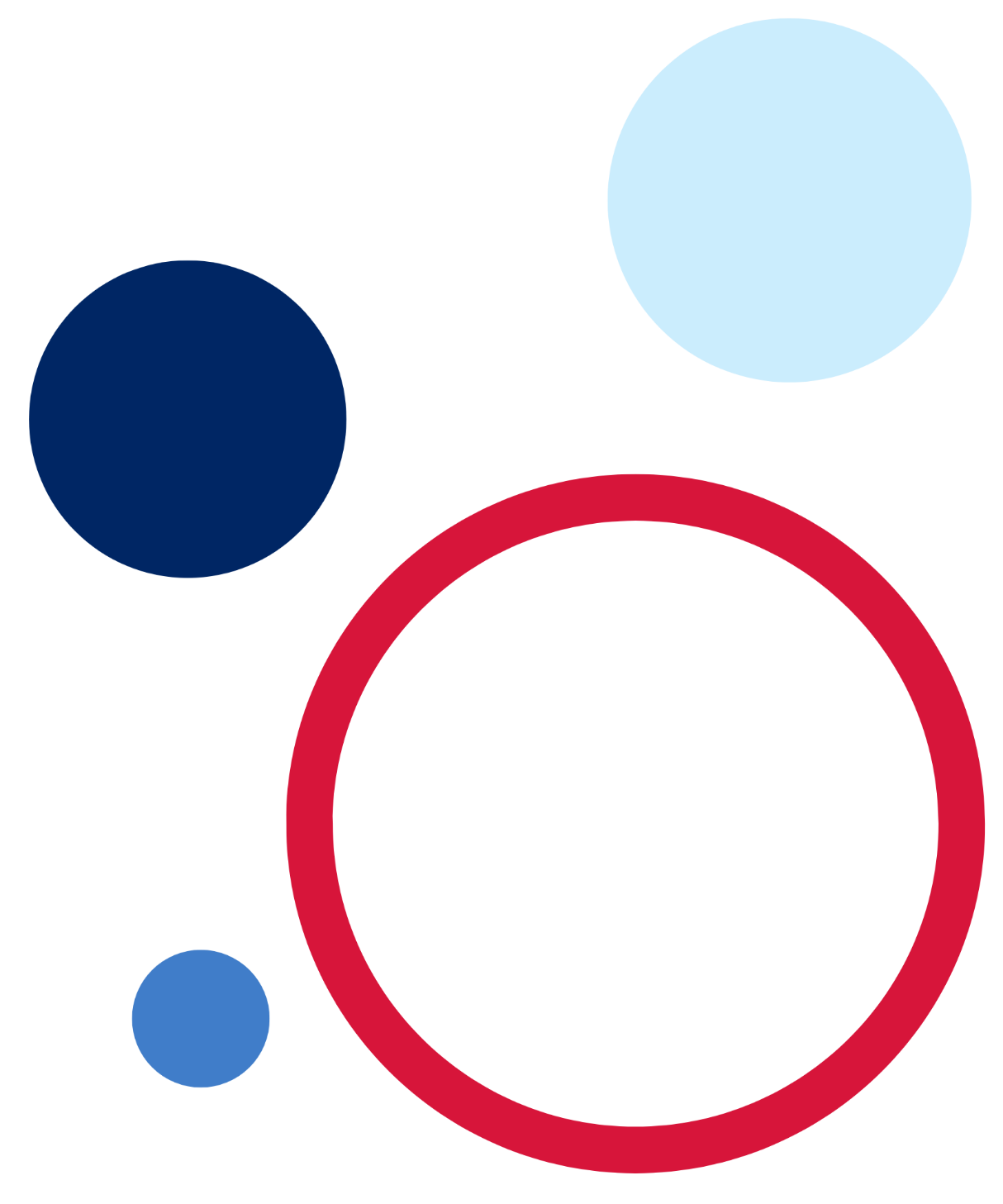
# Geography 11–12 – Earth’s natural systems learning sequence



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This resource has been developed to assist teachers in NSW Department of Education schools to create learning that is contextualised to their classroom. It can be used as a basis for the teacher’s own program, assessment, or scope and sequence or be used as an example of how the new curriculum could be implemented. The resource has suggested timeframes that may need to be adjusted by the teacher to meet the needs of their students.

## Content focus

**Students** investigate **the diverse landscapes of the Earth’s surface and its distinctive physical features to inspire curiosity and wonder. They examine the cycles, circulations, interconnections and spatial patterns that combine to form the Earth’s integrated systems, and investigate natural processes, cycles and circulations that change the Earth’s land and water cover. It is a study of the Earth’s interdependent systems, the complexities and connectedness of different components.**

**Duration:** this sequence of learning is designed to be completed in 40 indicative hours.

## Outcomes

* **GE-11-01** examines places, environments and natural and human phenomena, for their characteristics, spatial patterns, interactions and changes over time
* **GE-11-02** explains geographical processes and influences, at a range of scales, that form and transform places and environments
* **GE-11-05** analyses and synthesises relevant geographical information from a variety of sources
* **GE-11-06** identifies geographical methods used in geographical inquiry and their relevance in the contemporary world
* **GE-11-07** applies geographical inquiry skills and tools, including spatial technologies, fieldwork, and ethical practices, to investigate places and environments
* **GE-11-08** applies mathematical ideas and techniques to analyse geographical data
* **GE-11-09** communicates and applies geographical understanding, using geographical knowledge, concepts, terms and tools, in appropriate forms

Related Life Skills outcomes: **GE-LS-01, GE-LS-02, GE-LS-03, GE-LS-04, GE-LS-05, GE-LS-08, GE-LS-10, GE-LS-11, GE-LS-12**

[Geography 11–12 Syllabus](https://curriculum.nsw.edu.au/syllabuses/geography-11-12-2022) © NSW Education Standards Authority (NESA) for and on behalf of the Crown in right of the State of New South Wales, 2022.

## Learning sequence 1: Overview of the uniqueness and diversity of Earth

**Teacher note:** examples included in the syllabus are provided to support delivery of course content. These examples are not mandatory and teachers may choose to use the examples provided or select appropriate alternatives.

This focus area includes an overview of the uniqueness and diversity of the Earth. It is intended to provide a broad perspective as a context for studying the focus area.

Allocate a maximum of **4 hours** to this part of the focus area.

### Syllabus content

* Nature as a source of wonder

**Example(s)**:

* Inspirational landscapes.
* Biodiversity hotspots.
* Great wildlife migrations across air, land and sea.
* People’s connection to the natural world and why it can vary

**Example(s)**:

* Proximity to nature.
* Worldview.
* Aboriginal Peoples’ connection to Country.
* The ‘overview effect’.
* The universal value of Earth’s environments

**Example(s)**:

* Intrinsic value.
* The global commons.

#### Learning intentions and success criteria

**Teacher note:** these learning intentions and success criteria are general and should be contextualised to suit your school and students’ needs.

**Learning intentions**

Students:

* develop an understanding of the concepts of inspirational landscapes, biodiversity hotspots and great wildlife migrations
* explore the changing connections between people and nature, including the concepts of intrinsic value and global commons, and discuss the roles and responsibilities humans have in protecting the environment.

**Success criteria**

Students can:

* identify and describe key features of inspirational landscapes and explain why they are considered inspirational
* construct a well-reasoned paragraph on the importance of managing and protecting biodiversity hotspots, incorporating relevant facts and data
* engage in class discussions on the changing connections between people and nature, the intrinsic value of the environment and the role of humans as stewards of the Earth
* collaboratively create a mind map summarising the key characteristics, types, challenges and importance of global commons.

### Overview of the uniqueness and diversity of the Earth

**Teacher note**: the overview of the uniqueness and diversity of the Earth should cover a **maximum** of **4 hours** of teaching time. This section is intended to provide students with a broad overview of the focus area.

Access [UNESCO World Heritage Sites](https://whc.unesco.org/en/list/?&type=natural) and select an inspirational landscape image. Identify the key features of the landscape that make it inspirational.

Compile a list of features identified in the inspirational landscapes.

Construct a one paragraph response to the question, ‘Why is it important to manage and protect biodiversity hotspots?’

Access [Biodiversity hotspots](https://www.conservation.org/priorities/biodiversity-hotspots) and [Biodiversity hotspots defined](https://www.cepf.net/our-work/biodiversity-hotspots/hotspots-defined) to identify facts and data to support your response. Share completed work with another student for [peer feedback](https://app.education.nsw.gov.au/digital-learning-selector/LearningActivity/Card/549) on:

* clear and logical response
* arguments presented
* examples provided to support the argument.

Conduct a [jigsaw activity](https://app.education.nsw.gov.au/digital-learning-selector/LearningActivity/Card/546) with the class and assign students to ‘home groups’ to research assigned animals. Complete a jigsaw activity to become an ‘expert’ and teach peers about an assigned animal. The following resources can be used as a starting point for research:

* [Great Animal Migrations: Where and When to Witness Them](https://www.toursbylocals.com/blog/great-animal-migrations)
* [Nature’s Most Impressive Animal Migrations](https://education.nationalgeographic.org/resource/natures-most-impressive-animal-migrations)
* [Data from space unveils global view of animals on the move](https://www.mpg.de/18465516/data-from-space-unveils-a-global-view-of-animals-on-the-move)
* [Sea Turtle Migration](https://www.seeturtles.org/sea-turtle-migration)
* [12,000 Miles to Go: Migrating with Shearwaters](https://ocean.si.edu/ocean-life/seabirds/12000-miles-go-migrating-shearwaters)
* [Yellowstone Bison](https://www.nps.gov/yell/learn/nature/bison.htm#:~:text=Bison%20migrate%20up%20to%2070,in%20the%20Greater%20Yellowstone%20Ecosystem.).

In the final stage of the jigsaw activity, complete the following table.

Table 1 – wildlife migration

|  |  |
| --- | --- |
| Task | Assigned animal information |
| Description of where the animal migrates |  |
| How far the animal migrates and over what period |  |
| Purpose of migration |  |
| What geopolitical regions the animal migrates through |  |
| Climatic regions or biomes the animal migrates through |  |
| Potential impact of humans on the migratory pattern |  |

Participate in a [peer discussion](https://app.education.nsw.gov.au/digital-learning-selector/LearningActivity/Card/547) to discuss the statement, ‘Migratory animals are potentially effective indicators of environmental changes that affect us all.’

Complete a class discussion about the changing connections between people and nature. Use the following statements to stimulate the discussion:

* We have reduced proximity to nature (urbanisation and town planning).
* We have changes in types of leisure (indoor and virtual recreation options).
* We have changes in transport and work.

Access [The Land Owns Us (6:14)](https://youtu.be/w0sWIVR1hXw) and as a class, discuss Aboriginal Peoples’ connection to Country and how it varies from those already discussed in the previous activity.

Access NASA Earth Science and Remote Sensing Unit’s ‘[Highlights’ video (3:20)](https://eol.jsc.nasa.gov/ESRS/HDEV/#:~:text=PDF%20reader.)-,Highlights,-%3A) . Take notes to assist in completing the following questions:

* What are you observing? For example, land mass, atmospheric conditions or human settlement.
* How might viewing Earth from space change your perspective on, and connection to, the natural world?

In small groups, discuss the following questions:

* Why do we protect and conserve the natural world?
* If the natural environment does not provide benefits to humans, does it have value?

