MINISTRY OF EDUCATION

GEOGRAPHY
for Senior High Schools
TEACHER MANUAL

Year 2

NATIONAL COUNCIL FOR CURRICULUM & ASSESSMENT OF MINISTRY OF EDUCATION

MINISTRY OF EDUCATION

REPUBLIC OF GHANA

GEOGRAPHY

For Senior High Schools

Teacher Manual

Year Two

NATIONAL COUNCIL FOR CURRICULUM & ASSESSMENT OF MINISTRY OF EDUCATION

GEOGRAPHY TEACHER MANUAL

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Introduction

The National Council for Curriculum and Assessment (NaCCA) has developed a new Senior High School (SHS) curriculum which aims to ensure that all learners achieve their potential by equipping them with 21st Century skills, competencies, character qualities and shared Ghanaian values. This will prepare learners to live a responsible adult life, further their education and enter the world of work.

This is the first time that Ghana has developed an SHS Curriculum which focuses on national values, attempting to educate a generation of Ghanaian youth who are proud of our country and can contribute effectively to its development.

This Teacher Manual for Geography is a single reference document which covers all aspects of the content, pedagogy, teaching and learning resources and assessment required to effectively teach Year Two of the new curriculum. It contains information for all 24 weeks of Year Two including the nine Key Assessments required for the Student Transcript Portal (STP).

Thank you for your continued efforts in teaching our children to become responsible citizens.

It is our belief that, if implemented effectively, this new curriculum will go a long way to transforming our Senior High Schools and developing Ghana so that we become a proud, prosperous and values-driven nation where our people are our greatest national asset.

Acknowledgements

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SECTION 1: THE EARTH'S DYNAMIC PROCESSES AND LANDFORMS

STRAND: THE EARTH AND ITS NEIGHBOURHOODS

Sub-Strand: The Earth and Its Features

Learning Outcomes

- **With** *reference to the shape and movement of the Earth, discuss the concept of continental drift*
- **Identify** *the different types of landforms (mountains and plains), describe the processes that create them, and examine their importance*

Content Standards

- *Demonstrate an understanding of the internal structure of the Earth and the concept of continental drift.*
- *Demonstrate knowledge and understanding of landforms, their importance, and the processes that lead to their creation.*

Hint

- *Assign learners their **Portfolios** by Week 2. Refer to **Appendix A** for details of the structure of the portfolio. The **Portfolios** will be collected in **week 21** in the **2nd semester**, scored, and recorded.*
- *Assign **Group Project Work** in Week 3. See **Appendix B,** which has been provided at the end of this section, detailing the structure of the group project. The group project will be submitted in **Week 8**.*

INTRODUCTION AND SECTION SUMMARY

The Earth is a dynamic place, full of fascinating features both above and below its surface. This section begins by exploring the internal structure of the Earth and discusses the properties of three layers; the core, mantle, and crust. The second section delves deep into the concept of Continental Drift and explains how continents have shifted over geological time. The last section is devoted to the study of mountains and their importance, highlighting their formation, and ecological significance. The focal areas covered in the section are intended to provide learners with a comprehensive understanding of Earth's dynamic processes and landscapes.

The weeks covered by the section are:

Week 1: The Internal Structure of the Earth

Week 2: The Concept of Continental Drift

Week 3: Mountains and their Importance

Week 4: Plains and their Importance

SUMMARY OF PEDAGOGICAL EXEMPLARS

This section discusses the diverse pedagogical exemplars that can be employed to enhance learner engagement and understanding. Talk for Learning through discussions fosters critical thinking and communication skills by encouraging learners to discuss and debate topics. Activity-Based Learning includes drawing structures and diagrams, reproducing maps, and creating posters and sketches of landforms, enabling hands-on exploration of concepts. Exploratory Learning involves research and nature walks to mountains, hills, and plains, allowing learners to connect theoretical knowledge with real-world observations. Collaborative Learning is facilitated through small, mixed-gender groups, promoting teamwork and diverse perspectives. Digital Learning utilises videos to provide a visual and auditory representation of complex focal areas, making abstract concepts more accessible. Together, these approaches create a rich, multifaceted learning environment.

ASSESSMENT SUMMARY

The assessment strategies that can be useful for effectively assessing learners' understanding of the Internal Structure of the Earth, the Concept of Continental Drift, and the socio-economic importance of Mountains and Plains have been captured in the summary. They include group presentations, discussions, and class exercises. Using these formative and summative strategies can help evaluate learners' abilities to analyse complex landform formation processes and propose innovative solutions. Summative assessments, like group presentations, assess learners' overall comprehension of these topics, along with their critical thinking, analysis, and synthesis skills. Teachers can refer to the Teacher Assessment Manual and Toolkit (TAMT) for further guidance on implementing these assessment strategies effectively.

WEEK 1

Learning Indicator: *Sketch, label, and describe the internal structure of the Earth.*

FOCAL AREA: THE INTERNAL STRUCTURE OF THE EARTH

Meaning of Internal Structure of the Earth

The internal structure of the Earth describes the stratified arrangement beneath the Earth, consisting of several distinct layers, each with its unique characteristics and compositions.

Internal Structure of the Earth

The internal structure of the Earth is made up of three main distinct layers and these are

1. the crust (or lithosphere)
2. the mantle (or mesosphere)
3. the core (or barysphere)

The Crust (Lithosphere)

a. It is the outermost layer of the internal structure of the Earth.
b. It has a variety of rocks and minerals.
c. It is the thinnest layer compared to the other layers.
d. It ranges between 5 km to 70 km in thickness.
e. It is made up of continental crust (Silica and Aluminium - *sial*) and oceanic crust (Silica and Magnesium - *sima*)
f. The continental crust is primarily composed of granitic rocks while the oceanic crust is made up of basaltic rocks.
g. The average density ranges from 2.7 g/cm^3 to 3.0 g/cm^3
h. The layer that separates the crust from the mantle is called *Mohorovicic discontinuity* or simply, *Moho*.

The Mantle (Mesosphere)

a. It is found beneath the Earth's crust.
b. It is composed of solid rock (peridotite), primarily a mix of silicate minerals like olivine and pyroxene (augite).
c. Its thickness is about 2900 km below the Earth's surface.
d. The mantle is divided into two parts: the upper mantle, which is solid but ductile and the lower mantle, which is solid and more rigid.
e. It is the thickest layer, accounting for about 84% of the Earth's volume.
f. It is also less dense than the core, with values ranging from 3.3 g/cm^3 to 5.5 g/cm^3
g. Convection currents in the mantle drive plate tectonics.
h. The layer that separates the mantle from the core is called Gutenberg discontinuity.

The Core (Barysphere)

a. It is the innermost layer of the Earth.
b. It consists of two distinct sections: the inner core and the outer core.
c. The outer core forms a 2400-kilometre-thick band around the inner core.
d. The outer core has a viscous flowing nature with a density of 10 g/cm^3
e. The inner core has a radius of about 960 kilometres.
f. The inner core is solid, with a density of 13 g/cm^3
g. Both the outer and inner core are composed primarily of iron and nickel.
h. Despite high temperatures (up to about 6,000°C), it remains solid due to immense pressures.

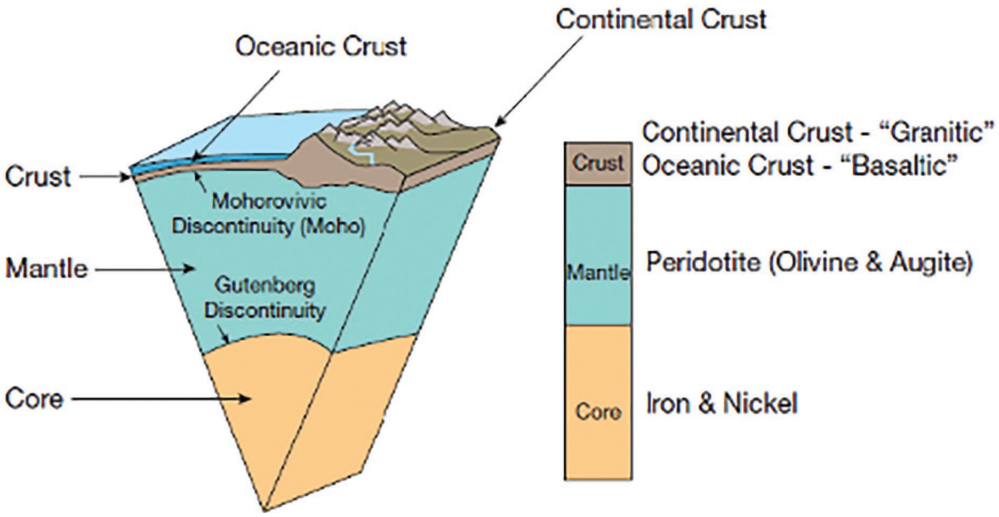

Figure 1.1: Diagram showing the internal structure of the Earth (Peterson et al., 2019)

Learning Tasks

1. Discuss the components of the internal structure of the Earth.
2. Draw a well-labelled diagram showing the internal structure of the Earth.

PEDAGOGICAL EXEMPLARS

Talk for learning

Using videos or pictures and other resources, Learners in pairs discuss the components of the internal structure of the Earth and share with the whole class.

1. Give learners a structured worksheet or graphic organiser that outlines the key components of the Earth's internal structure (e.g., crust, mantle, and core).
2. Provide physical or digital models of the Earth's layers, as well as labelled diagrams and illustrations.
3. Form pair base on learning abilities and assign differentiated roles within the pairs: For example, the high-ability learner could be responsible for researching and

explaining the characteristics of each layer, while the lower learner focuses on drawing a labelled diagram or creating a mnemonic device to remember the layers in order.

4. Provide a range of questions and activities with varying levels of complexity.
5. Encourage the use of multimedia resources: Suggest that learners refer to online videos, interactive simulations, or educational websites to deepen their understanding of the Earth's internal structure.
6. When the pairs present their findings to the class, encourage them to use a variety of modes (e.g., verbal, visual, and kinaesthetic) to accommodate different learning styles. Provide guiding questions or a presentation template to structure their sharing.
7. Monitor the whole class discussions and be ready to provide additional explanations, clarifications, or suggestions to ensure all learners can actively participate and contribute.
8. Formatively assess learners to gauge their comprehension and adjust your support or differentiation strategies as needed.

Activity-Based Learning

Using appropriate resources, draw a well-labelled diagram showing the internal structure of the Earth.

1. Curate age-appropriate resources, such as textbooks, scientific articles, video lessons, and interactive simulations.
2. Organise the resources based on complexity or learning style to cater to different needs.
3. Break down the task into manageable steps, such as identifying the key layers, labelling them, and adding relevant details.
4. Provide partially completed diagrams or templates for learners to fill in, gradually increasing the level of complexity.
5. Offer guidance on the appropriate use of labels, legends, and colour-coding to create a clear and informative diagram.
6. Provide choices for the level of detail and labelled components required in the diagram.
7. Regularly check in with learners, offering guidance, feedback, and opportunities for revision as they work on their diagrams.
8. Encourage learners to self-assess their progress and seek help when needed.

Learners in group discussions should not forget the emotions people attach to religious, political, and ethnic issues.

Key Assessment

Level 1: Name the three main layers of the Earth.

Level 1: Explain the differences between the Earth's mantle and core.

Level 2: Sketch and label the internal structure of the Earth and explain four (4) characteristics of the crust.

WEEK 2

Learning Indicator: *Explain the concept of continental drift and discuss the supporting evidence.*

FOCAL AREA: THE CONCEPT OF CONTINENTAL DRIFT

Continental Drift Theory

Continental drift is a theory that describes the movement of continents across the Earth's surface over geological time.

To understand the mechanism behind the movement of the continents, one needs to understand the plate tectonic movements. Plate tectonics is the scientific theory that explains the large-scale movement of Earth's lithosphere, which is divided into several rigid sections or 'plates'. These plates float on top of the semi-fluid asthenosphere, which lies beneath the lithosphere. The movement of these plates is driven by forces such as mantle convection, gravity, and the Earth's rotation. There are three main types of plate boundaries where different interactions occur:

1. **Divergent Boundaries:** Plates move apart from each other, leading to the creation of new crust as magma rises from below the Earth's surface. An example is the Mid-Atlantic Ridge.
2. **Convergent Boundaries:** Plates move toward each other, causing one plate to be forced beneath another in a process called subduction. This often leads to the formation of mountains, volcanic activity, and earthquakes. The Himalayas are a result of convergent boundaries.
3. **Transform Boundaries:** Plates slide past each other horizontally. This lateral movement can cause significant earthquakes along fault lines, such as the San Andreas Fault in California.

In 1912, the German meteorologist and explorer, Alfred Wegener, presented the theory that the continents were once joined in one big landmass and have over millions of years slowly drifted apart and into their present positions. He named this supercontinent Pangaea, a Greek word meaning "all land". The rest of the Earth's surface was covered by a massive ocean called Panthalassa. Over time, Pangaea split into two sub-continents namely, Laurasia and Gondwanaland separated by the Tethys Sea. Laurasia in the north contained present-day Asia, Europe, and North America. Gondwanaland in the south included South America, Africa, India (then separate from Asia), Australia and Antarctica. Wegener's theory was fiercely rejected at the time. After all, "What did a meteorologist, an outsider, know about geology?" Since the 1960s however, this theory has been accepted among most Earth scientists.

