflated balloon. The gas inside fills the balloon, expanding to fit the available space inside. Once inflated, the balloon is no longer small and limp. It is full and firm due to the gas inside. Just as air or helium fill a balloon, the gases in our atmosphere spread and expand to fill the space around the world. These gases are our atmosphere and while invisible, they form a crucial layer that blankets our planet.

All the planets in our solar system have an atmosphere. Some planets and moons have atmospheres that are quite different to Earth's. This is part of what makes each planet unique. For example, Mercury has a particularly thin and wispy atmosphere, while Venus and Jupiter are covered by ample thick blankets of atmosphere. Nearly all of Earth's atmosphere is oxygen and nitrogen. This is life-giving and demonstrates the strong link between life on a planet and the type of atmosphere it has. There is also water vapor, dust, and a small amount of trace gases in Earth's atmosphere.

Our atmosphere gives us the oxygen we need to live and protects us from harmful radiation from ultraviolet rays. Like a blanket, the atmosphere regulates the temperatures necessary for life on Earth. This insulates the planet, keeping it warm and helps to prevent extreme temperature fluctuations between day and night. Earth is the only planet to have liquid water and the atmosphere plays an important role in this. The way the atmosphere envelopes around Earth creates pressure and without this we wouldn't have water, an essential for all life.

Our atmosphere also plays a crucial role in generating the weather. As the atmosphere insulates the whole planet, it traps heat. Our weather patterns are created as this heat and water moves around the Earth. The sun's heat on gases within the atmosphere causes the air to move around the planet as it becomes warmer or colder. Warm air is less dense and contains more energy than cold air, so it rises. As the air moves, it creates shifts in the atmosphere. These shifts are what lead to different weather systems moving around the planet. They may bring warm, sunny days, or rain and inclement weather. Understanding the atmosphere is key to predicting weather because the interaction between elements within our atmosphere, such as temperature, humidity, air pressure, and wind, create our weather.

The wind that moves around the land is also created by our atmosphere. Wind is the movement of air due to different air pressures within the atmosphere that shift across the surface of the Earth. Two terms are commonly used to describe these shifts: high-pressure and low-pressure systems. These terms describe where the weather system is in the atmosphere, with a high-pressure system describing a weather system higher up in the atmosphere and a low-pressure system being closer to land. Each system is characterised by dominant weather conditions.

High-pressure systems generally bring clear skies and cooler temperatures because air is moving from a higher pressure point in the atmosphere to a lower one. The air descends and spreads outwards. On the other hand, low-pressure systems have lower atmospheric pressure compared to the air surrounding them, so the air is rising. This can often bring unsettled and warmer weather. As the air from high-pressure areas moves into areas of low-pressure, winds develop. A gentle breeze will dance and sway if there is little difference between the two systems. There will be massive gusts if there is a large difference, created as the air moves quickly between the two.

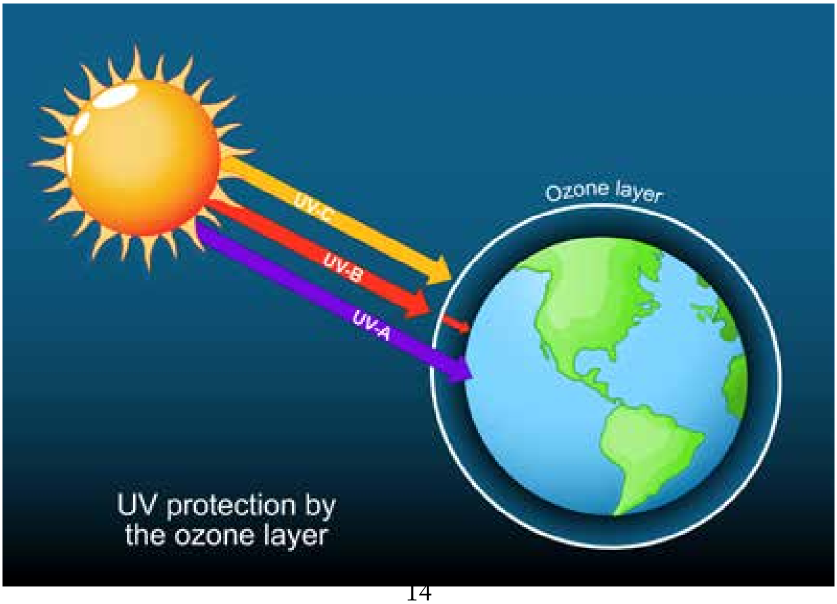
While it plays a critical role in establishing what life is like on Earth and creating our weather patterns, the atmosphere is only a very thin layer. This thin layer is incredibly significant though. Just as the inside of the Earth is layered, there are different layers in the atmosphere. The nitrogen, oxygen, and smaller trace gases of our atmosphere, such as argon, carbon dioxide, helium, and neon, are found in the following layers:

troposphere
stratosphere
mesosphere
ionosphere
thermosphere
exosphere.

The troposphere is the thickest and lowest part of Earth's atmosphere. It extends from the ground up, continuing for around 12 kilometres (7 miles). Nearly all of our weather is formed in this part of the atmosphere, being the layer where water vapor is found. Compared to other layers of the atmosphere, the troposphere is more humid given this water vapour. However, moving vertically up through the troposphere, the air becomes thinner. This is why climbers ascending Mount Everest rely on oxygen tanks. As they gain altitude there is less oxygen in the air. As it thins, the temperature drops. Higher up in the troposphere it is colder and there is less pressure and less oxygen. Most commercial airplanes fly within the troposphere and so need to be able to withstand the cold temperatures of this altitude and the turbulent conditions that moving air pressure systems can create. In the upper boundary of the troposphere there are jet-streams. These are fast moving winds in the thinner, upper layer and commercial aircraft climb to higher altitudes to use these jet-streams. This allows them to move through the air quicker and save fuel by travelling along these streams of rapidly moving air.

Beyond the troposphere is the stratosphere. With little water vapour, this layer of the atmosphere is very dry, so clouds are rare. If they do form, they are very wispy and thin. The stratosphere extends to about 50 kilometres (31 miles) above Earth's surface and this layer is crucial to all life on Earth. This is because the ozone layer is part of the stratosphere. Like the oxygen and nitrogen, ozone is a gas. Forming a layer in the stratosphere, ozone absorbs harmful ultraviolet (UV) radiation from the sun that would otherwise reach the Earth's surface. Absorbing these most dangerous types of UV radiation, the ozone layer acts like Earth's sunscreen and makes life possible.

Today scientists are concerned about the effects of ozone depletion in this part of the atmosphere. Ozone concentrations happen naturally within our atmosphere and the ozone layer is uneven, being thinner near the north and south poles. However, it has become evident that the ozone shield is depleting and an annual ozone "hole" over Antarctica has been present each spring for many decades. Scientists from various research institutes and universities continue to monitor this. The ozone layer serves as a protective shield for both humans and ecosystems and helps to regulate the climate, safeguarding life on Earth as we know it, so this is important work.



CHAPTER 4

Earth's Atmosphere — Part 2

The atmosphere is divided into layers that vary in temperature. The troposphere is the lowest part and the part of the atmosphere that we live in. Most of our weather is contained here, as is around three-quarters of our air and almost all of our rain. The boundary layer is the lowest part of the troposphere and where the winds blow. The next layer is the stratosphere, which is a lot hotter because of the absorption of ultraviolet radiation from the sun. The ozone layer in the stratosphere serves to protect us from harmful radiation and is important for the health of our whole planet. Beyond these two layers are four more, including the place where some of the coldest temperatures of our Earth have been recorded.

The region above the stratosphere is the mesosphere. It is within the mesosphere that shooting stars are found. Known as meteors, these are debris of rock that enter Earth's atmosphere from outer space. When you watch the night sky you can sometimes see what are commonly called "shooting stars". They are recognisable from their fire tail which burns as they briefly race through the atmosphere. Compared with other atmospheric layers, less is know about the mesosphere. This is because this layer of the atmosphere is too high to use weather balloons or aircraft for research, but too low for spacecraft.

The ionosphere is above this layer, sitting within the bottom of the thermosphere. Notice how the word "ion" is included in its name and this gives a clue. Ions are atoms with an electric charge and the ionosphere is charged with ions. This layer of the atmosphere conducts electricity and reflects radio waves. The energy from solar radiation helps us to listen to our favourite radio stations and also causes the spectacular auroras in the skies of the northern and southern hemispheres. The ionosphere is a vital layer for both light and sound.