**Teacher note:** establish a designated area within the classroom for implementing a [Line of Continuum](https://goalbookapp.com/toolkit/v/strategy/student-barometer) activity. Direct students to position themselves along the line based on where they think their viewpoint on the given question fits best. Encourage students to take turns explaining their chosen positions and allow them to adjust their stance if their peers' arguments lead them to reconsider their perspectives.

Complete a [Line of Continuum](https://goalbookapp.com/toolkit/v/strategy/student-barometer) activity in response to the following question, ‘If the natural environment offers no advantages to humans, does it possess intrinsic value?’

Access [The Global commons](https://globalcommonsalliance.org/global-commons/) and [Global commons](https://geography-revision.co.uk/a-level/human/global-commons/). In pairs, construct a [mind map](https://app.education.nsw.gov.au/digital-learning-selector/LearningActivity/Card/542) summary of the article. The mind map must include the:

* key characteristics of global commons as defined by the United Nations
* four main types of global commons mentioned on the website
* main challenges associated with the management of global commons.

Answer the following questions:

* How do global commons differ from other types of resources in terms of ownership and management?
* Why are global commons important for the overall health of the Earth and its inhabitants?
* What are some of the consequences of the ‘tragedy of the commons’ in the context of global commons?
* How important is universal value of the environment (global commons) to you personally?
* What role do you think humans have as stewards in protecting the intrinsic value of the Earth?

## Learning sequence 2: Processes, cycles and circulations connecting natural systems

**Teacher note:** examples included in the syllabus are provided to support delivery of course content. These examples are not mandatory and teachers may choose to use the examples provided or select appropriate alternatives.

### Syllabus content

* Characteristics of Earth’s natural systems and factors affecting their functioning

**Example(s)**:

* Latitude.
* Altitude.
* Continentality.
* Oceanity.
* Seasonality.
* The processes, cycles and circulations connecting natural systems, including:

**atmospheric systems:**

**Example(s)**:

* global atmospheric circulations
* weather systems
* atmosphere–ocean circulations.

**hydrological systems:**

**Example(s)**:

* precipitation patterns and cycles
* catchment functioning
* water storages and flows.

**geomorphic systems:**

**Example(s)**:

* processes at tectonic boundaries
* volcanic eruptions
* soil formation
* coastal and river processes
* cycles of weathering, erosion and deposition.

**ecological systems:**

**Example(s)**:

* energy flows
* nutrient cycles
* biological productivity
* land-based and marine ecosystems
* natural phenomena such as species migration.

#### Learning intentions and success criteria

**Teacher note:** these learning intentions and success criteria are general and should be contextualised to suit your school and students’ needs.

**Learning intentions**

Students:

* understand the concepts of latitude, longitude, and their role in determining a location on Earth and global weather patterns
* understand global atmospheric circulations and its impact on weather and climate patterns
* understand the layers of Earth's atmosphere, their characteristics and their relationship with temperature changes
* understand the key features and processes of the water cycle and the factors that influence precipitation patterns in different locations
* investigate catchment functioning, including the construction of cross sections, transects and hydrographs, and analyse the factors that impact catchment functioning in different locations
* understand the fundamental concepts of plate tectonics and their role in shaping the Earth's surface, including the formation of continents and geological features
* explore the process of soil formation and the factors that influence soil profiles, as well as the importance of soil management
* examine the role of coastal and river processes in shaping landscapes and the formation of various landforms
* demonstrate how energy flows through ecological systems and identify the trophic levels in the flow of energy
* recognise the characteristics of different terrestrial and marine ecosystems and the biotic and abiotic factors that shape them.

**Success criteria**

Students can:

* accurately define latitude and longitude and explain how they form a coordinate system and global weather pattern
* create and interpret climate graphs and analyse seasonal variations in relation to Earth's tilt and orbit
* accurately describe the processes of global atmospheric circulation and explain its influence on weather and climate patterns
* identify and explain the characteristics of each layer of the Earth's atmosphere, as well as graph and interpret temperature changes in these layers
* analyse Earth's energy budget and heat map and discuss the factors that affect the balance of absorbed sunlight and radiated heat in different areas
* discuss the closed nature of the water cycle and the role of plants and atmospheric circulations in the process
* identify different types of water storages, discuss their benefits and drawbacks, and research the percentage of water stored in various systems in Australia and worldwide
* describe the changes in the Australian continent over time and the impact of tectonic plate movements on its geography
* identify and describe the main layers of soil profiles and the factors that influence soil formation
* explain the role of the carbon cycle in sustaining life on Earth and the differences between the slow and fast carbon cycles
* identify the different trophic levels in the flow of energy and explain why energy is lost at each level
* describe the characteristics of different terrestrial and marine ecosystems and the factors that determine their type and location
* identify and describe the nutrients within an ecosystem and explain how decomposition and weathering contribute to the movement of nutrients
* show the factors that affect the biological productivity of terrestrial and ocean biomes and explain the relationship between biological productivity and biodiversity.

### Characteristics of Earth’s natural systems and factors affecting their functioning

**Teacher note:** students may have prior knowledge of latitude, altitude, and some aspects of climate and weather from Geography Stage 5. Depending on class context, it may be necessary to revise these concepts and skills before moving onto the following content. Students must develop an understanding of differential heating as it forms the basis of other concepts like global atmospheric circulations.

Access [Latitude and longitude explained (2:33)](https://www.youtube.com/watch?v=-8gg98ws2Eo), [Differential heating](https://www.futurelearn.com/info/courses/learn-about-weather/0/steps/28845) and [Annual Migration of Tropical Rain Belt](https://www.climate.gov/news-features/understanding-climate/annual-migration-tropical-rain-belt) to answer the following questions:

* What are latitude and longitude and how do they help us determine a location on Earth?
* How does the Earth's tilt affect the distribution of latitudes and their exposure to sunlight?
* How do the latitude and longitude lines intersect to form a coordinate system?
* How does differential heating contribute to climate variations across different latitudes?
* In what ways does Earth's rotation influence the distribution of heat from the equator to the poles?
* How does the tropical rain belt affect global weather patterns?
* What are the characteristics of the tropical rain belt's climate?

Construct an annotated diagram that demonstrates the Earth's hemispheres, the equator and the poles. The diagram should also show the difference in the concentration of the Earth's rays due to the curvature of the Earth.

The diagram should follow these steps:

1. Begin with a blank piece of paper or use a drawing tool or software like Adobe Illustrator, Inkscape or Microsoft PowerPoint.
2. Draw a large circle to represent the Earth. You can use the circle or ellipse tool in your chosen software or a compass if you're drawing by hand.
3. Divide the circle into 2 equal parts, to represent the northern and southern hemispheres, by drawing a horizontal line across the middle. This line represents the equator at 0 degrees latitude.
4. Label the top point of the circle as the ‘North Pole (90°N)’ and the bottom point as the ‘South Pole (90°S)’. These points represent the poles at 90 degrees north and south.
5. To show the difference in concentration of the Earth's rays at the equator and at higher altitudes, draw a series of parallel lines at an angle from left to right, representing sunlight coming from the sun.
6. To represent the curvature of the Earth, make the parallel lines slightly curved. This will demonstrate that the sunlight strikes the Earth's surface at different angles, depending on the latitude.
7. At the equator, the sunlight should be perpendicular (90 degrees) to the surface. At higher latitudes, the sunlight will strike the surface at more oblique angles. You can use arrows to show the angle at which sunlight hits the Earth's surface at various latitudes.
8. Label the area near the equator as ‘High concentration of Earth's rays’ or ‘Direct sunlight’ and label the area near the poles as ‘Low concentration of Earth's rays’ or ‘Indirect sunlight’.
9. If you want to add more detail, you can use colours to represent the intensity of sunlight. For example, use a warm colour such as red or orange at the equator to indicate high solar radiation. Use cooler colours like blue or purple near the poles to represent lower solar radiation.
10. Submit and save or export your diagram in the desired format and review it to ensure all the elements are accurately represented.

Using a blank map, locate 5–8 different cities and record their altitude. In pairs, discuss: ‘How does the impact of latitude and altitude account for the variation in temperature among the specified cities?’

Access [Google Earth Ecuador](https://earth.google.com/web/search/ecuador/@-1.36031805,-83.8949062,15.09896049a,2381866.32911568d,35y,0h,0t,0r/data=CnIaSBJCCiUweDkwMjM4N2RkYTg5YTRiZDU6MHg5ZDc2YWYwNDExOWMzNzAyGU-OAkTBTP2_Ifj4hOy8i1PAKgdlY3VhZG9yGAIgASImCiQJWUjcXAeLOkARV0jcXAeLOsAZveYF9vhFRkAhXnalyTw2UMA) and record the latitude for the following cities:

Table 2 – Ecuador cities summary

|  |  |  |  |
| --- | --- | --- | --- |
| Location | Latitude | Altitude | Highest daily temperature |
| Cotopaxi |  |  |  |
| Quito |  |  |  |
| Latacunga |  |  |  |
| Ibarra |  |  |  |
| Esmeraldas |  |  |  |
| Guayaquil |  |  |  |

**Teacher note:** students will compare weather data for locations at different elevations to discover the effect that elevation has on temperature. The example used in this sequence is Ecuador, and has been adapted from the resources available at Centre for Innovation in Engineering and Science Education (CIESE) real time data projects. Teachers may wish to adapt to their local context or another location relevant to student context.

Refer to the information and Table 2 above and access [The Weather Channel](https://weather.com/en-AU/weather/today/l/ASXX0023:1:AS?Goto=Redirected) to find the highest temperature recorded for each city on the specified day. Record these temperatures in the ‘Highest daily temperature’ column of the table provided.

Use the [CIESE Implementation Assistance](https://ciese.org/curriculum/weatherproj2/en/popup/graph.shtml) scatter plot to learn about scatter plot graphs.

Using [Weather Scope](https://ciese.org/curriculum/weatherproj2/en/popup/graph4.shtml), observe and discuss the characteristics and features of a scatter graph.

Use a spreadsheet program or create a scatter graph, illustrating data presented in Table 2. Answer the following questions:

* How can a scatter graph help identify trends or patterns in a dataset?
* When is it appropriate to use a scatter graph instead of other types of data visualisations?
* How do you determine if there is a positive, negative or no correlation between 2 variables in a scatter graph? (Correlation is used to describe the relationship between 2 variables).
* Can a scatter graph be used to establish causation between 2 variables? Why or why not? (Causation means a change in one variable directly leads to a change in another variable).

Based on the table and graph, predict the temperature for the following elevations:

* 0 m
* 1,000 m
* 2,000 m
* 3,000 m
* 4,000 m.

A scatter graph, also known as a scatter plot or scatter diagram, is a type of data visualisation that displays the relationship between 2 numerical variables. Each data point on the graph represents a pair of values, one from each variable, plotted on a Cartesian coordinate system. Scatter graphs are widely used in geography including in statistics, data analysis, and scientific research, to explore relationships, trends, and potential causality between variables. The main characteristics and features of a scatter graph include:

* **Axes**: scatter graphs have 2 axes – the horizontal (x-axis) and the vertical (y-axis). Each axis represents one of the 2 variables being compared.
* **Data points**: data points are plotted as individual points or markers on the graph, with their positions determined by the values of the 2 variables. Each data point represents an observation from the dataset.
* **Distribution**: scatter graphs can reveal the distribution of the data points, providing insight into the concentration, spread, or outliers within the data.
* **Trend**: a scatter graph can help identify trends or patterns in the data, such as positive or negative correlations, or the lack of a relationship between the 2 variables.
* **Correlation**: the degree to which the 2 variables are related can be visually assessed in a scatter graph. A positive correlation indicates that as one variable increases, the other tends to increase as well; a negative correlation means that as one variable increases, the other tends to decrease. No correlation suggests that there is no observable relationship between the 2 variables.
* **Line of best fit**: a line of best fit, or regression line, can be added to the scatter graph to quantify the relationship between the 2 variables. This line may be linear or nonlinear, depending on the nature of the relationship.