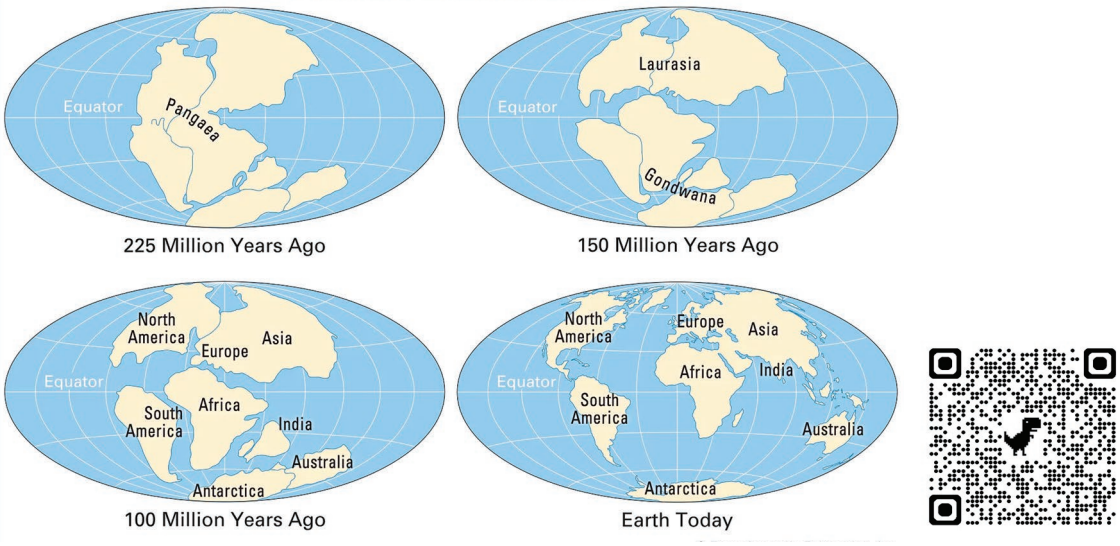

Figure: 2.1: Chronology of plate movements

There is a link between Plate tectonic movements and continental drift in the sense that plate tectonics provides the mechanism that Wegener's continental drift theory lacked. It explains how the continents move over the Earth's surface through the interactions of tectonic plates. The movement of these plates causes continents to shift, collide, and drift apart over geological time scales, thereby supporting Wegener's hypothesis. Thus, plate tectonics not only validates the concept of continental drift but also offers a comprehensive framework for understanding the dynamic nature of Earth's surface.

Evidence of Continental Drift

1. **Fitting of the Continents:** The coastlines of South America and Africa seem to fit together like puzzle pieces, particularly along the eastern bulge of South America and the western bulge of Africa. This observation was one of the first to spark the idea of continental drift.

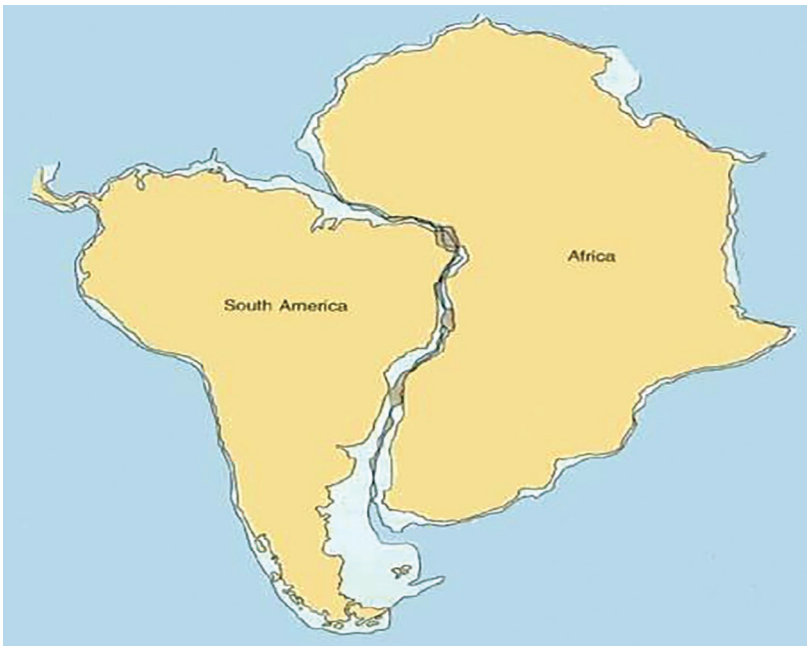

Figure 2.2: Fitting of Continents

2. **Fossil Distribution:** Fossils of the same species of plants and animals have been found on continents that are now widely separated by oceans. For example, fossils of the reptile Mesosaurus have been found in both South America and Africa. These land-based creatures would not have been able to swim across vast oceans, suggesting they must have lived on a connected landmass.

Figure 2.3: Fossil Distribution

3. **Rock Formations:** Similar rock formations and mountain ranges are found on continents that are now separated by oceans. For instance, the Appalachian Mountains in the northeastern portion of North America have similar formations to the Scottish Highlands; the rock strata of the Karroo system of South Africa match correctly with the Santa Catarina system in Brazil and Ghanaian mountain ranges (the Akuapem-Togo ranges).

Figure 2.4: Matching rock formation

4. **Ancient Climate Evidence:** Scratches left by glaciers on rocks in continents like Africa, South America, India, and Australia all point to a time when these landmasses were closer together near the South Pole. This would not be possible if the continents had always been in their current positions.

Learning Tasks

1. Research the concept of continental drift from various sources including the internet, libraries, and books.
2. Discuss the concept and evidence of continental drift using available sources and present findings.

PEDAGOGICAL EXEMPLARS

Exploratory Learning

Research about continental drift from various sources including the internet, library, and books.

1. Break down the research task into manageable steps, such as formulating research questions on the theory of continental drift, locating relevant sources, evaluating information, and synthesising findings. Example: Who propounded the theory of continental drift?
2. Offer guidance on effective note-taking strategies and the organisation of research findings.
3. Assemble a collection of print and digital resources covering various aspects of continents, including textbooks, academic journals, and reputable websites. Organise the resources by topic, difficulty level, or learning style to cater to different learner preferences.
4. Provide different levels of complexity for the research task, such as requiring a more in-depth analysis for advanced learners or a broader overview for those who need more support. Adjust the length, format, and depth of the final research product (e.g., written report, oral presentation, multimedia presentation) to match the diverse needs of learners.
5. Encourage learners to work in pairs or small groups to share resources, discuss findings, and collectively synthesise their research.
6. Suggest the use of digital tools and software for research, data analysis, and presentation creation, such as online databases, mind mapping applications, or multimedia authoring tools.
7. Regularly check in with learners, offering guidance, feedback, and opportunities for revision as they progress through the research process.
8. Clarify concepts, answer questions, and provide personalised support to address individual needs when needed.
9. Encourage learners to self-assess their progress and seek help when needed.

Collaborative Learning

In small mixed-gender groups of assigned roles, discuss the concept and evidence of continental drift using available sources and present findings.

1. Assign learners to small, diverse groups, considering their strengths, learning styles, and intellectual abilities.
2. Provide clear guidelines for the group roles, such as discussion leader, note-taker, presenter, and researcher, to ensure effective collaboration.
3. Offer a set of discussion outlines to help the groups explore the concept and evidence of continental drift.
4. Suggest strategies for effective group discussion, such as active listening, respectful disagreement, and building on each other's ideas.
5. Allow learners to choose the presentation format that best suits their strengths and preferences, such as a slide show, a poster, or a multimedia presentation.
6. Provide constructive feedback that highlights the strengths of the presentation and offers suggestions for improvement.
7. Allow time for the groups to reflect on their learning process, the challenges they faced, and the strategies they used to overcome them.
8. Offer clarification, answer questions, and provide personalised support as needed.

Learners should consider the emotions of individuals who struggle to express themselves.

Key Assessment

Level 1: Match the continental plate to its direction of movement:

a. North American Plate	(i) Westward
b. Eurasian Plate	(ii) Northward
c. Pacific Plate	(iii) Eastward

Level 2

1. Based on your understanding of continental drift theory and the historical breakup of Pangaea, group the following present-day continents under Laurasia and Gondwanaland.
   a. North America
   b. South America
   c. Africa
   d. Europe
   e. Asia
   f. Antarctica
   g. Australia
2. Create a model that represents the continents before they drifted apart (Pangaea) and explain their reasoning.

Level 3: Discuss at least three pieces of evidence of the continental drift theory.

Level 4

1. You are a science communicator tasked with creating an engaging multimedia presentation about the theory of continental drift and its importance. Let your presentation cover the key historical figures, evidence, and concepts behind continental drift, as well as its lasting impact on our understanding of Earth's geology and evolution. Incorporate visual aids, animations, interactive elements, and any other creative approaches to help your audience grasp these complex ideas.
2. How did Alfred Wegener's theory of continental drift contribute to our understanding of plate tectonics, and what evidence supports this theory?

Hint

- *Assign learners their **Portfolios** by Week 2. Refer to **Appendix A** for details of the structure of the portfolio. The **Portfolios** will be collected in **week 21** in the **2nd semester**, scored, and recorded*
- *The recommended mode of assessment for Week 2 is research (individual). Refer to Key Assessment Level 4b for an example of a discussion question. See Appendix C for a sample marks scheme to score the research (individual).*

WEEK 3

Learning Indicator: *Identify the different types of mountains (e.g., volcanic, fold and block), their characteristics, the processes that create them and their importance.*

FOCAL AREA: MOUNTAINS AND THEIR IMPORTANCE

Meaning of Mountains

Mountains are landforms that are formed from large-scale Earth movements and usually rise significantly above the surrounding area. They are characterised by several key features such as high elevation, steep slopes, limited summit area and isolation or ranges.

Types of Mountains

1. **Fold Mountains:** They are mountains that are formed from the bending and crumpling of sedimentary rock strata through the process of compressional forces. The bending or crumpling of the rock layers that are ductile (bendable) as opposed to brittle (hard but liable to break) is often referred to as folding systems. This leads to the formation of a series of upfolds and downfolds called anticlines and synclines, respectively. There are five types of folding systems depending on the nature of the compressional forces. These are simple (symmetrical), asymmetrical, overfold (overturn), recumbent and overthrust (napped) folds as shown in Figure 3.1.

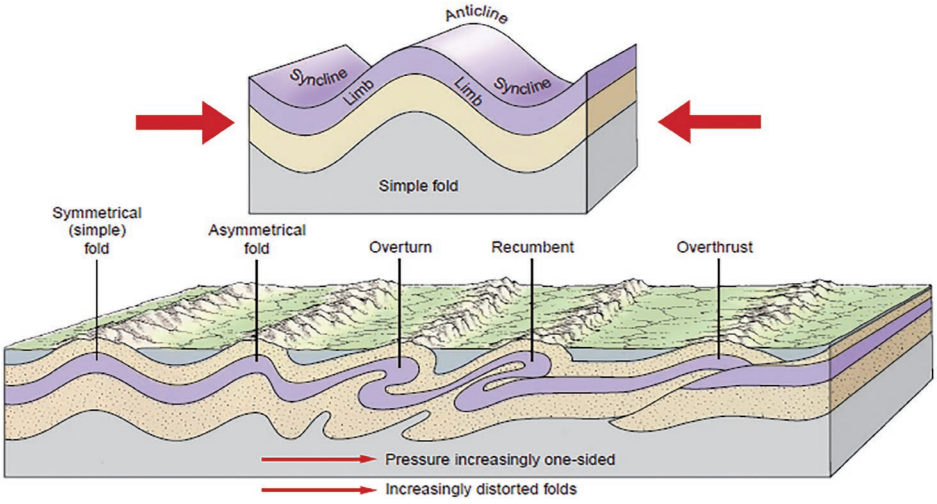

Figure 3.1: Diagram showing the types of fold systems (Peterson et al., 2019)

Characteristics/Features of Fold Mountains

1. They are formed within sedimentary rocks.
2. They formed from compressional forces.
3. The tops of fold mountains are typically convex in shape, forming an upward-curving arch or dome-like structure.
4. They are usually in elongated linear ranges that can stretch for hundreds or even thousands of kilometres.

5. They are easily susceptible to erosion.
6. They are usually formed at the coastal margins of continents.
7. Examples include the Himalayan mountains (Asia), the Rockies (North America) and the Andes (South America).

Process of Formation

The formation begins when two tectonic plates collide and cause the less dense plate to subdue (sink) beneath the other leading to the creation of a deep, elongated depression or trench in the Earth's surface called a geosyncline. Sediments are then accumulated in the geosyncline basin over time. The accumulated sediments become compacted and cemented forming sedimentary rock. The layers of the sedimentary rock are then subjected to compressional forces causing the deposited material to crumple to form a series of upfolds. The sedimentary rocks form fold mountains at subduction zones because they are less dense. The rocks are pushed up over the ocean floor when the two plates collide. This will eventually trigger volcanic activity, and earthquakes caused by frictional forces as the two plates collide. This will push the upfold to form elongated ranges called fold mountains as shown in Figure 3.2.

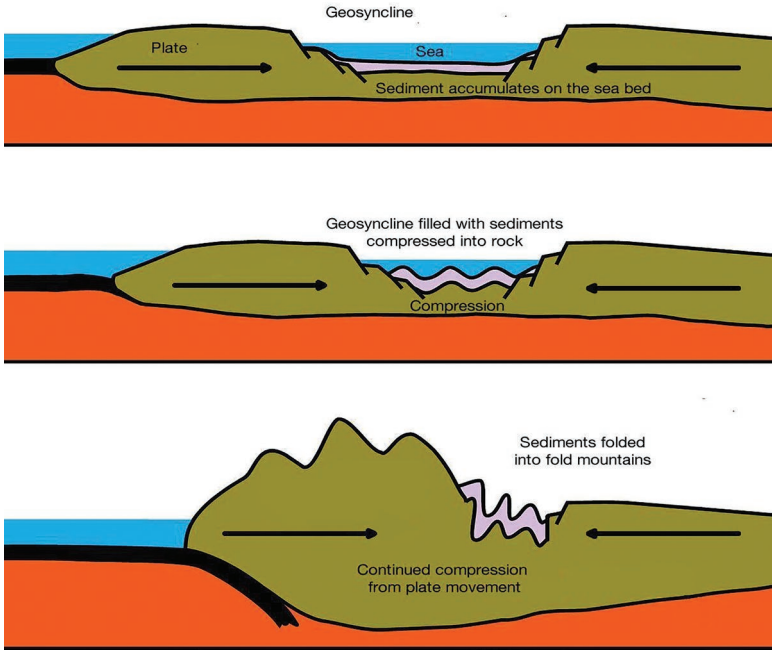

Figure 3.2: Processes leading to the formation of Fold Mountains

8. **Volcanic Mountains:** They are mountains formed from the eruption of molten rock (magma). from the Earth's interior. They occur primarily through the accumulation of erupted material such as lava, ash, and other volcanic material.

Characteristics of Volcanic Mountains

1. They are formed from molten rocks.
2. They are layered structures of alternating lava flows, volcanic ash, and other volcanic debris.
3. They are conical in shape.

4. They typically have steep and conical slopes with the steepness close to the vent.
5. They may be formed from either quiet or violent eruptions.
6. The summit of a volcanic mountain often has a bowl-shape depression called a crater.

Types of Volcanic Mountains

a. Based on the Nature of the Eruption

i. **Quiet (Effusive) Volcanoes:** They are volcanoes characterised by the relatively gentle and non-explosive eruption of lava.

ii. **Explosive Volcanoes:** These are volcanoes characterised by violent and powerful eruptions that release a mixture of hot gas, ash, and rock fragments.

c. Based on Activity

i. **Active Volcanoes:** These are volcanoes that have erupted recently and are likely to erupt again. An example is Mt. Stromboli in Italy.

ii. **Dormant or sleeping volcanoes:** These are volcanoes that have erupted in the last 2000 years and may erupt again. An example is Mt. Vesuvius in Italy.

iii. **Extinct Volcano:** These are volcanoes that have not erupted in recent historical times, and there is no evidence of a magma reservoir within the volcano. An example is Mt. Thielson in Oregon USA.

d. Based on structure

i. **Shield Volcanoes:** They are volcanoes shaped like a bowl or shield in the middle with long gentle slopes made by basaltic (highly fluid) lava flows. These are formed by the eruption of low-viscosity lava that can flow a great distance from a vent. Examples are Mauna Loa, in Hawaii and Pico do Fogo in Cabo Verde Islands.

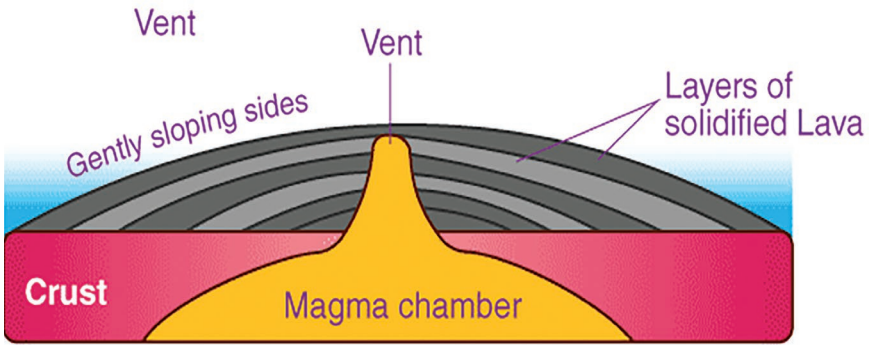

Figure 3.3: Shield volcano

ii. **Cinder Volcano/Cone:** They are circular or oval cones made up of small fragments of lava from a single vent that have been blown up. Cinder cones result from eruptions of mostly small pieces of scoria and pyroclastics that build up around the vent. Examples are Parícutin (Mexico) and Lava Butte (USA).

iii. **Composite Volcano (Stratovolcano):** They are steep-sided volcanoes composed of many layers of volcanic rocks, usually made from acidic (highly

viscous) lava, ash, and rock debris. These types of volcanoes are tall conical mountains composed of lava flows and other ejected materials in alternate layers. They are formed from the slowly built-up of the repeated eruption of lava flows, pyroclastic flows and ash forming a cone-shaped feature with steep sides and a crater at the top. Examples are Mount Kilimanjaro (Tanzania) and Mount Fuji (Japan).

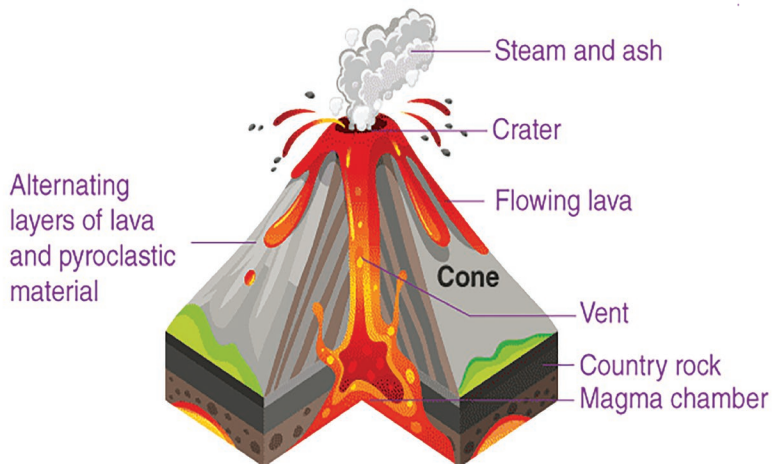

Figure 3.4: Composite Cone

4. **Block Mountains:** They are mountains that are formed by the displacement of rock strata along the line of a fault as a result of considerable pressure (compressional and tensional forces). A fault is a line of crack or fracture in the Earth's crust along which a displacement has occurred. There are three types of faulting, and these are Normal, Reverse and Tear/Strike-Slip as shown in Figure 3. Hade refers to the inclination of the fault to the vertical. Upthrow refers to upward displacement while Downthrow refers to downward displacement. Throw refers to the vertical displacement and Heave refers to lateral displacement.

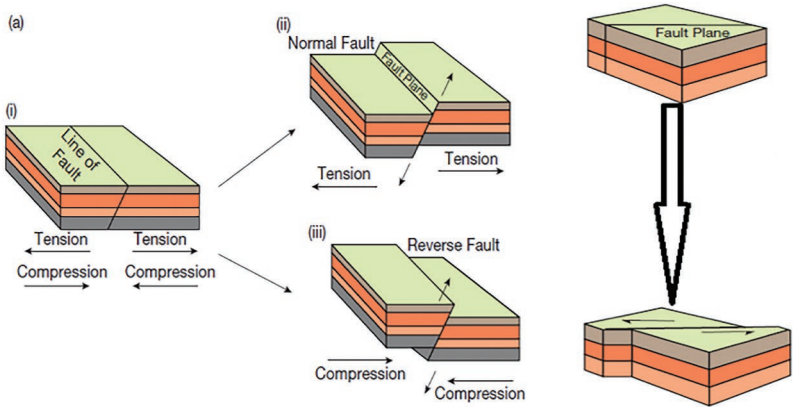

Figure 3.5: Diagram showing the types of faulting (Peterson et al., 2019)

Types of faults

1. **Normal Fault:** It formed as a result of tensional forces that pull the Earth's crust apart. In a normal fault, the hanging wall (the block that lies above the fault line) moves downward relative to the footwall (the block that lies below the fault line.) They are often associated with features such as fault scarp and graben/rift valley as the hanging wall subsides. The bedding plane forms an obtuse angle ($> 90^\circ < 180^\circ$)

with the fault plane/line. The normal fault causes crustal stretching. Examples include the Great Rift Valley (East Africa), Great basin of Utah (USA), Death Valley (California, USA) and Basin and Range Province (Western USA).

2. **Reverse fault:** It is formed as a result of compressional forces that push the Earth's crust together. In a reverse fault, the hanging wall moves upward relative to the footwall. They are commonly associated with features such as fault thrusts, mountain ranges and block mountains/horst as the hanging wall is thrust upwards. The bedding plane forms an acute angle (< 90°) with the fault plane/line. The reverse fault causes crustal shortening. Examples include Himalayan Mountains (Asia), Andes Mountains (South America), Alps Mountains (Europe).
3. **Tear Fault:** It is also known as a wrench fault, strike-slip fault or transcurrent fault**.** It is formed as a result of the lateral or horizontal movement of the Earth's crust. In other words, the crustal blocks slide past each other horizontally. The movement along a tear fault is parallel to the strike of the fault plane. They can create linear scarps or cliffs on the Earth's surface, where the horizontal movement has caused a displacement of the land. They are often associated with earthquakes, as the horizontal movement can generate significant seismic energy. Examples include the San Andreas Fault (California) and the Alpine Fault (New Zealand).

Characteristics of Block Mountains

1. They are formed from faulting.
2. They have steep sides.
3. They have relatively flat summits.
4. They are separated by rift valleys.
5. Examples include Mt. Ruwenzori (DR Congo), Vosges (eastern border of France) and Black Forest (Germany).

Processes leading to the Formation of Block Mountains

The formation of block mountains begins with the development of fault lines in the Earth's crust. The fault lines are usually caused by disturbances within the earth's crust. Tensional or compressional force begins to act on the opposite sides of the block where the fault lines have developed. In the case of tensional force, the two blocks outside the fault lines are pulled apart leading to the sinking of the central block thereby leaving the outside blocks standing as block mountains. Regarding compressional force, the two blocks outside the fault lines are pushed toward the centre leading to the uplift of the central block as Block Mountain. The uplifted blocks may either be tilted to form block mountains (tilt blocks), or they may be horizontal to form horsts.

Importance of Mountains to Socio-economic Development

1. Mountains are abundant in natural resources like minerals, hydropower, and fertile soils suitable for agriculture. These resources can drive economic growth and provide livelihoods for local communities.
2. With stunning landscapes, diverse ecosystems, and adventure opportunities, mountains are a popular tourist destination. Tourism in these areas can generate income, create jobs, and support regional development.

3. Mountains harbour a significant portion of the world's biodiversity, with unique species of plants, animals, and ecosystems. This biodiversity is essential for maintaining healthy ecosystems, providing ecosystem services, and inspiring scientific research.
4. Mountains function as "water towers," storing and releasing water that supports downstream communities and ecosystems. This water is vital for drinking, irrigation, hydropower, and industrial purposes.
5. Mountains play a vital role in regulating global climate by influencing weather patterns, storing carbon, and reflecting solar radiation.

Learning Tasks

1. Examine the process that creates mountains.
2. Create posters on different types of mountains, their features, processes, and benefits leading to their formation.

PEDAGOGICAL EXEMPLARS

Exploratory learning

Through nature walk, observe mountains/hills (or any high grounds) in the vicinity; use videos and sequential photos to examine the processes that create such highlands.

1. In a small mixed-ability group, task learners to brainstorm and create a detailed observation guide that outlines the key features and processes learners should focus on, such as rock types, the pattern of alignment, texture and height, massiveness, and slopes.
2. Include a range of questions and prompts to encourage deeper observation and analysis to cater to learners with different learning abilities.
3. Offer a choice of observation sites that suit learners' interests and abilities.
4. Provide options for the level of physical activity, such as a shorter, more accessible route for some learners and a longer, more challenging hike for others.
5. For video, utilise multimedia elements, like animations or simulations, to visualise the dynamic processes that shape highlands.
6. Provide clarification, answer questions, and offer personalised guidance as needed.
7. Encourage learners to seek help and advocate for their needs throughout the learning experience.
8. Provide opportunities for learners to present their findings, hypotheses, and conclusions to the class, either individually or in their groups.
9. Encourage peer feedback and discussions, guiding learners to provide constructive comments and ask thoughtful questions.
10. Develop formative and summative assessments that evaluate the learners' observation skills, their understanding of the formation processes, and their ability to communicate their findings effectively.
11. Provide timely and constructive feedback that highlights the learners' strengths, identifies areas for improvement, and offers suggestions for further exploration.

Activity-Based Learning

Create posters on different types of mountains, their features, processes, and benefits leading to their formation.

1. Assemble a collection of resources, including pictures, cardboard, colour pens and interactive simulations, which cover a variety of mountain types, their characteristics, and the processes of mountain formation.
2. Organise the resources by topic, complexity, or learning style to cater to different learner preferences.
3. Offer examples of well-designed posters or provide access to online poster design tools to inspire and guide the learners.
4. Break down the poster creation task into manageable steps, such as research, content organisation, design, and presentation.
5. Offer a range of mountain types or specific aspects of mountains for learners to focus on, allowing them to choose based on their interests and abilities.
6. Provide different levels of complexity for the poster content, such as requiring more in-depth analysis or technical details for advanced learners, or a broader overview for those who need more support.
7. Assign learners to small, diverse groups to work on the poster project together.
8. Provide opportunities for group members to share their research findings, discuss the content, and collectively decide on the poster design and presentation.
9. Encourage learners to self-assess their progress and seek help when needed.
10. Provide a structured format for the poster presentations, allowing learners to highlight their work and share their learning with the class.
11. Encourage peer feedback and discussions, guiding learners to provide constructive comments and ask thoughtful questions.
12. Offer your feedback, highlighting the strengths of the posters and providing suggestions for improvement.

Learners should create an environment in which others believe that their thoughts and opinions are valued

Key Assessment

Level 1

1. List three types of mountains.
2. List three reasons for the importance of mountains.

Level 2: In your own words, explain what a fault line is and how it is formed.

1. With the aid of diagrams, distinguish between normal and reverse faults.
2. Explain the processes that lead to the formation of fold mountains and outline their characteristics.

Level 3

1. Describe how faulting creates mountains.

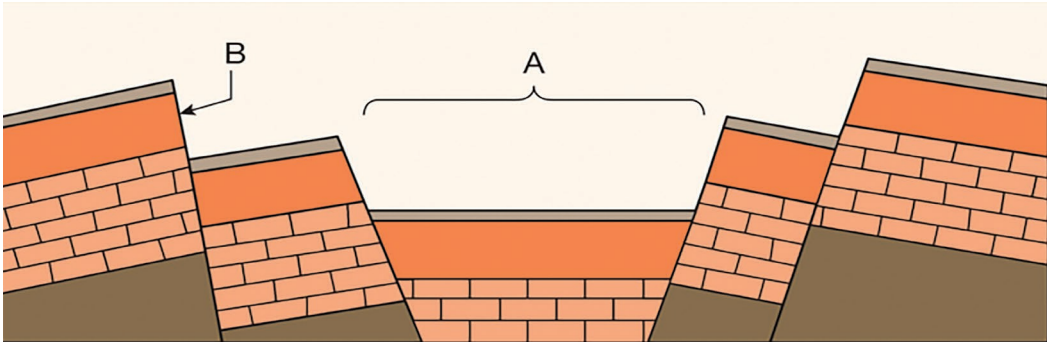

Figure 3.6: Features caused by Earth movement

Study Figure 3.6 and use it to answer the question 2

2. Name the landform at A and B and explain how landform A is formed.

Hint

*The recommended mode of assessment for Week 3 is **Group Project.** See **Appendix B** for further information on how to go about the project and a sample rubric to score the group project.*

WEEK 4

Learning Indicator: *Describe the types of plains (structural, erosional, and depositional) and the processes that create them and their importance.*

FOCAL AREA: PLAINS AND THEIR IMPORTANCE

Meaning of Plains

Plains are vast, mostly flat, or gently rolling expanses of land, rarely exceeding a few hundred feet in elevation.