The following instructions will support this learning activity:

1. Label the x-axis in meters from 0 to 7,000 m and the y-axis in Celsius from -15°C to 35°C.
2. Plot the data for altitude and temperature.
3. Add a linear trend line (line of best fit) through the data in the scatter plot. A trend line will not cross every point but rather there should be approximately the same number of points below the line as above it.
4. Look at the trend line. Estimate the approximate change in temperature for every increase of 1,000 m in elevation.

Answer the following questions and integrate data from the table:

* How does temperature vary with elevation in the city according to the table and graph?
* How does the temperature change with a 1,000 m increase in elevation in the city according to the table and graph?
* What are the factors that influence temperature variation with elevation in the city?

Conduct a discussion using the following prompt, ‘How does altitude influence the characteristics of Earth’s natural systems and their functioning?’

In small groups, investigate a specific ecosystem such as forests, grasslands or alpine tundra found at different altitudes. Each group completes research to discover how altitude impacts the assigned ecosystem and presents their findings to the class.

Use the [BOM recent and historical rainfall](http://www.bom.gov.au/climate/maps/rainfall/?variable=rainfall&map=totals&period=48month&region=nat&year=2022&month=07&day=31) map and complete the following:

* Describe the pattern of rainfall.
* What conclusions can you draw regarding the correlation between proximity to the coast and the amount of rainfall? Use [Continentality](https://glossary.lias.net/wiki/Continentality) and [Oceanity](https://glossary.lias.net/wiki/Oceanity) to further examine and improve your response.
* Describe any correlation between latitude and rainfall on the map.
* How might the rainfall pattern impact the diversity of flora and fauna? For example, in a tropical rainforest, the high annual rainfall contributes to an incredibly diverse ecosystem.

Review [Climate statistics for Australian locations](http://www.bom.gov.au/climate/averages/tables/cw_070282.shtml) and compare the temperature range between an inland city like Canberra and a coastal city like Sydney.

In the response, consider the geography and climate of the cities. For example, Canberra is located inland, which means it experiences a continental climate with greater temperature fluctuations between seasons. Sydney is located on the coast, which means it experiences a maritime climate with more moderate temperatures.

Use a [graphic organiser](https://app.education.nsw.gov.au/digital-learning-selector/LearningActivity/Card/599) to your support response and show the steps involved in analysing the temperature range of both cities. Create boxes for each step, such as ‘Gather temperature data’ or ‘Process or interpret the data’ and connect them with arrows to demonstrate the process.

[Brainstorm](https://app.education.nsw.gov.au/digital-learning-selector/LearningActivity/Card/542) factors that account for why inland areas like Canberra experience a greater temperature range than coastal cities like Sydney. Examples of these factors include temperature range, elevation, distance from water bodies, prevailing winds and ocean currents.

In small groups and using the class discussion, school resources and the [Continentality](https://glossary.lias.net/wiki/Continentality) and [Oceanity](https://glossary.lias.net/wiki/Oceanity) websites, answer the following questions:

* What causes coastal regions to have smaller temperature fluctuations compared to inland areas?
* What factors contribute to increased precipitation in coastal areas compared to locations farther inland?
* In what ways do continentality and oceanity influence a region's climate?

Access [Seasons (5:38)](https://youtu.be/tX3Y5bzNDiU) and record the seasons in the northern and southern hemispheres in the following table.

Table 3 – seasons

|  |  |  |
| --- | --- | --- |
| Months | Southern Hemisphere | Northern Hemisphere |
| Dec – Feb |  |  |
| Mar – May |  |  |
| June – Aug |  |  |
| Sept – Nov |  |  |

Using Figures 1–4 below, complete following climate graphs in Table 4.

Figure 1 – climate graph of Kathmandu airport, Nepal

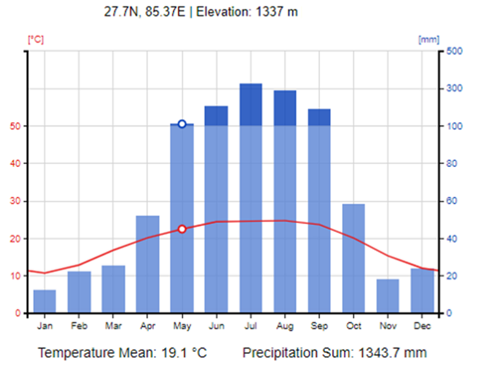


Figure 2 – climate graph of Kuwait

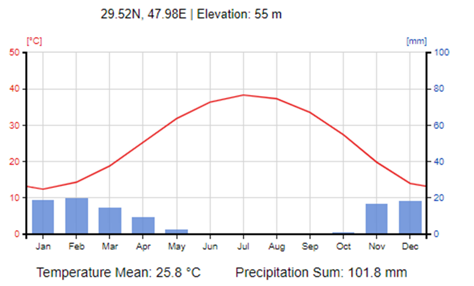


Figure 3 – climate graph of Sydney airport, Australia

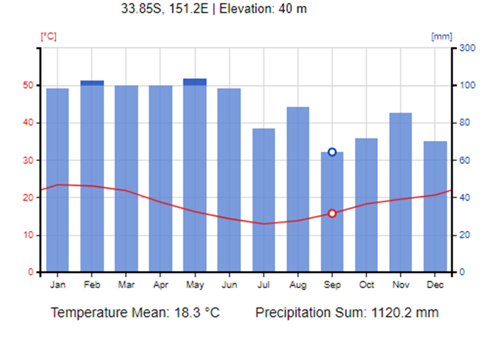
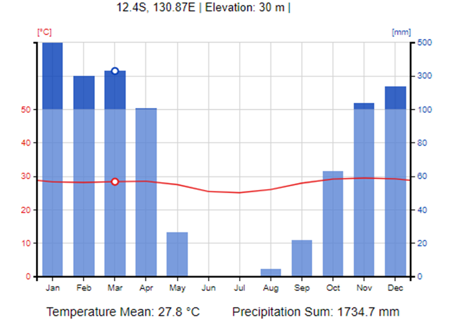


Figure 4 – climate graph of Darwin airport, Australia



Figures 1 to 4 by ClimateCharts.net is licensed under [CC-BY-4.0](https://creativecommons.org/licenses/by/4.0/).

Table 4 – climate graphs

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | Kathmandu | Kuwait | Sydney | Darwin |
| Latitude |  |  |  |  |
| Altitude |  |  |  |  |
| Hottest month |  |  |  |  |
| Wettest season |  |  |  |  |
| Describe the main geographic features that influence climate |  |  |  |  |

**Teacher note:** the climate graphs (Figures 1 to 4) were created by [ClimateCharts.net](https://climatecharts.net/), and are licensed under [CC-BY-4.0](https://creativecommons.org/licenses/by/4.0/). Teachers may wish to change the examples to locations more suitable to the school context.

Complete the following questions:

* What causes the Earth to have a 23.5° tilt in its axis of rotation?
* How does the Earth's elliptical orbit around the Sun affect its distance from the Sun throughout the year?
* How does the Earth's proximity to the Sun in January impact the seasons the Northern Hemisphere experiences?
* How does the tilt of the Earth's axis lead to the occurrence of seasons?
* How do the seasons experienced in the northern and southern hemispheres relate to each other?
* Which latitudes on Earth receive the most intense sunlight during solstices and equinoxes?

Access [Indigenous seasonal calendars](https://www.csiro.au/en/research/indigenous-science/indigenous-knowledge/calendars), [Indigenous Weather Knowledge](http://www.bom.gov.au/iwk/index.shtml) and [About the Indigenous seasonal calendars](https://www.csiro.au/en/research/indigenous-science/Indigenous-knowledge/Calendars/About). Answer the following questions:

* How do the Indigenous seasonal calendars differ from the Western 4-season calendar in understanding and managing Country in Australia?
* What role does seasonal understanding play in the activities and management of Country for Aboriginal and Torres Strait Islander Peoples?
* How has CSIRO contributed to the development and application of the Indigenous seasonal calendars?
* In what ways have the co-produced seasonal calendars been effective in representing Indigenous understanding of and connection to Country?

### The processes, cycles and circulations connecting natural systems

#### Atmospheric systems

Access [What is Global atmospheric circulation, Part one – differential heating (2:50)](https://youtu.be/7fd03fBRsuU). Identify any terminology that is unfamiliar. Answer the following questions:

* How does global atmospheric circulation affect weather and climate patterns?
* What is the main source of heat for the Earth and how does it travel to us?
* What causes differential heating across the globe and how is this related to the curvature of the Earth?
* What is the importance of the reflectivity (or albedo) of the Earth's surface in determining how much of the sun's radiation is used for heating the Earth?
* How does global atmospheric circulation act as an air conditioning system?

Explain the layers of the atmosphere including troposphere, stratosphere, mesosphere, thermosphere and exosphere using [Earth's Atmosphere: A Multi-layered Cake](https://climate.nasa.gov/news/2919/earths-atmosphere-a-multi-layered-cake/).

Graph the temperature changes in each layer of the atmosphere. Use [Earth's Atmosphere: A Multi-layered Cake](https://climate.nasa.gov/news/2919/earths-atmosphere-a-multi-layered-cake/). The graph should include each layer in kilometres (altitude above sea level) on the Y-axis (vertical) and temperature on the X-axis (horizontal).

Explain the characteristics of each layer of the atmosphere.

Access [Earth’s Energy Budget.](https://earthobservatory.nasa.gov/features/EnergyBalance/page4.php) Interpret the heat map (thematic map) of outgoing energy. Discuss the following:

* What does the colour coding on the heat map represent?
* Are there any areas of the map that appear to receive more absorbed sunlight than others?
* Are there any factors, such as geographical location or time of day, that might affect the balance of absorbed sunlight and radiated heat in different areas of the map?
* How does heat impact climate in a particular geographical location?

In pairs, students answer the following questions:

* What is Earth's energy budget and how is it related to the temperature stability?
* How much of the solar energy that reaches Earth is reflected back to space and what are the primary factors responsible for this reflection?
* What happens to the solar energy that is absorbed by the atmosphere and what are the main atmospheric components that absorb this energy?
* How does the Earth's surface absorb and distribute incoming solar radiation?
* How does the temperature of the Earth's surface and atmosphere relate to the amount of heat radiated by each? A resource to further support this response is [Surface Energy Budget](https://earthobservatory.nasa.gov/features/EnergyBalance/page5.php).
* What is radiative cooling and how does it help prevent runaway heating on Earth?

Access [What is global circulation? | Part Two | The three cells (3:35)](https://www.youtube.com/watch?v=xqM83_og1Fc) and [Prevailing winds](https://education.nationalgeographic.org/resource/prevailing-winds/). Identify any terminology that is unfamiliar. Answer the following questions:

* What are the 3 large atmospheric cells that exist in both hemispheres?
* How does the unequal distribution of land and ocean affect the global atmospheric circulation?
* What are the 3 cells that exist in both the northern and southern hemispheres and what are their characteristics?
* How do the mid-latitude cells (Ferral cells) differ from the other cells in the global circulation system and what role do they play in transporting heat?