General Characteristics of Plains

1. They are generally considered lowlands, rarely exceeding a few hundred feet above sea level.
2. They show a gently rolling or undulating topography.
3. They stretch for hundreds or even thousands of kilometres.
4. They are subjected to sheet erosion.
5. They often feature prominent river systems, lakes, and wetlands.
6. They have few natural obstacles such as hills or mountains.

Types of Plains

1. **Structural plains.** These are areas that are structurally depressed, forming some of the largest natural lowlands on Earth's surface. These plains are created by horizontally bedded rocks that have remained relatively undisturbed by the Earth's crustal movements. Notable examples include the Russian Platform, the Great Plains of the USA, and Australia's central lowlands.
2. **Erosional Plains:** They are formed by the relentless work of natural forces like rain, rivers, ice, and wind. These agents wear down the Earth's surface, smoothing out bumps and eventually reducing even towering mountains to gently rolling plains over millions of years. These plains, often called peneplains, are formed by the process of denudation, where the land is gradually worn away.

Forms of Erosional Plains

a. **Erosional Plains formed by Rivers:** Rivers, as they flow from their source to the sea, carve out valleys and widen their banks. This process, along with the erosion of the land between rivers, gradually lowers the overall elevation of the area, creating a flatter landscape.

b. **Erosional Plains formed by Winds:** In dry and semi-dry regions, wind plays a significant role in shaping the land. Wind erosion carries away loose materials, lowering the ground level and creating vast plains. These plains, often covered in gravel or stones, are called 'regs' or desert pavements in Africa. In these arid regions, weathering also contributes to the formation of gently sloping plains called pediments or pediplains, as mountains are gradually worn down.

c. **Erosional plains formed by Ice:** Glaciers and massive ice sheets, in regions where they exist, have a powerful impact on the landscape. As they move, they carve and smooth the land, creating vast, flat plains known as ice-scoured plains. The weight and movement of the ice also create depressions in the land, which often fill with water to form lakes. This process is clear in northern Europe and Canada, where extensive ice-scoured plains are found. Finland, for example, is a country dotted with over 35,000 lakes, covering a significant portion of its land.

4. **Depositional Plains:** These are plains formed by the deposition of materials brought by various agents of transportation. They are comparatively level but rise gently towards adjacent highlands. Their fertility and economic development depend greatly on the types of sediments that are deposited.

Forms of Depositional Plains

a. **Depositional plains formed by Rivers:** Some of the world's largest plains are formed by the deposition of sediment carried by major rivers. As rivers flow from their mountainous sources, they erode the land, carrying away vast amounts of sediment. This sediment is then deposited in the lower reaches of the river, creating fertile *alluvial plains, floodplains, and deltas*. These plains are incredibly productive for agriculture, supporting a wide range of crops and dense populations. The Nile Delta in Egypt is famous for its rice and cotton, the Ganges Delta for rice and jute, and the North China Plain, where the Yellow River has deposited a thick layer of sediment, is home to a diverse array of crops.

b. **Depositional plains formed by Wind:** In deserts, weathering and wind erosion break down rocks into fine particles called loess. These particles are then picked up by strong winds and carried away, eventually settling in surrounding areas. When enough loess accumulates, it can form vast, flat plains known as loess plains. Examples of these plains can be found in parts of Argentina, where they are known as the Pampas, and in northern China.

c. **Depositional plains formed by Ice:** As glaciers and ice sheets melt, they deposit a mixture of unsorted sand, gravel, and boulders, creating outwash plains. These plains are often barren, like some parts of Holland and northern Germany. However, when glaciers deposit a mix of boulders and clay, known as boulder clay, it can create fertile till plains or drift plains. These areas, like the Midwest of the USA and East Anglia in England, are often valuable for farming.

d. **Depositional plains formed by the action of Waves:** In coastal regions, waves and winds often drive beach materials, mud, sand, or shingle, landwards and deposit them on the coastal plain to form marine swamps, mud- flats, tidal and estuarine lowlands. An appreciable portion of the coastal lowlands of Belgium, the Netherlands and the Gulf Coast of the U.S.A. were formed in this way. Uplift may raise the coastal lowlands slightly and they then form an emergent coastal plain e.g., the coastal margins from Florida to Texas.

Importance of Plains to Socio-economic Development

a. Plains often have fertile soils, formed by the deposition of sediments from rivers, wind, or glaciers. This makes them ideal for agriculture, allowing for large-scale cultivation of crops and raising livestock. An example is The Great Plains of North America.

b. The ease of building and infrastructure development on flat land makes plains attractive for human settlements. Major cities and transportation hubs are often located on plains. An example in Ghana is the plain where the capital city Accra is situated.

c. Plains provide easily accessible deposits of mineral and other natural resources. An example is the Amazon Basin in Brazil which is not only known for its rainforest but also has significant deposits of minerals, including iron ore, bauxite, and manganese.

d. Plains serve as places of cultural significance. An example is the Nile Basin, which has been recognised as a centre of civilization for millennia, hosting ancient Egyptian cities like Alexandria and Cairo where people grow crops using the fertility created by annual flooding.

e. Plains can support diverse ecosystems. Grasslands, savannas, and wetlands are all commonly found in plains, providing habitats for a variety of plant and animal life.

Learning Tasks

1. Watch a video on plains and share your thoughts with the class.
2. Distinguish between the mode of formation of one erosional plain and one depositional plain.
3. Discuss the importance of plains.

PEDAGOGICAL EXEMPLARS

Digital learning

In small GESI responsive groups (interactive, collaborative, diverse needs, and mixed ability); learners watch a video on plains and share their thoughts with the class.

1. Carefully curate the groups to ensure diversity in terms of gender, ability, background, and learning styles.
2. Provide clear instructions and guidelines for group interactions, emphasising the importance of inclusive and respectful discussions.
3. Create a comprehensive observation guide that prompts learners to focus on key features and processes related to the formation of plains, such as erosion, deposition, and tectonic movements.
4. Encourage learners to take notes, make sketches, and formulate hypotheses during the video observation.

5. Guide the small groups in discussing their observations, findings, and hypotheses about the formation of plains.
6. Provide scaffolding and support, as needed, to ensure all learners can contribute meaningfully to the group discussions.
7. Encourage learners to advocate for their needs and seek help throughout the learning experience.
8. Offer timely and constructive feedback that highlights the learners' strengths, identifies areas for improvement, and provides suggestions for further exploration.
9. Develop formative and summative assessments that evaluate the learners' observation skills, their understanding of the formation processes, and their ability to communicate their findings effectively.
10. Allocate time for learners to reflect on their learning experience, the strategies they used, and the challenges they overcame, promoting metacognitive development.

Activity-Based Learning

1. Individually make sketches of plains and describe their features.
2. Discuss the importance of plains.
    a. Guide learners to create a sketch that outlines the key features of plains.
    b. Offer a range of questions that cater to different intellectual abilities.
    c. Provide options for the sketching process, such as the level of detail, the use of colour, or the incorporation of annotations and labels.
    d. Supplement the sketching activities with opportunities for learners to engage with physical or digital models of plains.
    e. Organise structured small-group discussions, where learners can share their sketches and exchange ideas about the importance of plains.
    f. Provide various levels of scaffolding, such as step-by-step instructions, reference materials, or modelling examples, to support learners who require additional assistance.
    g. Encourage learners to seek help and advocate for their needs throughout the learning experience.
    h. Offer timely and constructive feedback that highlights the learners' strengths, identifies areas for improvement, and provides suggestions for further exploration.
    i. Develop formative and summative assessments that evaluate the learners' observation skills, their ability to describe the features of plains and their understanding of the importance of plains.
    j. Provide opportunities for learners to self-assess their progress, reflect on their learning journey, and set personal goals for improvement.

In groups, learners with strong characters should be aware of this in order not to abuse the emotions of other members.

Key Assessment

Level 1

1. State three types of plains.
2. List five characteristics of plains.

Level 2: Explain five reasons for the importance of plains.

1. Explain five importance of plains.
2. Identify the types of plains and describe a structural plain.

Level 3: Compare and contrast the physical characteristics and economic importance of two plain types.

Level 4: Analyse the role that plains play in supporting large-scale agriculture and food production.

Hint

- *The recommended mode of assessment for Week 4 is checklist. Refer to Key Assessment Level 2 item i and ii in the Key Assessment for an example of a checklist question. See Appendix D for a sample rubric to score the checklist.*
- *Scores on individual class exercise should be ready for submission to **STP** this week. It should be an average of the various class exercises you have conducted over the past four weeks.*

SECTION 1 REVIEW

Over the first four weeks, the section delved into the fundamental physical features and processes shaping the Earth's surface. Week 1 explored the internal structure of the Earth, examining the composition and characteristics of the core, mantle, and crust. In Week 2, learners investigated the concept of continental drift, analysing the evidence behind the movement and positioning of Earth's land masses. The section then turned to major Earth landforms, with Week 3 examining the formation and importance of mountains, and Week 4 focusing on plains and their significance. Learners gained a comprehensive understanding of how these diverse physical structures emerged and the socio-economic importance of these major landforms. Collectively, these initial weeks provided a solid foundation on the Earth's internal structure and the surface-level processes that carved the landscape, enabling learners to develop a holistic appreciation for the planet's geological evolution and current landscape.

APPENDIX A: SAMPLE ACADEMIC PROGRESS PORTFOLIO (INDIVIDUAL)

Purpose: The purpose of this portfolio is to highlight s' development, skills, reflections, and the knowledge they have acquired over the academic year. It acts as a thorough documentation of their educational journey, showcasing their achievements and growth throughout the year.

Task

Build a portfolio of your academic progress to include the artefacts below:

a. class exercise and homework book for Geography
b. Copy(ies) of group exercises (handwritten or photocopied)
c. Individual project(s)
d. A copy of group project (reflective journal), handwritten or photocopied.

Organisation of the Portfolio

As part of the structure of the portfolio, make sure the following information have been provided:

a. Cover Page (Title, name, Class, Date of submission)
b. Table of Contents

How to Administer

i. Conduct a class session to explain the purpose and importance of the portfolio.
ii. Discuss how it reflects academic growth and serves as a tool for self-assessment.
iii. Outline the required artifacts clearly.
iv. Instruct s to organise their portfolios in a binder or digital format.
v. Set clear deadlines for the submission of each component.
vi. Provide a final deadline for the complete portfolio submission.
vii. Organise peer review sessions where s can share their portfolios with classmates.
viii. Remind learners to include a reflective journal entry at the end of their portfolio (This should summarise their learning experiences, challenges faced, and areas for improvement).
ix. Share rubrics of the portfolio with s.
x. Consider hosting a showcase day where s can present their portfolios to peers, teachers, and parents. This can foster a sense of accomplishment and encourage pride in their work.

Rubrics for Portfolio (Individual)

a. Cover page – [1 mark]

b. Table of content – [1 mark]

c. Individual class exercise and homework book for Geography – [10 marks]

d. Individual project work – [10 marks]

e. At least a copy of one group class exercise – [10 marks]

f. A copy of group project work (reflective journal) – [10 marks]

g. Reflect on your experiences in geography throughout the academic year considering the following prompts in your response: – [8 marks]

   i. *Difficulty Level:* Do you find geography to be a challenging subject? What specific aspects make it difficult or manageable for you?

   ii. *Interest and Engagement:* How engaged do you feel during geography lessons? Are there particular topics that sparked your interest or made the subject more enjoyable?

   iii. *Alternative Choices:* If given the opportunity to opt for a different subject instead of geography, would you choose to do so? Why or why not? Consider what you hope to gain from your education and how geography fits into your academic and career goals.

In your reflection, aim to express your thoughts clearly and support them with examples from your experiences. Keep your response to a maximum of 200 words.

Total – 50 marks but should be scaled down to 10%.

APPENDIX B: MARKING SCHEME FOR GROUP PROJECT WORK

Assessment Task

Refer to the 2024 West African Senior School Certificate Examination (WASSCE) topographic map on a scale of 1:50000 to answer the following questions:

a. In your answer booklet, draw an outline of the mapped area to a fourth of the original scale.

b. In your new outline, insert and name:

   i. the full length of River Pra and its direction of flow with an arrow.

   ii. one named left bank tributary of River Pra

   iii. KAYEREKU settlement

   iv. the full length of the railway line

c. What is the bearing of TWIFO MAMPON from Adugyaa?

Refer to section 2 week 5 of the Teacher Manual (TM) and Section 2 of the Learner Material for other assessment task(s).

Submission: The Group Project must be submitted by the end of Week 8 of the first semester for scoring. That notwithstanding, teacher and s may agree on an earlier submission based on the project's specifics.

Marking scheme

Outline – [4 marks]

(NB: If either the length, measuring 9.1 cm (± 0.2 cm), or the breadth, also measuring 9.1 cm (± 0.2 cm), falls outside the specified range, but not both, then award half marks (2 marks) instead of the full 4 marks. In that case, all marks for the features to be inserted in the new outline will also be reduced by half).

New length = Old length × Scale factor

$36.4 \times 1/4 = 9.1$ cm

New breadth = Old breadth × Scale factor

$36.4 \times 1/4 = 9.1$ cm

Hence, the new outline is a square with 9.1 cm sides.