In groups, use the information from [What is global circulation? | Part Two | The three cells (3:35)](https://www.youtube.com/watch?v=xqM83_og1Fc) and further research, to create a diagram or model of the global atmospheric circulation system. The diagram or model should include the 3 different cells and their characteristics, for example, prevailing winds.

**Possible extension activity:** each group will present their diagram or model and answer the following questions:

* How do semi-permanent areas of high- and low-pressure result from the circulation cells and how do they influence the formation of climatic zones?
* How does the Hadley cell at the equator influence the climate in regions around the world? What is the effect on Australia and NSW?
* How does the rotation of the Earth affect the global atmospheric circulation?
* What are some of the factors that can influence the strength and stability of the global atmospheric circulation system over time?
* How do ocean currents interact with the global atmospheric circulation system and what effects can they have on regional climates?

Access [the art of the chart: how to read a weather map](https://media.bom.gov.au/social/blog/2391/the-art-of-the-chart-how-to-read-a-weather-map/) and view the embedded film clip. Complete the following questions.

* What are the main features of a weather map (synoptic chart)?
* How do isobars (isoline) indicate the flow of air around weather systems?
* What are high- and low-pressure systems, and what do their numbers indicate?
* What are fronts and how do they appear on a weather map?
* How can you use isobars on a weather map to interpret wind strength and direction?

Discuss low-pressure systems and the frequency and impact of east coast lows and cyclones.

Work in pairs and access [Interactive Weather and Wave Forecast Maps](http://www.bom.gov.au/australia/charts/viewer/index.shtml) to predict the weather for any 3 capital cities for 24 hours, 48 hours and 96 hours in the future. Record predictions and check them against the actual conditions in the future.

Construct an answer to the following question, ‘Why is accurately forecasting the weather so complicated?’

Access the [Understanding El Niño–Southern Oscillation (ENSO) (4:13)](https://www.youtube.com/watch?v=dzat16LMtQk), [What is Niño and how does it impact Australia?](http://www.bom.gov.au/climate/updates/articles/a008-el-nino-and-australia.shtml) and [Understanding the Indian Ocean Dipole (3:32)](https://www.youtube.com/watch?v=J6hOVatamYs) to explain the phenomenon of El Niño and La Niña. These are large-scale climate patterns that affect global atmospheric circulations.

Collaboratively develop a table that identifies the causes of El Niño and La Niña, the effects on weather and climate, and how they interact with other factors such as the jet stream.

Using the table and further research on El Niño and La Niña, develop a poster to explain the causes and effects of these climate patterns. The poster should use data from the [Climate Driver Update](http://www.bom.gov.au/climate/enso/#tabs=Overview) including the current forecast of Pacific, Indian and Southern Oceans.

#### Hydrological systems

Access [Natural and urban water cycle](https://www.melbournewater.com.au/education/activities-all-ages/natural-and-urban-water-cycle) and [From Clouds to Currents What is the Water Cycle?](https://www.smithsonianmag.com/blogs/national-museum-of-natural-history/2022/02/10/from-clouds-to-currents-what-is-the-water-cycle/) to draw and label the key features of the water cycle or hydrological system, including:

* precipitation
* condensation
* groundwater
* infiltration
* transpiration
* evaporation.

Research further water cycle features and define [evapotranspiration](http://www.bom.gov.au/watl/eto/about.shtml#:~:text=Evapotranspiration%20is%20the%20term%20used,of%20both%20transpiration%20and%20evaporation.), percolation, groundwater discharge, throughflow, aquifer, surface and sub-surface runoff. Add these features to the diagram.

Using the water cycle diagram constructed, conduct a [Think-Pair-Share](https://app.education.nsw.gov.au/digital-learning-selector/LearningActivity/Card/645) to explore and discuss the following questions:

* Why is the water cycle referred to as a closed cycle?
* What drives the water cycle?
* Why are plants critical to the water cycle?
* How do atmospheric circulations like La Niña and El Niño alter the operation of the water cycle?

Using the Bureau of Meteorology’s (BOM) [Average annual, seasonal and monthly rainfall](http://www.bom.gov.au/climate/change/about/rain_averagemaps.shtml), create a [Venn diagram](https://app.education.nsw.gov.au/digital-learning-selector/LearningActivity/Card/599) that compares and contrasts precipitation in 2 NSW locations. The first location should be on the east coast and the second should be inland, for example, Coffs Harbour and Cobar.

Write a paragraph explaining the impact of the [Rain Shadow Effect (4:26)](https://www.youtube.com/watch?v=DoKTTHd-XEQ) in varying precipitation between the 2 locations. Explain one other factor that may cause variation between these 2 locations.

Complete the following questions using the rainfall information, graphs, choropleth maps and data on pages 6 and 7 of the [State of the Climate 2022](http://www.bom.gov.au/state-of-the-climate/) report.

* What is the trend in rainfall in the south-west of Australia since 1970?
* Which months have seen the largest decrease in rainfall in the south-west of Australia since 1970?
* What is the trend in rainfall in the south-east of Australia since the late 1990s?
* How has rainfall in northern Australia changed since the 1970s?
* What are some drivers that influence Australian rainfall?
* Despite natural variability, what long-term trend is evident in Australia's rainfall records?
* How many years out of the past 22 have had below-average rainfall in southern Australia between April and October?
* What factors are responsible for the decrease in rainfall in southern Australia?
* What is the significance of rainfall in the cooler months for southern Australia?

Using the [State of the Climate 2022](http://www.bom.gov.au/state-of-the-climate/) report (page 8) heavy rainfall information and data, answer the following questions:

* What was the main observation regarding heavy rainfall events in Australia?
* What is the relationship between short-duration extreme rainfall events and flash flooding?
* What weather systems typically cause heavy rainfall events in Australia?
* What has happened to the number of low-pressure systems in southern Australia in recent decades and what are the implications?
* How does the relationship between atmospheric moisture and global warming affect the likelihood and intensity of heavy rainfall events in Australia?

Use [Asia Pacific Regional Reference Map: Annual Precipitation](https://reliefweb.int/map/world/asia-pacific-regional-reference-map-annual-precipitation) and [Regional Climate Maps: Asia](https://www.cpc.ncep.noaa.gov/products/analysis_monitoring/regional_monitoring/asia.html) to research the precipitation patterns for a selected location in Asia.

Briefly explain the factors that influence the precipitation of the chosen location. For example:

* latitude
* altitude
* topography
* distance from water bodies
* air pressure
* winds.

Identify the different types of water storages in the selected location in Asia, including dams, reservoirs, aquifers, and natural water bodies such as rivers and lakes. In pairs, locate where water is stored and flows.

Use the [Water in Australia 2019–20 report](http://www.bom.gov.au/water/waterinaustralia/) and [Energy Education](https://energyeducation.ca/encyclopedia/Water_storage) to complete following table.

Table 5 – water storage

|  |  |  |
| --- | --- | --- |
| Water resources | Australia | Worldwide |
| Freshwater systems |  |  |
| Oceans |  |  |
| Groundwater |  |  |
| Icecaps and glaciers | N/A |  |
| Lakes |  |  |
| Swamps |  |  |
| Rivers |  |  |

Access [Water Cycle – Stores and Flows (7:11)](https://youtu.be/H_noB4UYDJU) and pause the video at 4:45 to complete the following table. Complete Table 6 by identifying the inputs, processes, outputs and stores likely to be occurring in a fjord.

Table 6 – water cycle, stores and flows

|  |  |  |  |
| --- | --- | --- | --- |
| Inputs | Processes | Outputs | Stores |
|  |  |  |  |
|  |  |  |  |
|  |  |  |  |
|  |  |  |  |

Resume [Water Cycle – Stores and Flows (7:11)](https://youtu.be/H_noB4UYDJU) and identify inputs, processes, outputs and stores. As a class, discuss and complete the following questions:

* What are the main inputs and outputs of the water cycle?
* How does precipitation contribute to the water cycle?
* What is evaporation and how does it fit into the water cycle?
* What role do plants play in the water cycle?
* What is the difference between a closed and open system?

**Teacher note:** schools may like to consider conducting fieldwork in this section of the learning sequence by undertaking a geographical inquiry in a local catchment or sub catchment. Fieldwork examples that would align with this section of the learning sequence would include constructing a transect, recording river flow and constructing a hydrograph or interviews with experts in the field.

In groups, examine a case study of a water storage project. Use the outline below to gain an overview of the case study options. For example:

1. **Snowy Hydro 2.0**: this is a proposed expansion of the existing Snowy Mountains Hydroelectric Scheme in New South Wales. The project aims to increase the capacity of the hydroelectric system by building a network of tunnels and dams to store and release water to generate electricity.
2. **Murray-Darling Basin Plan**: this is a government initiative aimed at managing the water resources of the Murray-Darling Basin, which spans across New South Wales, Victoria, South Australia, Queensland and the Australian Capital Territory. The plan involves reducing water consumption by irrigators, increasing environmental flows and improving water efficiency.
3. **Tasmanian Hydroelectric Scheme**: this is a network of hydroelectric power stations located across Tasmania. The scheme utilises the island's abundant rainfall and rugged terrain to generate electricity by storing and releasing water from dams and reservoirs.
4. **Brisbane's water grid**: this is a network of dams, pipelines, and treatment plants that supply water to the city of Brisbane and surrounding regions. The water grid includes several dams, including the Wivenhoe, Somerset, and North Pine dams, which store water for drinking, irrigation and industrial use.

Each group must complete a report on their assigned case study that includes:

* the benefits and drawbacks of the project
* impacts on the environment
* measures taken to mitigate these impacts.

Groups should use a combination of geographical tools to support their report findings, including:

* maps (for example, topographic, land use and hydrological maps, cadastral/zoning maps)
* aerial photography (for example, satellite, historical)
* statistical analysis (for example, total water storage and flow)
* Geographic information systems (GIS).

**Teacher note:** students will need access to tracing paper and a topographic map of a catchment area. [Google maps](https://www.google.com/maps/@-33.2069038,150.5107629,7.65z) in terrain mode may be a useful resource for this. For the task on water catchment stories, the resource [Water in New South Wales](https://www.industry.nsw.gov.au/water/basins-catchments/snapshots) may be shared with the class to provide students with inspiration for choice of catchments.

Using [National Geographic – Tributary](https://education.nationalgeographic.org/resource/tributary), tracing paper and topographic maps, construct an annotated diagram of a catchment that includes the following details:

* watershed with relevant spot heights identified
* tributaries
* rivers
* overland flow direction.

Students access [Cross-sections and transects (2:53)](https://education.nsw.gov.au/teaching-and-learning/curriculum/hsie/hsie-curriculum-resources-k-12/hsie-7-10-curriculum-resources/cross-sections-and-transects) and the topographic map of your catchment to draw a cross-section. Calculate vertical exaggeration for the cross-section.

**Teacher note:** students may need to access the video [Mapwork Vertical Exaggeration (6:14)](https://youtu.be/wGnoU0HbbP0) for an explanation on how to calculate vertical exaggeration. Consider accessing past examinations for skills questions requiring knowledge and understanding of vertical exaggeration.

Using the definitions found on the [Queensland Government Wetland Info](https://wetlandinfo.des.qld.gov.au/wetlands/ecology/processes-systems/water/hydrology/) webpage, and a local topographic map, conduct a [Think-Pair-Share](https://app.education.nsw.gov.au/digital-learning-selector/LearningActivity/Card/645) to identify examples of catchment scales in your regional area. For regional areas, identify examples of each catchment scale, such as:

* region
* sub catchment
* land unit
* subunit.

**Teacher note:** schools may like to consider conducting fieldwork in this section of the learning sequence by undertaking a geographical inquiry in a local catchment or sub catchment. Fieldwork examples that would align with this section of the learning sequence would include constructing a transect, recording river flow and constructing a hydrograph or interviews with experts in the field.

Access [Queensland Government Wetland Info – River Flows (hydrograph)](https://wetlandinfo.des.qld.gov.au/wetlands/ecology/processes-systems/water/hydrology/river-flows/) and discuss the following questions as a class:

* What is a hydrograph and how is it used to describe river flows over time?
* How is baseflow separated from direct runoff or quick flow in a hydrograph?
* What is lag time and how is it related to the catchment's flashiness?
* How does flooding occur and what are its effects on the river system?
* What is bank storage or recharge and how does it occur during high flow or flood?
* What is flood recession and why is it important for fish species and riverbanks?
* How does the flow velocity in the river channel change from the riverbed to the river surface?

**Extension activity**

In groups, research and present a catchment story. A catchment story will outline how one NSW catchment has formed, including its key physical and human features. For example, the Warragamba Dam is the main water storage for Sydney's drinking water supply. The proposed dam raising project aims to increase the dam's capacity by 14 meters to provide additional water storage for the city. Inspiration for the catchment story may be sourced from Queensland examples at [Queensland Government Wetland Info – Catchment stories](https://wetlandinfo.des.qld.gov.au/wetlands/ecology/processes-systems/water/catchment-stories/).

In researching the catchment, the following aspects should be considered:

* geological and geographical overview of the catchment
* natural features of the catchment – topography and geology
* natural features of the catchment – rainfall
* natural features of the catchment – vegetation
* significant modification to natural features of the catchment – dams, weirs
* any relevant sub catchment details and interactions.

Once completed, groups swap and review catchment stories. Groups design an infographic on the factors that impact catchment functioning at different locations across NSW. The infographic should visually display the information mentioned above in a clear and concise manner. The infographic should be visually appealing, easy to understand, and should provide a clear understanding of the factors that impact catchment functioning.

#### Geomorphic systems

**Teacher note:** it is assumed that this will be revision of content covered in Stage 4 or 5. In classes where pre-testing or questioning indicates that this is not the case, teachers may need to provide more detail or scaffolding at the start.

Use [Plate Tectonic Types](https://earthhow.com/plate-tectonics-types-divergent-convergent-transform-plates/) and [Plate Boundaries](https://www.calacademy.org/explore-science/plate-boundaries-divergent-convergent-and-transform) to complete Table 7 and answer the following questions in Table 8.

Table 7 – plate tectonics

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Plate boundary | Type of movement | Examples | Landforms created | Plate boundary |
| Transform |  |  |  |  |
| Convergent |  |  |  |  |
| Divergent |  |  |  |  |

Table 8 – questions about tectonic plates

|  |
| --- |
| Questions about tectonic plates |
| What are tectonic plates and how are they formed? |
| What evidence supports the theory of plate tectonics? What is seafloor spreading and how does it support the theory of plate tectonics? |
| How do tectonic plates move and what causes these movements? |

Access and discuss the [History of the Earth poster](https://ecat.ga.gov.au/geonetwork/srv/eng/catalog.search#/metadata/68903). Respond to the following questions:

* What does the History of the Earth poster depict?
* What is the geological time scale?
* How has the Earth's surface changed over time according to the poster?
* What are some of the key events in Earth's history that are highlighted in the poster?
* How have the oceans, continents and boundaries changed over time?

Access GIS’s [Australia – Evolution of a Continent](https://www.ga.gov.au/static/palaeo/palaeo.html) and play the slideshow revealing Australia’s land mass changes through time. Complete the following questions:

* How has the Australia continent changed over time?
* How have the movements of tectonic plates influenced the geography of Australia
* What were the major events that occurred in Australia?
* How did the breakup of the supercontinent Gondwana affect the geography of Australia?
* How did the rise and fall of sea levels influence the geography of Australia?
* What is the relationship between plate tectonics and the formation of Australia's Great Dividing Range?

As a class, discuss how the Australian continent has undergone significant landmass and tectonic plate changes over time, including the separation from other continents and geological events that shaped its mountains, rivers and deserts.

Complete 2 predicting questions about Australian earthquakes:

1. Is it likely that Australia would have many earthquakes? Why?
2. Where would you expect the most earthquakes to occur in Australia? Why?

Access the GIS map of [Historical earthquakes of Australia](https://geoscience-au.maps.arcgis.com/apps/MapSeries/index.html?appid=72ad590cc9364e41b06907406bb7712e) and [Topography of Australia poster [1.04 MB]](https://www.ga.gov.au/__data/assets/pdf_file/0003/86637/Topography-of-Australia-poster.pdf). Answer the following questions:

* What is the history of seismic activity in Australia? Which regions of Australia are most prone to earthquakes, and why?
* How does the location of Australia's tectonic plate affect its susceptibility to earthquakes?
* What is the ‘Ring of Fire’ and where is it located?
* How does the topography and the 'Ring of Fire' contribute to seismic activity in Australia, and the Pacific and Indian Oceans?
* Can earthquakes occur in regions outside of tectonic plate boundaries? If so, how?

Access [How volcanic eruptions shape Earth (3:44)](https://youtu.be/bHNDRquJ8U8) to complete a [Think-Pair-Share](https://app.education.nsw.gov.au/digital-learning-selector/LearningActivity/Card/645) based on the following questions:

* Where are volcanoes found on Earth?
* How are volcanoes formed?
* What happens when magma reaches the surface of the Earth?
* How does lava turn into igneous rock?
* What are the different types of volcanic mountains and what are their characteristics?
* What are craters and calderas and how are they formed?

**Teacher note:** the following questions could be completed as a modelled, guided and independent activity to demonstrate PEEL writing structures.

Review [Volcano](https://www.community-safety.ga.gov.au/hazards/volcano) and [Astounding Facts About a Volcanic Landscape](https://www.worldatlas.com/articles/astounding-facts-about-a-volcanic-landscape.html). Use a PEEL [writing scaffold](https://app.education.nsw.gov.au/digital-learning-selector/LearningActivity/Card/625#.ZCF_6hR7VfM.link) to answer the following:

* Explain how there are remnants of volcanos in Australia despite not being on the edge of tectonic plates
* Explain why volcanos can be described as both destructive and constructive.
* Explain how the interaction between plate boundaries has shaped the earth.

Use [Queensland Government – How soils form](https://www.qld.gov.au/environment/land/management/soil/soil-explained/forms) to discuss the image ‘Soil profile’ showing the different layers or horizons. In groups, answer the following questions:

* What is soil profile and what are the main layers of soil profiles? Relate your response to the image.
* How does the accumulation of material through the action of water, wind and gravity contribute to soil formation?
* How do physical, chemical and biological weathering affect soil formation?
* What are the 5 main interacting factors affecting soil formation? What is the influence of parent materials on soil properties? How do organisms influence soil formation? What is the role of climate in soil formation?
* How does the topography of a slope affect soil formation?
* What are the main horizons of soils and how do they differ in terms of texture, fertility and biological activity?
* Why is soil considered a valuable resource and why is it important to manage it carefully?
* How would the factors of time, parent material, climate, topography and organism influence a soil profile?

**Teacher note:** [What is the Process of Soil Formation and Factors That Affect Soil Formation?](https://eartheclipse.com/environment/process-and-factors-of-soil-formation.html) provides useful background information on soil formation and factors influencing soil formation. This resource might be useful for teacher professional learning. Teachers may also wish to create an alternative fieldwork task for this sequence. The illustration of soil profile could be replaced with an actual soil profile in the school or local environment. This could use the same discussion questions and include a horizon identification and soil ribbon task.

[Soil Profiling: The Proper Tools (4:55)](https://youtu.be/UtgTUXl4HMM) will support teacher understanding of the profiling process. At the end of this sequence on soil formation, teachers may consider including an HSC style skills task pertaining to ternary graphs or provide soil data for students to construct a ternary graph. [Reading Ternary Diagrams](https://grapherhelp.goldensoftware.com/Graphs/Reading_Ternary_Diagrams.htm) and the videos [other graphs (2:49)](https://education.nsw.gov.au/teaching-and-learning/curriculum/hsie/hsie-curriculum-resources-k-12/hsie-7-10-curriculum-resources/other-graphs) and [Ternary plot basics (9:19)](https://youtu.be/KvGJoLIp3Sk) are useful in outlining this skill.

[NESA HSC exam papers](https://educationstandards.nsw.edu.au/wps/portal/nesa/11-12/resources/hsc-exam-papers) provide a useful reference point for exam style skills questions.

As a class, complete a sediment analysis exercise to identify and characterise the size and shape of soil materials in (a) given sample area(s) using [Grain size chart [PDF 461 KB]](https://www.ga.gov.au/__data/assets/pdf_file/0005/86549/Grain-size-card.pdf). Use the following procedure:

1. Collect soil sample(s) from the field or a designated area.
2. Place the soil sample(s) in a tray or container and remove any visible rocks or debris.
3. Divide the soil sample(s) into different fractions based on their grain size using the grain size cards as a reference. For example, separate the soil into sand, silt, and clay fractions.
4. Use [[Grain size card [PDF 461 KB]](https://www.ga.gov.au/__data/assets/pdf_file/0005/86549/Grain-size-card.pdf),](https://www.ga.gov.au/__data/assets/pdf_file/0005/86549/Grain-size-card.pdf) magnifying glass and/or microscope to examine the size and shape of the soil particles in each fraction. Measure the diameter of individual particles using a ruler or calliper.
5. Classify the soil particles based on their shape using a sphericity chart. Sphericity refers to the degree of roundness of a particle, with perfectly spherical particles having a sphericity value of 1.0 and irregular particles having a lower value.
6. Record the size and shape characteristics of each fraction in a table or spreadsheet and calculate the percentage of each fraction in the overall soil sample.

Post sediment analysis exercise:

* Compare the grain size distribution of the soil sample(s) to typical soil types, such as sand, loam, or clay.
* Discuss the potential implications of the soil grain size distribution for soil properties, such as water retention, nutrient availability, and compaction.
* Compare the sphericity values of the soil particles to typical values for different sedimentary environments, such as river or beach sediments.

Access [Australian Soil Classification (ASC) soil type map of NSW](https://www.environment.nsw.gov.au/eSpade2Webapp/) and a blank map of NSW to construct a soil map of NSW. Research and discuss the following:

* identifiable characteristics in a soil profile, for example, the B horizon of a Podosol soil is dominated by compounds of organic matter
* parent material
* porosity and water storage capacity
* processes involved in soil formation of the soil type.