Title (E.g. A Reduced Map of the River Pra Basin and Surrounding Features)– [2 marks]

New scale (1:200000)	– [2 marks]
Insertion of the four (4) features	– [8 marks]
Legend or key	– [2 marks]
Direction	– [2 marks]
Date (E.g. 18 – 09 - 2024)	– [2 marks]
Group members participation	– [3 marks]
Total	**– [25 marks]**

Note: *The new scale should be calculated for and indicated at the bottom of the map (the new* outline).

New Scale (NS) = Scale Factor (SF) × Old (Original) scale

NS = 1/4 × 1/50000 = 1/200000

Hence, NS = 1/200000 or 1:200000

APPENDIX C: MARKS SCHEME TO SCORE THE INDIVIDUAL RESEARCH

Content knowledge such as

a. clear explanation of Wegener's theory
b. historical context and significance
c. discussion of how Wegener's theory laid the groundwork for the development of plate tectonics etc. 3 marks each – [9 marks]

Identification and explanation of key pieces of evidence like

a. fossil distribution
b. geological similarities
c. fitting of the continents
d. ancient climate evidence, etc. 3 marks each – [12 marks]

Critical analysis of the theory bothering on

a. strengths of the theory
b. weaknesses of the theory
c. how the theory was received by the scientific community
d. current implications for geology, climate, and biodiversity

3 marks each – [12 marks]

Organisation of the write-up, clarity of expression, and logical flow of ideas – [5 marks]

Conclusion – [2 marks]

Total – 40 marks

APPENDIX D: SAMPLE RUBRIC TO SCORE THE CHECKLIST

Question	Options	Tick the Best Answer			
		A	B	C	D
1. Which of the following is **not** a type of plain?	Depositional plain Erosional plain Glacial plain Structural plan				
2. What is a structural plain?	A flat area formed by volcanic activity A large, flat expanse of land that has been uplifted or shaped by geological processes A mountain range formed by tectonic collisions A valley formed by erosion				
3. Which of the following is an example of a structural plain?	The Himalayas The Great Plains of North America The Nile Delta in Egypt The Appalachian Mountains				

SECTION 2: MAP SKILLS AND ANALYSIS

STRAND: NAVIGATING OUR ENVIRONMENT

Sub-Strand: Maps: Their Elements and Analyses

Learning Outcome: *Using the knowledge from maps and scales, reproduce maps, measure distances and areas, determine direction and bearings, and draw cross-sectional profiles between places*

Content Standard: *Demonstrate skill in map analysis*

Hint

Mid-Semester Examination *for the first semester is in Week 6. Refer to* ***Appendix E*** *for a Table of Specification to guide you to set the questions. Set questions to cover all the indicators covered for at least weeks 1 to 5.*

INTRODUCTION AND SECTION SUMMARY

This section delves into the essential skills of map reading and interpretation. It explores techniques for enlarging and reducing maps to suit specific needs. It also covers the methods for accurately measuring distances and areas on topographical maps. Furthermore, the section examines the concept of bearings and directions, allowing for precise navigation on maps. Finally, it introduces sectional drawing, a technique for visualising the three-dimensional landscape from a two-dimensional map. Through the calculation of the gradient, learners will gain a quantitative understanding of slope steepness. These combined skills will equip learners with the skills for interpreting and utilising topographical maps effectively.

The weeks covered by the section are:

Week 5: Techniques of Map Enlargement and Reduction

Week 6: Measurement of Distances and Areas on Topographical Maps

Week 7: Directions and Bearings

Week 8: Sectional Drawing and Calculation of Gradient

SUMMARY OF PEDAGOGICAL EXEMPLARS

This section discusses the diverse pedagogical strategies that can enhance teaching and learning. Learners engaged in the Talk for Learning approach by watching educational videos and subsequently discussing concepts to solidify understanding and develop critical thinking skills. Project-based learning is adopted to foster practical skills and real-world application through hands-on activities like map reproduction, distance, and area measurement on topographical maps. Additionally, exploratory learning will be used to

enhance collaborative, problem-solving and experiential learning as learners work in pairs to determine direction and bearing.

ASSESSMENT SUMMARY

The use of group assignments, strategic reasoning assessments, and class exercises provides comprehensive formative and summative evaluation opportunities for assessing learning. Group work allows learners to collaborate, apply knowledge, and engage in higher-order thinking, developing critical thinking skills. Strategic reasoning assessments gauge learners' ability to think critically, make logical connections, and evaluate evidence. Shorter class exercises measure understanding, recall, and application of knowledge. Together, these assessment strategies offer ongoing feedback, enabling learners to monitor progress, identify areas for improvement, and make adjustments. This multifaceted approach comprehensively evaluates learners' knowledge, skills, and abilities across a range of Depth of Knowledge (DoK) levels, supporting holistic learning outcomes aligned with curriculum standards. Teachers can refer to the Teacher Assessment Manual and Toolkit (TAMK) for further guidance on implementing these assessment strategies effectively.

WEEK 5

Learning Indicator: *Reproduce map by reduction and enlargement*

FOCAL AREA: TECHNIQUES OF MAP ENLARGEMENT AND REDUCTION

Techniques of Map Reduction

The relationship between map scale and the size of the map area is inverse - larger scale maps have a smaller denominator in their representative fraction (RF), meaning they cover a smaller geographic area but show more detail. Conversely, smaller-scale maps have a larger denominator in their RF, allowing them to depict larger areas but with less detailed features.

For example, a map at 1:50,000 scale is considered a larger scale map compared to one at 1:100,000 scale. The 1:50,000 map will show more detail over a smaller geographic extent, while the 1:100,000 map will cover a larger area but with less detail. To reduce or enlarge a map a Scale Factor (S.F) must be calculated. Scale Factor refers to the ratio of the original scale to the new scale. The formula is given as:

$$\text{S.F.} = \frac{\text{New Scale}}{\text{Old (original Scale)}} \quad \text{or S.F.} = \frac{\text{Denominator of Old (original) Scale}}{\text{Denominator of New Scale)}}$$

A fraction is usually obtained as the scale factor, and this is used to determine the length and breadth of the new map outline.

Procedure to Reduce a Topographical Map

1. Identify the scale of the original/old map, typically found at the bottom of the mapped area. Also, note the desired scale (new scale) for the map reduction. In the case where the scale factor is given, the new scale must be calculated and quoted typically at the bottom of the new outline.
2. Calculate the scale factor by dividing the denominators of the original scale ratio by the new scale.
3. Measure the length and breadth of the original map using a ruler.
4. Determine the new length and breadth by multiplying the original length and breadth by the calculated scale factor. This will give you the smaller dimensions.
5. With the obtained smaller dimensions, draw a new map outline and state the new scale beneath the map.

Worked Example

Study the map of BUTO DISTRICT A (Figure 5.1) with a scale of 1:50,000 and draw a new map of the area covered by the map to a scale of 1:100,000.

Note

Use the procedure given above to reduce the map of BUTO DISTRICT

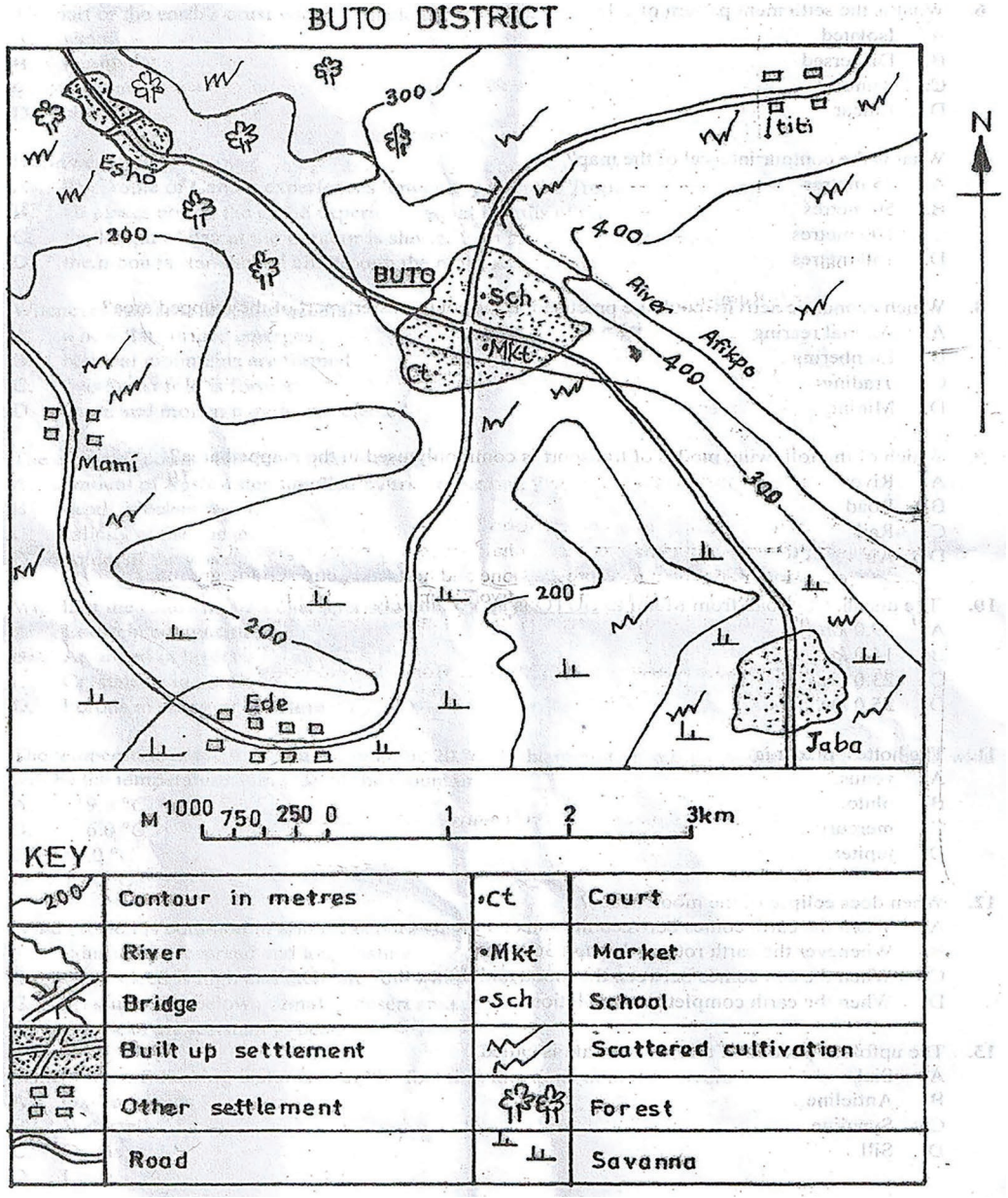

Figure 5.1: Buto District Map A

Techniques of Map Enlargement

Map enlargement deals with adjusting and magnifying an existing map to obtain a relatively larger map. Map enlargement focuses on increasing the scale and size of the original map. The magnitude or extent of this enlargement is directly reflected in the scale factor applied, which determines how much the original map is magnified.

Procedure to Enlarge a Topographical Map

1. Identify the scale of the original/old map, typically found at the bottom of the mapped area. Also, note the desired scale (new scale) for the map enlargement. In the case where the scale factor is given, the new scale must be calculated and quoted typically at the bottom of the new outline.
2. Calculate the scale factor by dividing the denominators of the original scale ratio by the new scale.

3. Measure the length and breadth of the original map using a ruler.
4. Determine the new length and breadth by multiplying the original length and breadth by the calculated scale factor. This will give you larger dimensions.
5. With the obtained larger dimensions, draw a new map outline and state the new scale beneath the map.

Worked Example

Study the map of BUTO DISTRICT B (Figure 5.2) with a scale of 1:50,000 and draw a new outline of the marked area **ABCD** as shown on the map to a scale of 1:25,000.

Note

Use the procedure given on map enlargement to enlarge marked area ABCD as shown on the map of BUTO DISTRICT.

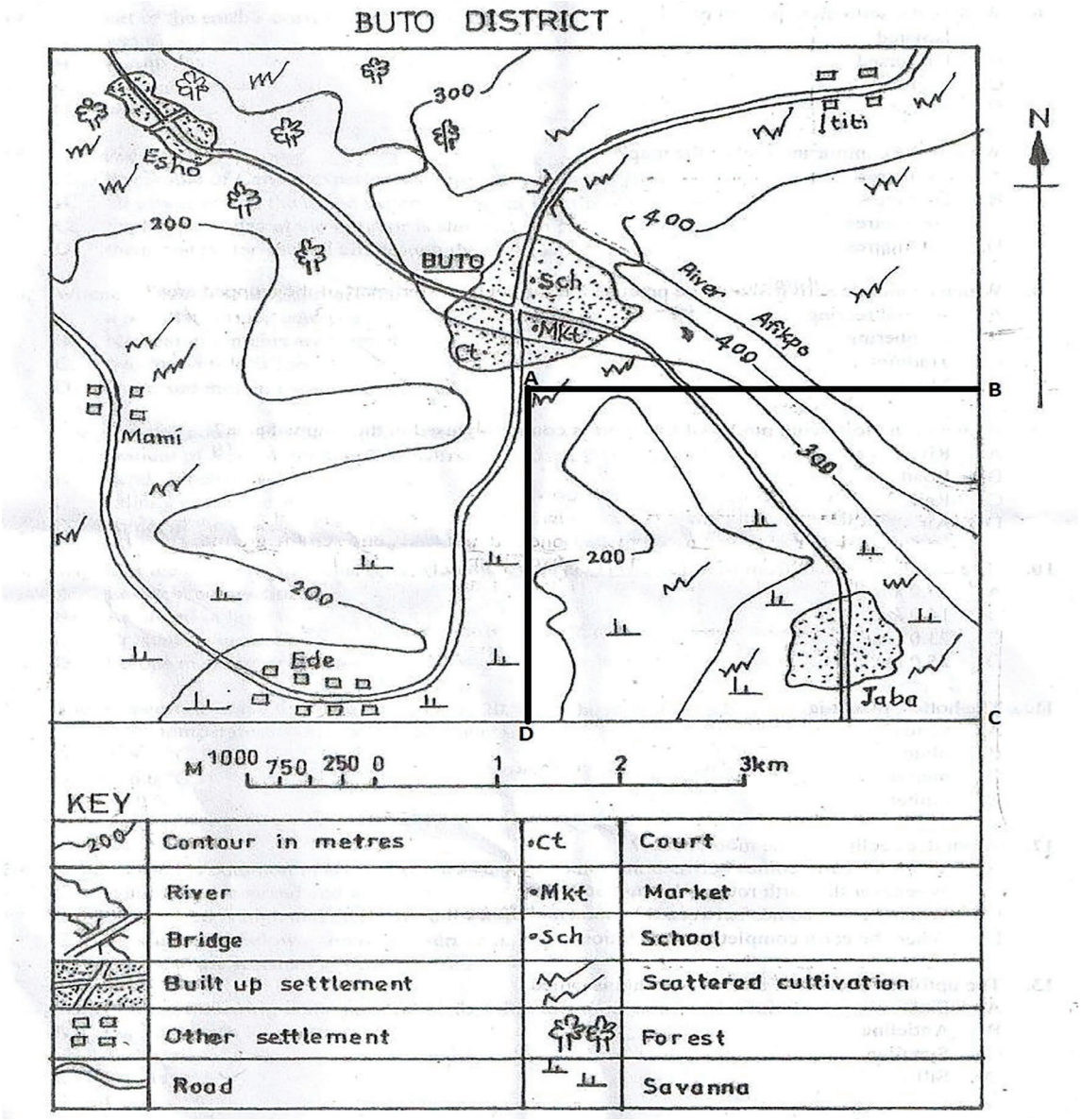

Figure 5.2: Buto District Map B

Inserting Features on a Reproduced or Enlarged Topographical Map

Features both natural and cultural can be represented on reduced or enlarged topographical maps. To represent these features the scale and the **key of conventional signs** with the help of grid lines are used.