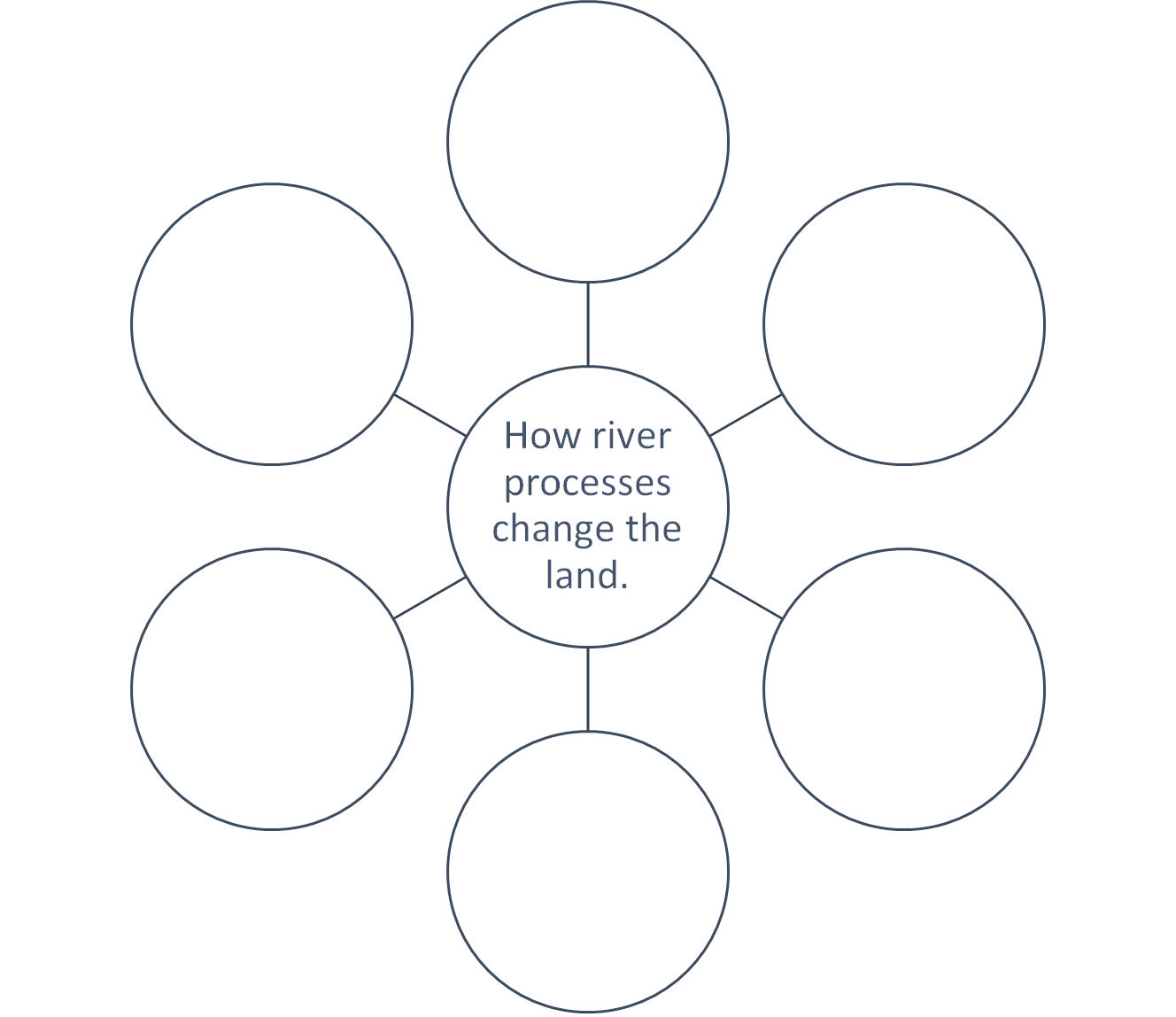
Access [River Erosion, Transportation and Deposition (2:09)](https://youtu.be/NJ6bjQPMhIA) and [Erosion and sedimentation: How rivers change the landscape (3:04)](https://youtu.be/EMwGPPJ1Umk). In small groups, research the following statement, ‘How does a river change the land?’

Use the information gathered to create a presentation that provides the following:

* an overview of different types of processes that erode the land and change rivers, such as hydraulic action, abrasion, attrition and solution.
* an overview of different types of processes that transport the eroded material, such as traction, saltation, suspension and solution.
* examples of landforms that are created by erosion and deposition along the course of the river, such as waterfalls or meanders.
* reasons why the landforms are different in the upper, middle and lower courses of the river.

The presentation will be in a form of the group’s choice, for example, a short presentation, a video, a Canva poster, a skit or play. Use the mind map below to collate information from each presentation.

Figure 5 – mind map



In 3 groups, research [coastal processes](http://www.geography.learnontheinternet.co.uk/topics/coastal_processes.html) that change the landscape. The groups will be erosion, transportation or deposition.

Each group will create a mind map for their coastal process. This mind map must define the process and describe the role of the process in changing the landscape.

Groups will also choose at least one landform created by this process and complete a [photo sketch](https://education.nsw.gov.au/teaching-and-learning/curriculum/hsie/hsie-curriculum-resources-k-12/hsie-7-10-curriculum-resources/photo-sketch) of the feature that is annotated to explain how the feature is created.

Display the mind map and photo sketch in a [gallery walk](https://app.education.nsw.gov.au/digital-learning-selector/LearningActivity/Card/555). When observing the gallery walk, complete the summary of the role of coastal processes below.

Table 9 – coastal processes

|  |  |  |
| --- | --- | --- |
| Coastal process | Description | Example of a landscape created by this process |
| Erosion |  |  |
| Transportation |  |  |
| Deposition |  |  |

Create an infographic that shows the entire cycle of weathering, erosion and deposition. Include information that shows the different scales within the cycle.

Complete a [parking lot](https://app.education.nsw.gov.au/digital-learning-selector/LearningActivity/Card/570) with the strengths and opportunities for improvement for other groups’ infographics.

Using [Weathering Types](https://geologyscience.com/geology/weathering-types/), further research and [Google Jamboard](https://app.education.nsw.gov.au/digital-learning-selector/LearningTool/Card/593), identify and describe:

* physical weathering
* chemical weathering
* biological weathering.

Discuss the following questions:

* What is physical weathering and how does it differ from chemical weathering?
* How do temperature and pressure contribute to physical weathering?
* What are the main processes involved in chemical weathering? How does oxidation contribute to chemical weathering?
* How does organic or biological weathering differ from physical and chemical weathering?

**Teacher note:** provide students with a selection of rock samples or images that can be used for the following activities. Have students correctly match the samples to their labels before starting.

Access the [National Geographic The Rock Cycle](https://education.nationalgeographic.org/resource/rock-cycle) to identify where in the cycle of weathering, erosion and deposition these samples belong and describe how each was formed, including the:

* identification based on their physical characteristics such as colour, texture and composition.
* three main types of rocks: sedimentary, igneous and metamorphic.

As a class, discuss the following questions:

* Why do we refer to the rock cycle as a cycle?
* What is the relationship between the different stages of the rock cycle?
* Why might the rock cycle be described as dynamic?

#### Ecological systems

Access [NASA Earth Observatory's ‘The Carbon Cycle](https://earthobservatory.nasa.gov/features/CarbonCycle)’ and discuss the following focus questions as a class:

* What role does the carbon cycle play in sustaining all life on earth?
* How does the slow carbon cycle differ from the fast carbon cycle?
* What role does the Earth’s orbit play in influencing the carbon cycle?
* How does chemical weathering relate to the slow carbon cycle?
* How does fast and slow carbon cycles maintain a steady concentration of carbon in the atmosphere, land, plants and ocean?
* How has the carbon cycle changed in response to climate change in Earth's past?
* How have variations in Earth's orbit affected the carbon cycle and led to ice ages and warm periods?
* How has the correlation between carbon dioxide levels and temperature been demonstrated over the past 800,000 years using Antarctic ice-core data?
* How does deforestation affect the carbon cycle, and why do crops or pasture store less carbon than forests?
* How have carbon dioxide and methane concentrations in the atmosphere changed since the beginning of the Industrial Revolution, and what are the implications of these changes? Include data in your response.

**Teacher note:** the carbon cycle is nature's way of reusing carbon atoms, which travel from the atmosphere into organisms in the Earth and then back into the atmosphere repeatedly. Most carbon is stored in rocks and sediments, while the rest is stored in the ocean, atmosphere and living organisms.

Access [Energy Flow (Ecosystem)](https://sciencing.com/energy-flow-ecosystem-definition-process-examples-with-diagram-13719231.html), [Ecological relationships and energy flow](https://www.bbc.co.uk/bitesize/guides/zp8d4qt/revision/1#:~:text=Energy%20flow-,The%20Sun%20is%20the%20original%20source%20of%20energy%20for%20almost,can%20be%20passed%20onto%20animals.) and [Photosynthesis.](https://education.nationalgeographic.org/resource/photosynthesis) Using the resources, complete the following questions:

* Define energy flow.
* Explain the process of photosynthesis in 1–2 sentences.
* Identify and describe each of the trophic levels in the flow of energy.
* Explain why energy is lost at each trophic level.
* Explain why energy flows are unidirectional and non-cyclical.

Using the research and notes on energy flows, create a food chain representing the energy flow between organisms in an ecosystem. This food chain should identify the different trophic levels and places where energy is lost from the flow.

In pairs, use bullet points to summarise:

* how energy flows through ecological systems
* how producers and consumers fit into the food chain
* the role of primary consumers in a food chain
* how the number of trophic levels in a food chain affect the amount of energy available to higher-level consumers
* how food webs differ from food chains, and how this affects the energy flow.

Access [Living World – Nutrient Cycles (4:08)](https://www.youtube.com/watch?v=T3bJla9N0pc) for background information on the nutrient cycle. Answer the following questions:

* What are the 3 stores of nutrients within an ecosystem?
* What is biomass, and how does it relate to the movement of nutrients within an ecosystem?
* How does the decomposition of dead material, such as leaves and animal scat, contribute to the movement of nutrients within an ecosystem?
* How can deforestation impact the nutrient content of the biomass within an ecosystem?
* How can rainfall impact the movement of nutrients within an ecosystem, particularly the litter and soil stores?
* What is leaching, and how can it impact the nutrient content of the soil within an ecosystem?
* What is weathering and how can it add nutrients to the soil within an ecosystem?
* What are some other ways in which nutrients can be added to or lost from the 3 stores within an ecosystem?

Use [Nutrient Cycling](https://mdocs.skidmore.edu/crandallparktrees/ecosystem/nutrient-cycling/) to record the different essential nutrients found in the soil in each category:

* non-mineral
* macro minerals
* micro-minerals.

Create a diagram identifying the nutrients found in soils (include the carbon, nitrogen and oxygen cycles).

Use [The Nutrient Cycle in the Rainforest](https://www.internetgeography.net/topics/the-nutrient-cycle-in-the-rainforest/) and [Under the Canopy: a guide to the rainforests of NSW](https://www.nationalparks.nsw.gov.au/education/teacher-resource-rainforests-nsw-stage-6-geography#:~:text=Under%20the%20Canopy%3A%20a%20guide%20to%20the%20rainforests%20of%20NSW%20(6.3MB%20pdf)) from NSW National parks and wildlife service to identify examples of the interdependence between the 3 stores of nutrients in the rainforest. Respond to the following prompts:

* To what extent is the nutrient cycle critical to the functioning of rainforests?
* Discuss the ways that humans can impact the nutrient cycles, both positively and negatively.