Procedure to Insert Features on Topographical Maps

1. Divide the original map into squares of equal sizes (usually called the grid system) using a pencil. Note that the higher the number of grid lines the more accurate the reproduction would be.
2. On plain paper draw the same number of squares for the new map using the scale factor to either enlarge or reduce it.
3. Pick out the features from the original map square by square and transfer them to the correct place on the new map.

Learning Tasks

1. Discuss the procedures to reduce a map
2. Discuss the procedures to enlarge a map
3. Elaborate the procedure to insert features on a reproduced map
4. Engage in map reduction and insert important physical and cultural features
5. Enlarge a map and insert important physical and cultural features

PEDAGOGICAL EXEMPLARS

Talk for learning

Using video, maps, and other relevant materials in all-inclusive, emphasising gender-responsive groups:

1. Discuss the steps or procedures to reduce and enlarge a map.
2. Elaborate on the steps or procedures to insert features on a reproduced map.
    a. Start with a short educational video that explains the concepts of map scales, reduction, and enlargement. This can also be done by using digital map apps (like Google Map) to zoom in and out while indicating the corresponding change of the map scale in the screen.
    b. After the video, hold a whole-class discussion, encouraging input from all learners. Use gender-neutral language and ensure that everyone feels comfortable contributing.
    c. Provide worksheets that illustrate the process of reducing and enlarging a map. Use visuals to demonstrate the calculations involved.
    d. Pair struggling learners with a confident peer who can guide them step-by-step while fostering discussion on why certain features are important and how they can be represented using the grid method.

e. Create a space for learners to display their reproduced maps. Ensure that all learners understand how to provide positive feedback using respectful language.

Project-based Learning

Engage in artwork by reducing and enlarging a given map individually and inserting important physical and human features.

1. Clearly explain the concept of map scale and how it represents distances on the ground.
2. Demonstrate how to calculate the scale factor for map enlargement and reduction.
3. Provide practical exercises with different scales.
4. Teach the procedure of using the grid method for reproducing a map at a different scale as well as inserting features proportionally.
5. Review the importance of map keys/legend and how they explain the symbols used.
6. Guide learners on using conventional signs to mark specific features on a reproduced map based on the legend or additional information.
7. Provide pre-made grids or templates for struggling learners.
8. Offer learners choices in the features they want to annotate based on their interests or the learning focus.
9. Cater for diverse learning styles by offering a variety of approaches for reproducing and inserting features on maps.
10. Provide specific and constructive feedback on the learners' map-related skills, highlighting their strengths, identifying areas for improvement, and suggesting strategies for further development.
11. Encourage learners to seek help, ask questions, and advocate for their needs throughout the learning process.
12. Allocate time for learners to reflect on their learning experiences, the strategies they used, and the challenges they overcame.

Learners during discussions should provide opportunities for others to practise identifying potential situations or experiences that lead to feeling overwhelmed and struggling to manage emotions.

Key Assessment

Level 1: State two factors to consider when enlarging or reducing a map to ensure important details are preserved.

Level 2: Explain the concept of map scale and how it represents distances on the ground.

Level 3

1. You are tasked with creating a reduced map of a hiking trail that currently has a scale of 1:5,000 to a new scale of 1:20,000 for a brochure. Explain the steps and considerations you would take to ensure that important details are preserved and describe how you would address the potential loss of detail in the new map.

2. Refer to the 2019 West African Examinations Council's topographic map with the scale, 1:50000 and draw a new outline of the mapped area to a scale of 1:200000 and insert the following; river Ankobra from the North-eastern to the southern part of the map the railway under construction from the western part of the map to Prestea township the Prestea township

Note

Get a copy of the topographic map from your geography laboratory, West African Examinations Council's (WAEC) office or any other appropriate source for the above task.

Hint

The recommended mode of assessment for Week 5 is Practical. Refer to Key Assessment Level 3, item ii in the Key Assessment for an example of a practical. question. See Appendix F for a sample rubric to score the Poster.

WEEK 6

Learning Indicator: *Measure distances and areas on maps*

FOCAL AREA: MEASUREMENT OF DISTANCES AND AREAS ON TOPOGRAPHICAL MAPS

Measurement of Distances on Topographical Maps

The distances that are measured on topographical maps can be straight (crow/plane flight) or curved along roads, railways, footpaths, and rivers.

Measuring Straight/Crow/Plane Flight Distances between Two Points

When measuring the straight/crow flight distances between two points on a topographical map, the following methods are used:

1. Ruler Method

Procedure

a. Identify the two points involved and draw a straight line to join them
b. Place the ruler along the straight line and take the map distance measurement
c. Using the RF Scale of the map, calculate the actual/ground distance

The formula is given as $= \frac{\text{Map distance} \times \text{denominator of map scale}}{100000}$

Note: 100000cm = 1km

2. Pair of Dividers Method

A pair of dividers is commonly used to measure short straight distances between two points.

Procedure

a. Identify the two points involved and draw a straight line to join them.
b. Open the pair of dividers to measure the distance along the line.
c. Using the RF Scale of the map, calculate the actual/ground distance

The formula is given as $= \frac{\text{Map distance} \times \text{denominator of map scale}}{100000}$

Note: 100000cm = 1km

Measuring Curved Distances between Two Points

When measuring curved distances between two points on a topographical map, the following methods are used:

1. Thread Method

Procedure

a. Lay the thread (preferably a white one for the markings to be visible) carefully along the curved path by marking the starting point with a pen on the thread, then continue to measure the curved feature by holding and gliding the thread along the curved feature on the topographical map.

b. Carefully follow the curves and bends as closely as possible to ensure that the thread does not slack.

c. Straighten the thread gently and lay it flat along the ruler to obtain the map distance.

d. Using the RF Scale of the map, calculate the actual/ground distance

The formula is given as $= \frac{\text{Map distance} \times \text{denominator of map scale}}{100000}$

Note: 100000cm = 1km

2. Paper Method

Procedure

a. Align one edge of the paper with the starting point of your curved distance.

b. Gently follow the curve with the paper's edge, marking points along your paper that match the twists and turns of the curved path on the map.

c. Once you have traced the curve onto your paper, use your ruler to measure the total length of the marked line segments on your paper to get the map distance.

d. Using the RF Scale of the map, calculate the actual/ground distance.

The formula is given as $= \frac{\text{Map distance} \times \text{denominator of map scale}}{100000}$

Measuring Areas on Maps

Introduction

The area of square and rectangular shapes or objects is calculated by the formula Area = Length × Breadth. The area of topographical maps is calculated by applying the same principle since they usually take the shape of a square or rectangle. Thus, to find the area of a topographical map, the length and the breadth must first be measured in the required unit after which their product (length × breadth) is calculated.

Procedure

1. On the topographical sheet provided, measure the length and the breadth using a ruler or a pair of dividers.
2. Relate the measurement taken with the ruler or the divider to the scale of the map to obtain the unit in which you are to calculate the area (usually in square kilometres).

Worked Example

Calculate the area of BUTO DISTRICT A map (Fig. 5.1) in square kilometres if it has a scale of 1:100000

Solution

$$\text{Area} = \text{Ground Length} \times \text{Ground Breadth}$$

$$\text{Map Length} = 11.3 \text{ cm}$$

$$\text{Actual Length} = \frac{11.3 \times 100000}{100000}$$

$$= 11.3 \text{ km}$$

$$\text{Map Breadth} = 13.5 \text{ cm}$$

$$\text{Actual Breadth} = \frac{11.5 \times 100000}{100000}$$

$$= 13.5 \text{ km}$$

$$\text{Area} = 11.3 \text{ km } 13.5 \text{ km}$$

$$= 152.55 \text{ km}^2$$

Learning Tasks

1. Discuss the techniques and steps to measure distances on a topographical map.
2. Discuss the techniques and steps to measure areas on a topographical map.
3. Measure distances on a given map.
4. Measure the area on a given map.
5. Carry out actual ground distance measurements on the school compound using a measuring tape.
6. Carry out actual area measurements on the school compound using a measuring tape.

PEDAGOGICAL EXEMPLARS

Talk for learning

Using video, maps, and other relevant materials in all-inclusive groups of people from different geographical areas, do a whole class discussion on the techniques, and steps to measure distances and areas on a topographical map after watching a video on distance measurement on maps.

1. Clearly define the goals for using maps and measuring distances and areas.
2. Consider learner strengths and weaknesses when forming groups.
3. Mix learners with different skill sets to encourage collaboration and peer learning.
4. Ensure each group has the necessary topographical maps, measuring tools (rulers, paper, pair of compass and pencils), and any additional resources they might need.
5. Teach learners how to use the map scale to calculate the actual distance between two points on the map.

6. Demonstrate using a ruler and the scale conversion factor.
7. Offer groups different versions of the activity with varying levels of complexity. This can involve providing pre-measured distances/areas for struggling learners.
8. After group work, facilitate a whole-class discussion where groups share their findings and the techniques they used.
9. Develop formative and summative assessments that evaluate the learners' observation skills, their ability to calculate distances and area on topographical maps.
10. Encourage learners to explain their reasoning and learn from each other's approaches.
11. Clarify concepts and provide additional explanations as needed.
12. Allocate time for learners to reflect on their learning experiences, the strategies they used, and the challenges they overcame.

Learners during discussions should provide opportunities for others to practise identifying potential situations or experiences that lead to feeling overwhelmed and struggling to manage emotions.

Activity-based Learning

Undertake the measurement of distances on a given map and areas of maps individually.

In pairs, carry out actual ground distance and area measurements on the school compound using a measuring tape.

1. Clearly explain the activity's goals and procedures.
2. Demonstrate how to use the measuring tape and record measurements.
3. Review safety rules for navigating the school compound, reminding learners to stay clear of hazards and respect boundaries.
4. Prepare differentiated materials beforehand. This may include pre-selected measurement tasks or data recording sheets with varying levels of complexity.
5. Pair learners with complementary strengths and weaknesses. However, consider pairing learners with shared interests in specific areas of the school compound to enhance engagement.
6. Provide clear, step-by-step instructions for each measurement task. Offer visual examples or diagrams to illustrate the process.
7. Offer a variety of measurement tasks with varying levels of difficulty. This could involve measuring straight distances, perimeters of rectangular areas, or circumferences of circular features.
8. Offer data recording sheets with pre-populated formulas or tables for calculations, reducing the cognitive load on struggling learners.
9. For learners who might find using a measuring tape challenging, consider alternative tools like pre-measured lengths of string or marked paces.
10. Facilitate a group discussion where pairs share their findings and compare their measurements. Encourage them to discuss any challenges they faced and how they overcame them.

11. Pose reflection questions to solidify learning. These could include prompting learners to explain the purpose of using a map scale for ground measurements or the importance of accurate measurement techniques.

Key Assessment

Level 1: Explain two factors to consider when measuring the area of a region on a topographical map.

Level 2: Explain the steps involved in measuring the distance between two points on a topographical Map.

Level 3: You have a topographical map with a scale of 1:50,000. Using a ruler, you measured the straight-line distance between two landmarks as 8 cm on the map. Calculate the actual ground distance between these two points. Additionally, explain how you would measure the distance between the two landmarks along a path that is not straight.

Hint

*The recommended mode of assessment for Week 6 is **Mid-Semester Examination.** Refer to **Appendix E** for a Table of Specification to guide you to set the questions. Set questions to cover all the indicators covered for at least weeks 1 to 5.*

WEEK 7

Learning Indicator: *Determine directions and bearings*

FOCAL AREA: DIRECTIONS AND BEARINGS

Measurement of Direction

Direction, in the context of map reading, refers to two related concepts:

1. The pathway or course along which an object or feature is moving or oriented. This describes the directional trajectory or orientation of a geographic element.
2. The location or positioning of one geographic feature concerning the position of another feature. This establishes the relative direction between two map elements based on their spatial relationship.

Forms of Directions as Indicated on a Compass Rose

A compass rose is a graphical device used on maps and charts to indicate the directional points.