Use the data from [Table 1: Global and ecosystem-scale estimates](https://www.nature.com/scitable/knowledge/library/terrestrial-primary-production-fuel-for-life-17567411/#:~:text=Table%201%3A%20Global%20and%20ecosystem%2Dscale%20estimates) to rank terrestrial biomes in order of greatest biological productivity to least. Answer the following question:

* Does this ranking give an accurate impression of the value of the individual biomes? Why or why not?

In pairs, brainstorm what quantitative data could be used to measure the biological productivity of an ecosystem.

In small groups, review the following definition of biological productivity:

Primary biological productivity refers to the amount of living plant or organic material (biomass) produced by plants (autotrophs) during the process of photosynthesis. This is measured in units of energy like kilojoules or in units of weight like tonnes. Secondary primary productivity refers to the generation of biomass by heterotrophs (consumers of plants like bacteria, fungi and animals). Biological productivity varies across the world and across time.’

Collaboratively create a visual representation of the definition, for example, a mind map.

As a class, complete the following:

* Brainstorm factors that may affect the biological productivity of terrestrial and ocean biomes.
* Discuss the contrast between the biological productivity of a region or ecosystem with the concept of biodiversity.

Use The World Bank article, [Improving Food Security and Agricultural Productivity: A Priority for Burkina Faso](https://www.worldbank.org/en/news/feature/2016/02/10/improving-food-security-and-agricultural-productivity-a-priority-for-burkina-faso) to respond to the following question:

To what extent is food security for the planet reliant on biological productivity?

Use school resources and National Geographic’s [Biomes, Ecosystems, and Habitats](https://education.nationalgeographic.org/resource/biomes-ecosystems-and-habitats/) to:

* define habitat, ecosystem and biome
* discuss ‘What are the key differences between ecosystems, habitat and biomes?’

Use school resources and [Marine Ecosystems](https://education.nationalgeographic.org/resource/marine-ecosystems) to complete the following questions:

* Describe marine ecosystems and their unique biotic and abiotic factors
* Draw photo sketches or field sketch of the main marine ecosystems, including: estuaries, mangrove forests, coral reefs and the open ocean
* Annotate each of these photo sketches or field sketch with key features (for example, where they are found, how they are created and the main organisms the marine ecosystem supports).

**Teacher note**: provide images of the marine ecosystems for use by students in completing a [photo sketc](https://education.nsw.gov.au/teaching-and-learning/curriculum/hsie/hsie-curriculum-resources-k-12/hsie-7-10-curriculum-resources/photo-sketch)h. Alternatively, if accessible to your school context, swap the photo sketch learning activity for a [field sketch](https://education.nsw.gov.au/teaching-and-learning/curriculum/hsie/hsie-curriculum-resources-k-12/hsie-7-10-curriculum-resources/conducting-a-field-sketch) activity.

Use school resources and [Terrestrial Ecosystem](https://education.nationalgeographic.org/resource/resource-library-terrestrial-ecosystem) to define a terrestrial ecosystem and identify examples of biotic and abiotic factors that determine the type of terrestrial ecosystem that will be found in a particular location.

Access [The Vital Chain: Connecting Ecosystems of Land and Sea](https://e360.yale.edu/features/the_vital_chain_connecting_the_ecosystems_of_land_and_sea) and make brief notes on 5 big ideas from the article. Using these notes, write a paragraph response to the following question: ‘Explain the importance of recognising and managing links between land based and marine ecosystems’.

In pairs, choose review [Animal Migration](https://education.nationalgeographic.org/resource/resource-library-animal-migration) and select 2 species that migrate. Complete a [Venn diagram](https://app.education.nsw.gov.au/digital-learning-selector/LearningActivity/Card/599) to compare where, when, why and how the 2 species migrate. Use a blank map and develop thematic map that identifies migration of pattern of species.

**Teacher note**: when developing a thematic map, it is important to:

* **determine the species' range.** Before creating a migration map, it's important to understand the species' range, or the area where the species is found throughout the year. This will help identify where the species migrates from and to.
* **gather data.** There are different types of data that can be used to create a migration map, such as bird banding records, satellite tracking data, citizen science observations, and climate data. Choose the data source that is most appropriate for your species and your research question.
* **choose a visualisation method.** There are different ways to visualise migration patterns, such as heat maps, flow maps, dot maps, and animation. Choose the method that best represents the data and makes it easy to understand.
* **identify migration routes.** Once you have gathered data, you can start identifying migration routes. You can do this by plotting the data on a map and looking for patterns. This will help you see where the species is moving from and to.
* **consider environmental factors.** Environmental factors such as weather patterns, food availability and breeding grounds can influence migration patterns. Consider incorporating this information into your map to provide a more comprehensive view of the species' movements.
* **label and include a legend.** To make the map easy to read, include a legend that explains the colours, symbols and labels used. Use clear labels to identify key migration routes and important locations.
* **add context.** Consider adding additional information to your map, such as geographic features, habitat types or human population areas. This can help provide context for the species' movements and help viewers understand why certain migration routes may be more challenging than others.

Use the Venn diagrams to collaboratively construct a simple mind map that summarises:

* the main reasons for species migration
* the links between the migrations and other natural systems.

Construct a 1–2 paragraph response to the following question, ‘To what extent is animal migration linked to other natural systems?’. On completion, pass the response to a peer for feedback based on the following criteria:

* The response has a clear topic sentence that answers the question, that is, makes a qualified judgement about the extent to which animal migration is linked to other natural systems.
* The response uses examples and evidence to support the main idea, for example, the response may link whale migration to atmosphere-ocean circulations and the warmth of the oceans.

## Learning sequence 3: Natural systems and land cover change

**Teacher note:** examples included in the syllabus are provided to support delivery of course content. These examples are not mandatory and teachers may choose to use the examples provided or select appropriate alternatives.

### Syllabus content

* The nature and extent of Earth’s land cover, including water
* Natural processes, cycles and circulations that change Earth’s land and water cover, including:
* climatic and glacial cycles
* the invasion and ecological succession of vegetation communities.
* The natural processes, cycles and circulations that have shaped the land and/or water cover of ONE place.

#### Learning intentions and success criteria

**Teacher note:** these learning intentions and success criteria are general and should be contextualised to suit your school and students’ needs.

**Learning intentions**

Students:

* develop an understanding of global land cover and land use patterns and the natural processes that influence them
* interpret and process data using various graphical representations and geographical tools
* investigate the impact of climatic and glacial cycles and ecological succession in shaping Earth's land and water cover
* understand the natural processes, cycles and circulations that have shaped the land and/or water cover of ONE place.

**Success Criteria**

Students can:

* accurately estimate land cover percentages and create a pie graph to represent the data
* compare and contrast different types of graphs and maps, and their respective advantages and disadvantages
* effectively use the websites and maps to visualise and analyse land cover and land use data
* describe the nature and extent of Earth's land and water cover and the factors that influence them
* explain the Last Glacial Maximum and its impact on Earth's climate, sea level and ice sheets
* create an illustrative timeline and response of invasion and the ecological succession of vegetation communities at Lake Mungo.

### The nature and extent of Earth’s land cover, including water

Working in pairs, use the definition the [Department of Agriculture, Fisheries and Forestry](https://www.agriculture.gov.au/abares/aclump/definitions#:~:text=Land%20cover%20refers%20to%20the,as%20agriculture%20and%20built%20environments.) and the National Ocean Service’s article ‘[What is the difference between land cover and land use](https://oceanservice.noaa.gov/facts/lclu.html#:~:text=Land%20cover%20data%20documents%20how,%2C%20conservation%2C%20or%20mixed%20uses.)’, provides of land cover and answer the following:

* identify examples of land cover
* explain how land cover is different to land use.

Access [Global Land Cover](https://lcviewer.vito.be/2019) to estimate the percentage of the world’s land cover in the following categories:

* forests
* shrubland
* herbaceous vegetation
* herbaceous wetland
* moss and lichen
* bare or sparse vegetation.

Use the percentages to create a sector graph.

Compare the sector graph with the world map graph from [How the world’s land is used: total area sizes by type of use & cover](https://ourworldindata.org/land-use#how-the-world-s-land-is-used-total-area-sizes-by-type-of-use-cover). In pairs, complete the following:

* Do the 2 charts convey identical data? Provide an explanation.
* What is the main source of data used for estimating global land use?
* How does the distribution of land use categories in the sector graphs compare to their visual representation on the world map graph?
* Which land cover classifications prove to be more valuable? Elaborate on the reasons.
* What are the advantages and disadvantages with using the world map as a substitute for a sector graph?
* What is the total land area occupied by agricultural land, and how does it break down between arable and permanent crops versus pastures?
* What percentage of the world's land is covered by urban areas, and how does this compare to other land use types?

Access the interactive map [Global land cover and land use 2019](https://glad.earthengine.app/view/global-land-cover-land-use-v1#lon=0;lat=0;zoom=3;) (GLAD) to answer the following:

* How does the GLAD website use Google Earth Engine to visualise global land cover and land use data? What is the map’s primary purpose?
* Is this a small scale or large-scale map?
* What geographical tools and skills are required to effectively interpret the data provided by the GLAD website?
* Who do you think is the intended audience of this map?
* How can the data from the GLAD website be combined with other geographic data or tools to create more comprehensive analysis of land cover and land use trends?

Access Google’s [My Maps](https://www.google.com.au/maps/about/mymaps/) to construct a land use map illustrating land cover in a suburb or regional area. Include the following spatial data on the map:

* Earth’s physical/natural features (for example, forested areas, wetlands, water bodies)
* anthropogenic elements that are derived from human activity and influence the environment (for example, plantations, crops and built environments).

Types of maps could include:

* **Topographic maps:** these maps show the physical features of the land, including elevation and contour lines. They can also show water bodies, vegetation, and built environments.
* **Land use maps:** these maps are specifically designed to show how land is being used in a particular area. They can show the different land use categories, such as residential, commercial, industrial, agricultural, and open space.
* **Precise maps:** these maps are created using precise measurements and provide detailed information on the location, shape, and size of natural and man-made features. They may include topographic data as well as information on boundaries, land ownership, and other cadastral details.
* **Cadastral maps:** these maps show the boundaries and ownership of land parcels within a particular area. They may include information on land use, zoning, and other regulatory data.

Complete a one paragraph response to the following question, ‘Describe the nature and extent of Earth’s land cover, including water’. The response should include reference to:

* the diverse nature and extent of land and water cover
* anthropogenic elements (for example, crops).

### Natural processes, cycles and circulations that change Earth’s land and water cover

Use the map, [The Global Last Glacial Maximum](https://www.antarcticglaciers.org/2017/06/global-last-glacial-maximum/) and a [blackline map of the world](https://www.teachersprintables.net/preview/Map_of_World) to draw an annotated map illustrating the glacial cover of earth at Last Glacial Maximum (LGM) roughly 20,000 years ago during the Pleistocene epoch. Answer the following questions:

* What is the LGM, and how did it impact the Earth's climate?
* What were the main drivers of the Earth's climate during the LGM?
* How did the LGM affect sea level and the extent of ice sheets around the world?
* What role did Antarctica play during the LGM and how did its ice sheet contribute to sea level changes?
* How have scientists been able to reconstruct past climate conditions during the Last Glacial Maximum and what techniques have they used to study the Earth's climate history?

Access Energy Education’s [Glacial and interglacial periods](https://energyeducation.ca/encyclopedia/Glacial_and_interglacial_periods) and discuss with a partner, the relevance of glacial cycles on the land and water cover we observe on Earth today. Include the following terms as prompts for discussion:

* Ice Age
* glacial
* interglacial.