1. **Cardinal directions** are the four main points of a compass: north, south, east, and west which are also known by the first letters: N, S, E, and W. These four directions are also known as cardinal points, as shown in Figure 7.1.

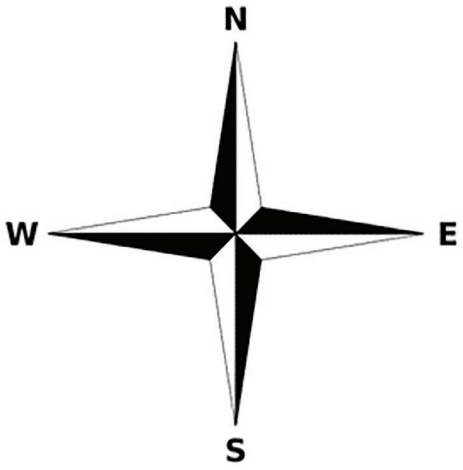

Figure 7.1: A compass rose showing just the cardinal points of north, south, east, and west

2. **Ordinal directions:** These refer to the directions located midway between each cardinal direction. On a compass rose, the ordinal directions are positioned in the middle of two cardinal directions. For example, NE (northeast) is halfway between North and East. A compass rose with both ordinal and cardinal directions will have eight points: North (N), Northeast (NE), East (E), Southeast (SE), South (S), Southwest (SW) and Northwest (NW) as shown in Figure 7.2. This increases the accuracy of measuring directions as compared to a compass rose with only the cardinal points.

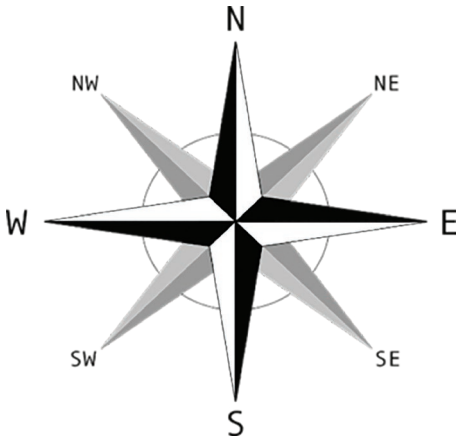

Figure 7.2: A compass rose shows cardinal and ordinal directions

3. **Secondary intercardinal directions:** Directions midway between each cardinal and ordinal direction are referred to as secondary intercardinal directions. Examples of secondary intercardinal directions are North-northwest (NNW), North-Northeast (NNE), and East-northeast (ENE). On a compass rose with ordinal, cardinal, and secondary intercardinal directions, there will be 16 points: N, S, E, W, NE, SW, NW, SE, NNE, SSW, NNW, SSE, WNW, ESE, ENE, and WSW as shown on Figure 7.3

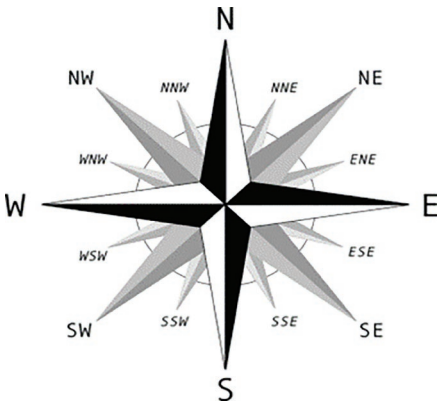

Figure 7.3: A compass rose showing cardinal, ordinal directions and secondary intercardinal directions

Procedure for Measuring Direction on a Map

Key Assumptions

When looking at a printed map it is important to know the orientation of the map in relation to points of the compass. The global convention for all printed maps is that the top edge is always North. There is usually an arrow with NORTH written on the arrow to confirm this somewhere on the map. Other clues also tell you which way north is, numbered horizontal grid lines increase as you move up the map for example. Always check because some printed maps do not follow this convention, particularly those drawn for tourists.

If you have a compass, then this can be used to determine the direction. Place the centre of the compass on the origin and make sure the North point agrees with the map orientation. North should point to the top of the map. If you do not have a compass, then a plastic protractor can be used. The circular ones are the best, but a half one can be used. You can convert degrees to compass points because each of the sixteen points of the compass is 22.5 degrees ($\frac{360}{16}$).

Step-by-step procedure

1. Locate the two points or places involved. For example, Town A and Town B.
2. Place the centre of your compass points at Town A because you are looking for the direction of Town B from Town A.
3. Using your ruler, join Town A to Town B with a straight line and check which of the compass points fall on the line.
4. The compass points (usually the cardinal and ordinal directions) on that line or near it is the direction of Town B from Town A

Sample Question

Find the direction of **DUAYAW-NKWANTA** from **Koforidua using the TANO NORTH EXTRACT** (Figure 7.4)

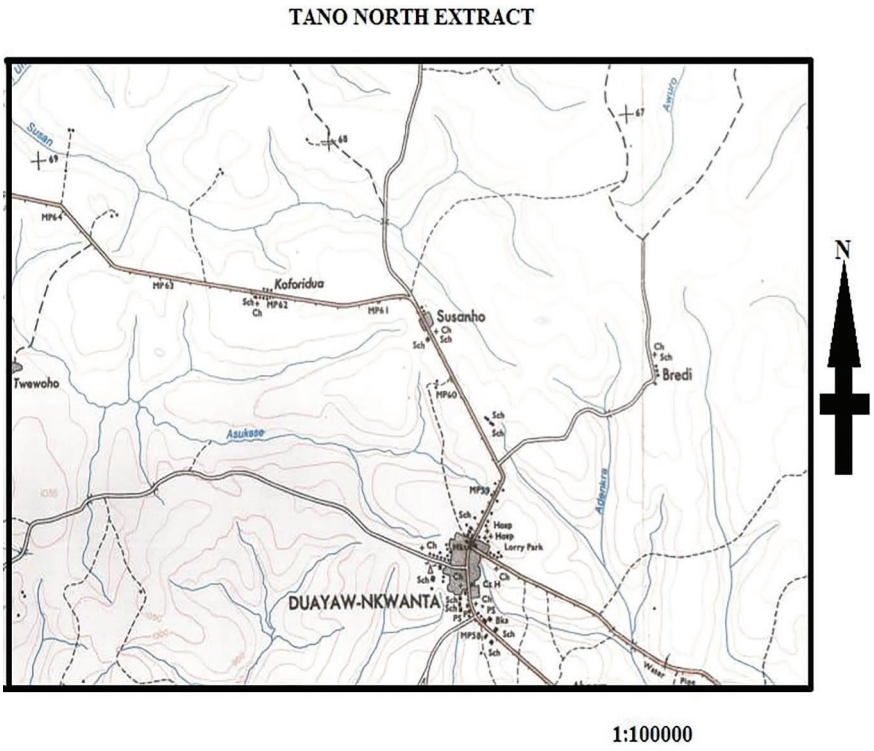

Figure 7.4: Tano North Map Extract

Note: The teacher should guide learners to use the procedure to measure the direction of **DUAYAW-NKWANTA** from **Koforidua**

Measurement of Bearing

Bearing refers to the position of one point or place in relation to another measured in degrees. It is an accurate way of giving the direction of one place in relation to another. Bearings are usually measured on topographical maps using the protractor. It is more accurate than a compass direction because it has 360 points compared to the 16 points of a compass. Bearings are always measured clockwise from north. It is important to make sure that 0 degrees on the protractor base line points exactly to the north. If the bearing from one point to the other is more than 180 degrees, place the protractor with 0 degrees facing

south and add 180 degrees to your reading. Make sure you are clear in which direction the bearing is required. For a bearing of point **A** to **B** place the protractor on point A. For a bearing of point **B** to **A**, place the protractor on point B.

For example, in the diagram below, Figure 7.4, what is the bearing from town B to A? Your protractor MUST sit on town B. The direction (B to A) is important as the bearing of town A to B would be very different. Turn your protractor round and add 180 degrees which gives the bearing of town B to A as 245 degrees.

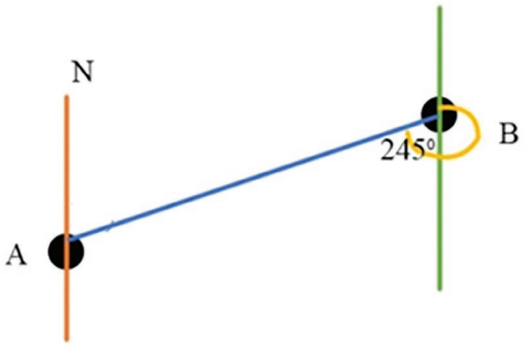

Figure 7. 5: An illustration of a location using Bearing

A compass rose showing cardinal, ordinal directions and secondary intercardinal directions with their aligned bearings as indicated in Figure 7.5.

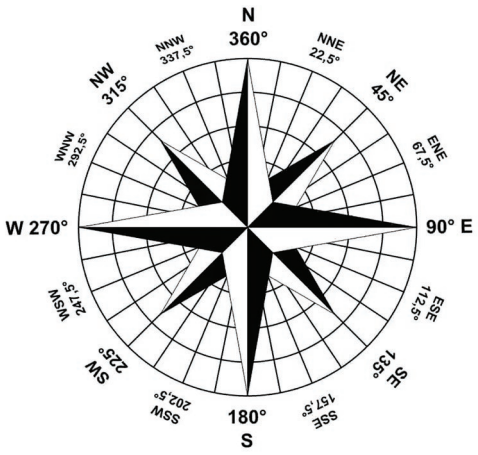

Figure 7.6: Compass points and their bearings

Procedure for Measuring Bearing on a Map

Using Figure 7.5, work out the bearing of towns A to B

1. Locate the two points or places involved on the map, in this case, Town A and Town B.
2. Place the centre of your compass points or protractor at Town A if you are looking for the bearing of Town A to Town B, make sure north, or 0 degrees is straight up, pointing to the top of the map.
3. Using a straight line (ruler recommended for accuracy), draw a line directly from Town A to Town B.

4. Place the centre of your protractor at Town A on the map. Ensure the baseline of the protractor (the straight line representing 0 to 180 degrees is it is a half-circle) aligns perfectly with the north line on the map.
5. Look where the line connecting Town A and Town B intersects the protractor's scale. This value represents the bearing of Town A to Town B in degrees.

Learning Tasks

1. Discuss the processes of measuring the bearing of places on a map.
2. Discuss the processes of determining the direction of places on a map.
3. Find the direction of places on a given map.
4. Find the bearing of places on a given map.

PEDAGOGICAL EXEMPLARS

Talk for Learning

Using videos, maps, and other relevant resources, initiate a class discussion on the processes of measuring bearing and determining the direction of places on a map.

1. Start with an interactive presentation that introduces key concepts of bearings and cardinal directions. Incorporate images, videos, and animations that illustrate how bearings work in real-world settings.
2. Facilitate a class discussion on the step-by-step procures to measure direction and bearing of places from another. Use scaffolding strategies to help struggling learners and challenge more confident learners to research about modern ways of determining direction using smartphones with compass.

Exploratory Learning

1. Work in pairs to find the direction and bearing of places on a given map.
2. Work individually to find the direction and calculate the bearing of places on a topographical map.
    a. Clearly define the goals for measuring bearing and determining the direction of places on a map.
    b. Ensure each learner has the necessary topographical maps, measuring tools and any key resources they might need.
    c. Teach learners the procedure to measure directions and bearings on a map.
    d. Offer groups different versions of the activity with varying levels of complexity.
    e. Facilitate a whole-class discussion where learners share their findings and the techniques they used.
    f. Develop formative and summative assessments that evaluate the learners' observation skills and their ability to measure distances and bearing on topographical maps.

g. Encourage learners to explain their reasoning and learn from each other's approaches.

h. Clarify concepts and provide additional explanations as needed.

i. Allocate time for learners to reflect on their learning experiences, the strategies they used, and the challenges they overcame.

Learners should be conscious of resolving interpersonal conflicts with each other if they arise in group discussions.

Key Assessment

Level 1

1. List the cardinal points of the compass.
2. Name two instruments used in measuring bearing on a topographical map.

Level 2

1. Explain the procedures involved in measuring bearings on a topographical map.
2. Find the direction and bearing of places on a given map.
3. Briefly describe the difference between cardinal and ordinal directions.

Level 3:

1. Find the bearing to the centre of AKROPONG from the centre of MAMFE using the AKUAPEM NORTH EXTRACT (Fig. 7.7)
2. You are standing at the main entrance of your school and need to reach the library. The following information is provided: The library is located 45° northeast of the main entrance. The distance from the entrance to the library is 300 meters.

    a. Calculate the bearing from the main entrance to the library.

    b. If you were to give someone directions to the library from the main entrance, how would you instruct them using cardinal directions and distance?

Hint

The recommended mode of assessment for Week 7 is Fieldwork. Refer to the question of Assessment level 3 II under the Key Assessment for an example of a task for debate. See Appendix G for a sample rubric to score the debate.