Use Figure 2 from the article ‘[Energy Education - Glacial and interglacial periods](https://energyeducation.ca/encyclopedia/Glacial_and_interglacial_periods)’ and [Introduction to Climate Science](https://open.oregonstate.education/climatechange/chapter/paleoclimate/) to answer the following questions:

* Approximately how long ago was the LGM?
* How much colder were global average surface air temperatures during the LGM?
* How much lower was atmospheric CO2 during the LGM compared to the pre-industrial late Holocene?
* What are glacial and interglacial periods, and how do they differ from each other?
* What causes the Earth to go through these cycles of glacial and interglacial periods?
* What evidence do we have of past glacial and interglacial periods, and how do we study them?
* How do glacial and interglacial periods affect the Earth's climate and ecosystems?
* Are we currently in an interglacial period, and if so, how long do these periods typically last?
* How have human activities influenced the Earth's climate and the occurrence of glacial and interglacial periods?

Access [Milankovitch (Orbital) Cycles and Their Role in Earth's Climate](https://climate.nasa.gov/news/2948/milankovitch-orbital-cycles-and-their-role-in-earths-climate/#:~:text=He%20calculated%20that%20Ice%20Ages,years%2C%20matching%20Earth's%20eccentricity%20cycle.) to conduct a [mind mapping](https://app.education.nsw.gov.au/digital-learning-selector/LearningActivity/Card/542) activity to answer the following questions:

* What are Milankovitch orbital cycles and how do they influence Earth's climate?
* How did Milutin Milankovitch discover the correlation between Earth's climate and its orbital cycles?
* What is the relationship between climatic and glacial cycles and changes in sea levels and ice sheets?

Use [Forces shaping Willandra Lakes (1:10)](http://www.visitmungo.com.au/landscape-in-action) to construct a flow chart summarising the sea-level and climate changes that occurred to form the current day Willandra Lakes region. Then use [45,000 years at Lake Mungo (1:08)](http://www.visitmungo.com.au/landscape-in-action) to describe in 1–2 paragraphs how sea level change influenced the Willandra Lakes land and water cover.

Create a series of study cards for the topic ‘Climatic and glacial cycles that change Earth’s land and water cover’. These study cards will act as revision prompts for this topic in the future.

Access [Ecological Succession (3:08)](https://youtu.be/zLduuefGVSc) and [Succession (2:33)](https://youtu.be/9kkWxUgMHfA) to define the following terms:

* ecological succession
* primary succession
* secondary succession.

**I**n pairs, use [Ecological succession](https://news.uchicago.edu/explainer/what-is-ecological-succession#climaxcommunity) and [Mungo Plants](https://www.donsmaps.com/mungoplants.html) to develop an illustrative timeline of invasion and the ecological succession of vegetation communities at Lake Mungo. The following questions should guide the inquiry:

* What was the climax community (definition below) that existed at Lake Mungo 45,000 years ago?
* How did the retreat of the inland lake (Lake Bungunnia) in the Murray Basin result in ecological succession?
* Describe the vegetation that exists at Lake Mungo today and how this community formed.

**Teacher note:** a ‘climax community’ is the stable and final stage of ecological succession in a particular habitat or ecosystem, characterised by a balance of species adapted to the prevailing environmental conditions.

Using previous activities and information, explain the influence of invasion and ecological succession on vegetation communities and change in land cover.

Work through the following scenario research task:

‘As an environmental engineer for UNESCO, you have been asked to prepare a report on the natural processes, cycles and circulations that have shaped the land or water cover in ONE place in the world. This report should be 3–5 pages and should integrate geographical tools such as maps, graphs and diagrams.’

The report should be broken into 4 sections, including:

* atmospheric systems
* hydrological systems
* geomorphic systems
* ecological systems.

Have students reflect on what they have learnt about the natural processes, cycles and circulations using the following sentence stems as a guide:

* I used to think …
* Now I think …

## Learning sequence 4: Case study and fieldwork

### Syllabus content

* The natural processes, cycles and circulations that have shaped the land and/or water cover of ONE place.

#### Learning intentions and success criteria

**Teacher note:** these learning intentions and success criteria are general and should be contextualised to suit your school and students’ needs.

**Learning intentions**

Students:

* gain practical experience in conducting fieldwork by using geographical tools and techniques to collect, analyse and interpret data from a natural environment
* develop the ability to connect theoretical knowledge of natural processes, cycles and circulations to real-world observations and findings during fieldwork
* learn to use geographical tools and instruments to collect and interpret primary data in the field effectively.

**Success criteria**

Students can:

* accurately identify and describe the natural processes, cycles and circulations that have shaped the land and water cover at Mt Kosciuszko
* effectively use geographical tools and instruments, such as GPS, topographic maps, and vegetation transects to collect primary data in the field
* interpret and process the primary data collected during the fieldwork, discussing the reliability, validity and limitations of the data
* produce a well-structured written response to the fieldwork question using both primary and secondary data to support their argument.

### Case study and fieldwork

**Before the fieldwork**

Familiarise with the geographical tools and instruments of measurement that will be used to collect primary data in the field. Practice utilising these tools in the school environment.

Visit the NSW National Parks and Wildlife Service website for more information on [Kosciuszko National Park](https://www.nationalparks.nsw.gov.au/visit-a-park/parks/kosciuszko-national-park) (KNP). Review the visitor information, topographic maps and overview for the [Perisher-Thredbo area](https://www.nationalparks.nsw.gov.au/visit-a-park/parks/thredbo-perisher-area) and the [Mount Kosciuszko summit walk.](https://www.nationalparks.nsw.gov.au/things-to-do/walking-tracks/mount-kosciuszko-summit-walk)

**Teacher note:** a briefing should be conducted with students prior to departing the school. This will include final information on weather, accommodation, risk mitigation and expectations of student behaviour.

Lead fieldwork at Kosciuszko National Park as part of [Assessment task 1](https://education.nsw.gov.au/teaching-and-learning/curriculum/hsie/planning-programming-and-assessing-hsie-11-12/planning-programming-assessing-geography-11-12). Alternative locations can be utilised, and fieldwork requirements adapted to suit the new context as required.

Complete a 3-day fieldwork activity, using geographical tools to collect primary data including:

* GPS to identify latitude and longitude
* using a topographic map, recording an estimated altitude and identifying aspect
* constructing a vegetation transect
* recording the characteristics of flora and implications for fauna
* estimating percentage of ground cover and vegetation diversity
* estimating percentage of canopy cover and species diversity
* recording climatic data
* drawing an annotated field sketch
* recording observations of water storage and flows
* collecting and interpreting photographic images.

**After the fieldwork**

Conduct a brainstorming session to identify the key learning from the fieldwork.

Contribute to a shared [Google Jamboard](https://app.education.nsw.gov.au/digital-learning-selector/LearningTool/Card/593) to compile class brainstorming responses about the key learnings from the fieldwork.

Display a range of photographs taken during the fieldwork. Review the photographs and use sticky notes to annotate each image, identifying the following:

* processes, cycles and circulations
* land cover
* water cover
* other relevant observations.

Select photos to be included as part of the primary data recorded on the fieldwork data sheets provided with [Assessment task 1](https://education.nsw.gov.au/teaching-and-learning/curriculum/hsie/planning-programming-and-assessing-hsie-11-12/planning-programming-assessing-geography-11-12).

Discuss and respond to the following questions:

* What processes, cycles and circulations were evident during the fieldwork?
* How are these processes, cycles and circulations impacted by the geographic location?
* Why does the data collected help us to understand the land and water cover in KNP?
* Is the data and information gathered reliable, valid and useful?
* Identify any limitations in the data collected.

**In-class assessment activity**

Students complete a written response to the fieldwork question:

‘Explain the natural processes, cycles and circulations that have shaped the land and water cover at Mt Kosciuszko. Use primary and secondary data to support your response.’

The written response **and** fieldwork notes should be collected for marking.

Complete a class discussion, sharing observations, findings and experiences from the fieldwork.

Identify any challenges, the limitations of the data, and the connections between the observed phenomena and the theoretical.

Create visual representations, such as graphs, charts or maps to illustrate the key findings from the fieldwork data.

Utilise these visualizations to better understand the natural processes, cycles and circulations at play in the study area.

Conduct research on secondary sources to gather additional information on the study area and compare their fieldwork findings with other studies and data.

Prepare a written report or presentation to summarise the fieldwork findings, the data analysis, and conclusions about the natural processes, cycles, and circulations that have shaped the land and water cover at the study site. Include both primary and secondary data to support their arguments and address any limitations in their research.

Reflect on and evaluate individual performance and consider lessons learned, challenges faced, and how tools, skills and knowledge can be applied to future fieldwork or other geographical studies.

## Additional information

The information below can be used to support teachers when using this teaching resource for Geography 11–12 (2022).

### Support and alignment

**Resource evaluation and support:** all curriculum resources are prepared through a rigorous process. Resources are periodically reviewed as part of our ongoing evaluation plan to ensure currency, relevance, and effectiveness. For additional support or advice contact the HSIE Curriculum team by emailing [hsie@det.nsw.edu.au](mailto:hsie@det.nsw.edu.au).

**Alignment to system priorities and/or needs:** [School Excellence Policy](https://education.nsw.gov.au/policy-library/policies/pd-2016-0468), [School Success Model.](https://education.nsw.gov.au/public-schools/school-success-model/school-success-model-explained)

**Alignment to the School Excellence Framework:** this resource supports the [School Excellence Framework](https://education.nsw.gov.au/teaching-and-learning/school-excellence-and-accountability/sef-evidence-guide/resources/about-sef) elements of curriculum (curriculum provision) and effective classroom practice (lesson planning, explicit teaching).

**Alignment to Australian Professional Teaching Standards:** this resource supports teachers to address [Australian Professional Teaching Standards](https://educationstandards.nsw.edu.au/wps/portal/nesa/teacher-accreditation/meeting-requirements/the-standards/proficient-teacher) 3.2.2, 3.3.2.

**Consulted with:** Curriculum and Reform, Inclusive Education, Multicultural Education, Aboriginal Outcomes and Partnerships and subject matter experts

**NSW syllabus:** Geography 11–12 Syllabus (2022)

**Syllabus outcomes:** GE11-01, GE11-02, GE11-05, GE11-06, GE11-07, GE11-08, GE11-09

**Author:** Curriculum Secondary Learners

**Publisher:** State of NSW, Department of Education

**Resource:** Learning sequence

**Related resources:** further resources to support Geography Stage 6 can be found on the [HSIE curriculum page](https://education.nsw.gov.au/teaching-and-learning/curriculum/key-learning-areas/hsie) and the [HSC hub](https://www.hschub.nsw.edu.au/).

**Professional learning:** relevant professional learning is available through the [HSIE statewide staffroom](https://teams.microsoft.com/l/team/19%3ace47173b5fe14e16918eac8ca5e40913%40thread.skype/conversations?groupId=cc91cc45-b966-4333-b01f-31e78225fac4&tenantId=05a0e69a-418a-47c1-9c25-9387261bf991).

**Universal Design for Learning:** [Universal Design for Learning planning tool](https://education.nsw.gov.au/teaching-and-learning/learning-from-home/teaching-at-home/teaching-and-learning-resources/universal-design-for-learning). Support the diverse learning needs of students using inclusive teaching and learning strategies.

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## References

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