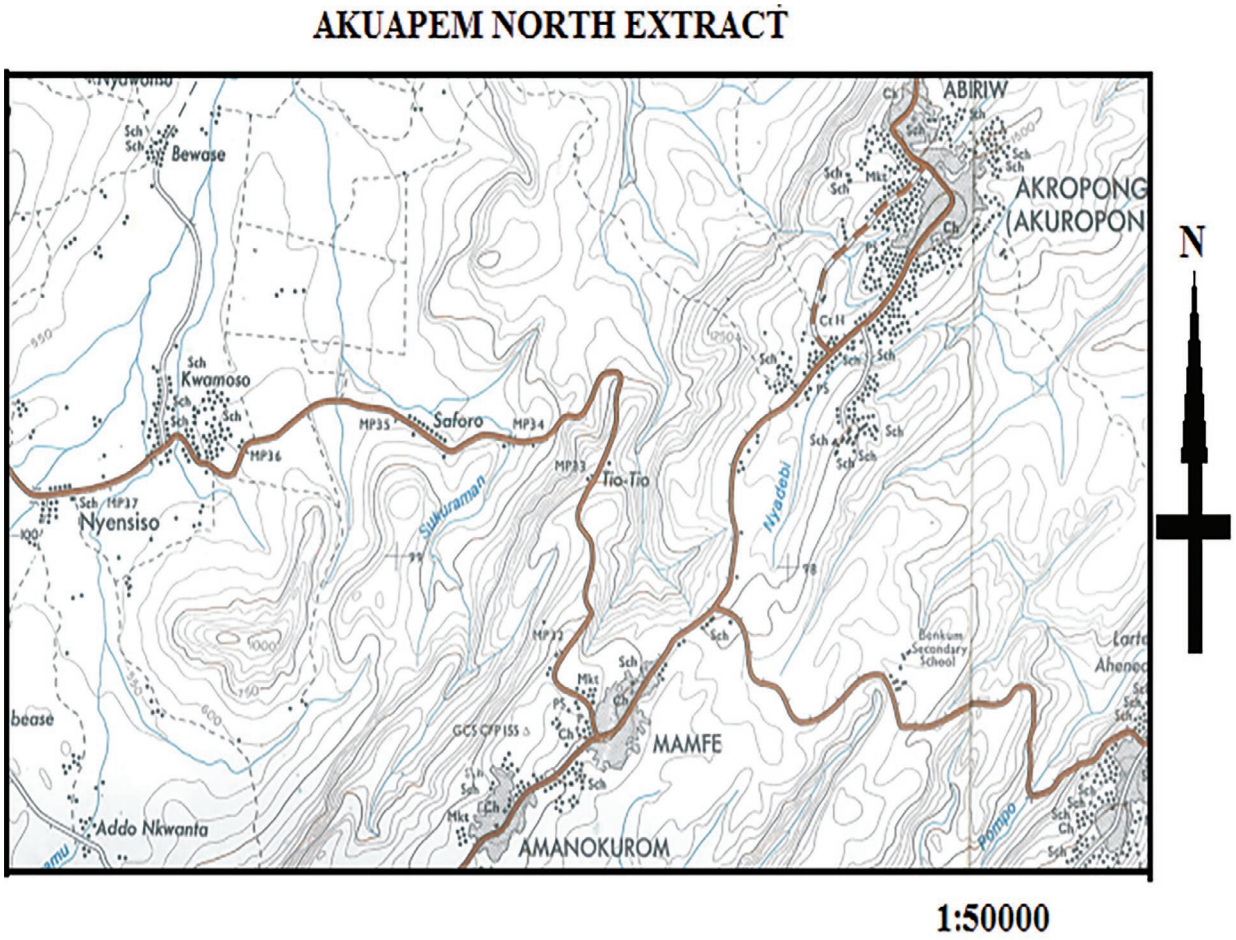

Figure 7.7: Akuapem North Map Extract

WEEK 8

Learning Indicator: *Draw sectional profiles (annotated) and calculate vertical exaggeration and gradient.*

FOCAL AREA: SECTIONAL PROFILE DRAWING AND CALCULATION OF GRADIENT

Sectional Profile (Cross-Sectional) Drawing

A sectional profile (cross-section) provides a precise diagram between two points which shows the slopes, their shape, land height, and other characteristics of a landform or geographic feature on a map. When a cross-section is drawn, it typically includes two different scales:

1. **Vertical Scale:** The vertical scale of a map refers to the representation of elevation or height on a map. It indicates the relationship between the actual height or depth of geographical features and their depiction on a graph sheet.
2. **Horizontal Scale:** The horizontal scale of a map refers to the ratio or relationship between distances on the map and the actual distances on the ground. It indicates how much the real-world distances have been reduced to fit onto the map. Note that the horizontal scale is the same as the map scale which is usually expressed in the Fractional/Ratio scale.

The use of these two distinct scales allows the cross-section to accurately represent both the vertical relief and the horizontal distances of the mapped terrain or landform. This enables detailed, true-to-scale visualisation of the feature's shape, elevation changes, and other physical attributes.

Procedure for Drawing a Cross-Profile/Section

1. Draw a straight line to join the two given points on the map when the line is not already given on the topographical sheet.
2. Lay a straight edge paper firmly on the straight line joining the two given points on the topographical map. Using a sharp pencil, carefully mark all the contour lines indicating their respective elevation any paths, roads, rivers, railway crossings, and any other important features you need to show or label on the paper. Make sure to label the features on the paper.
3. Draw the baseline (horizontal distance between the two given points) of the cross-section on a graph sheet of paper and transfer the tips marked on the piece of paper onto this baseline.
4. Draw straight vertical lines on both ends of the line representing the ground level.
5. Choose a vertical scale carefully, considering the overall height difference shown on the map and the complexity of the terrain. The vertical scale might be provided (this is usually a contour interval), or you will need to pick an appropriate one yourself. Remember that the horizontal scale is always the same as the scale of the original map.

6. Mark points using dots or asterisks at where the tips marked on the baseline intersect with its elevation (height).
7. After all the points are plotted, join them by a smooth line and shade within the borders of the cross-section to give it a good visual impression.
8. Label all the important features that are intersected along the line, including forest reserves, rivers, roads, valleys, settlements, plateaus, ridges, and plains.
9. Give it a clear title and state both the vertical scale and the horizontal scale.

Sample Question

Using a graph sheet, draw an annotated cross section from Point **X** to Point **Y** as shown on **the KWAHU WEST EXTRACT** map **(Figure 8.1).** Use the conventional signs in Figure 8.2 to guide the annotation.

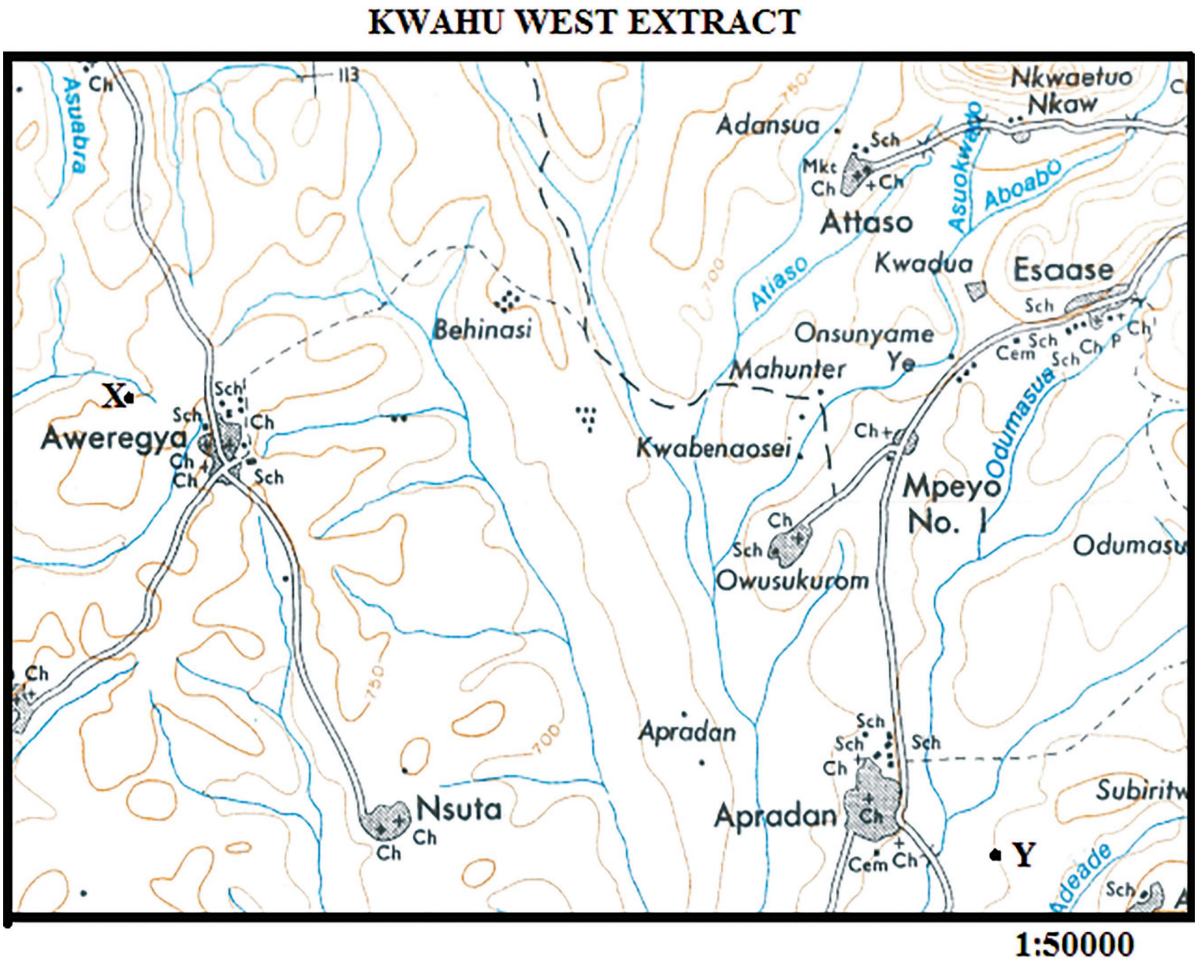

Figure 8.1: Kwahu West Map Extract

Note

The teacher should guide learners to use the procedure to draw an annotated cross-section from Point X to Point Y. Provide appropriate help as needed.

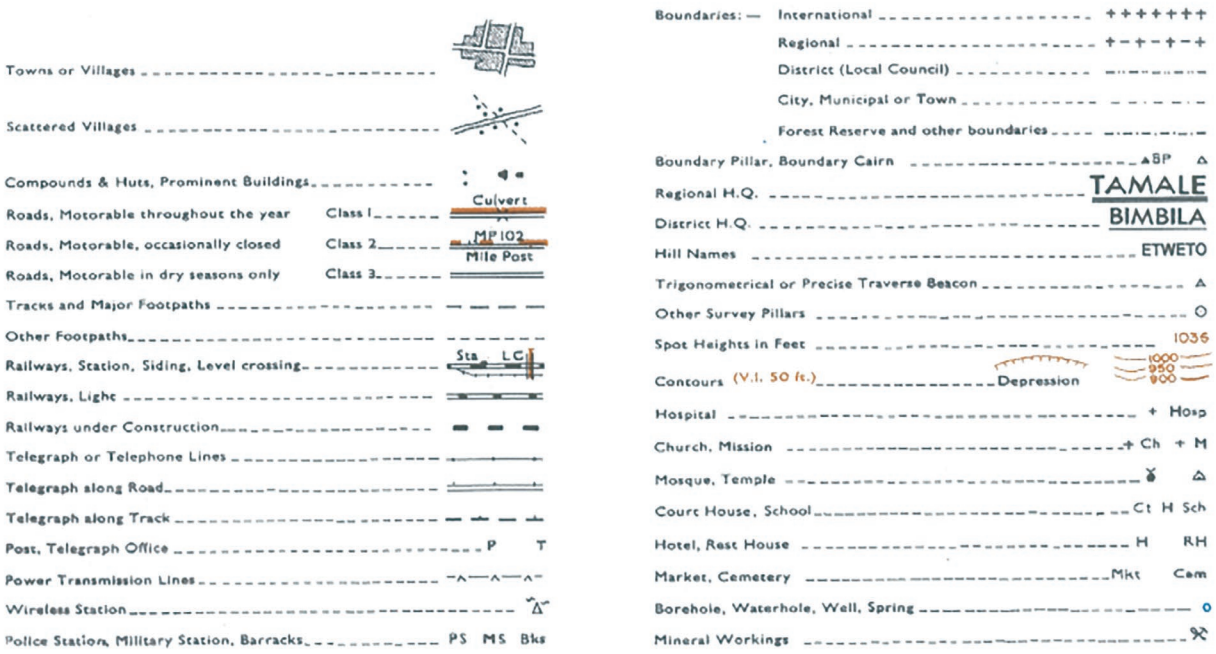

Figure 8.2: Conventional signs

Note

The teacher should guide learners to follow the procedure to draw the annotated cross-section from Point X to Point Y.

Importance of Cross-Profile/Section

1. A cross-section provides a more tangible way to visualise the landscape. It is like taking a vertical slice through the map, creating a side-view profile of the land.
2. The cross-section view allows a map reader to see and understand the hills, valleys, slopes, and overall variations in the terrain in a much more concrete manner.
3. Cross-section helps to easily analyse the steepness of slopes by looking at the spacing of contour lines.
4. By interpreting the cross-section, you can identify features like ridges, valleys, plateaus, and even cliffs.
5. A cross-section can reveal how different features on the map relate to each other in terms of elevation. For instance, it can show the depth of a river compared to the valley floor.
6. Cross-sections are vital for various planning and analysis activities. For example, hikers and climbers can use them to plan their routes and anticipate the terrain they will encounter.

Vertical Exaggeration

Vertical exaggeration (V.E.) involves intentionally magnifying the vertical scale in cross-sections on maps, making features appear steeper than they truly are in real life. Significantly, vertical exaggeration stretches the heights on a map, making hills look much steeper than they are. With a larger vertical scale, the changes in the elevation of the land are easier to understand. The formula that helps one know the number of times the elevation has been magnified is given as:

$$\text{V.E.} = \frac{\text{Vertical Scale}}{\text{Horizontal Scale}}$$

Calculation of Vertical exaggeration

Worked Example

1. Suppose the vertical scale for drawing a cross profile is 1 cm to 100 metres (thus if the elevation is measured in metres), and the representative fraction (R.F.) of the horizontal scale is 1:50000, we can calculate the vertical exaggeration as follows:

$$\begin{aligned}
\text{Vertical Scale} &= 1 \text{ cm to } 100 \text{ m} \\
&= 1{:}\ 100 \times 100 \text{ (that is, converting the metres into centimetres)} \\
&= 1{:}\ 10000 \text{ (in R.F). Note: } 100\text{cm} = 1\text{m} \\
\text{Horizontal Scale} &= 1{:}\ 50000 \\
\text{Then V.E.} &= \frac{\text{Vertical Scale}}{\text{Horizontal Scale}} = \frac{1{:}10000}{1{:}50000} = \frac{1}{10000} \div \frac{1}{50000} \\
\text{V.E.} &= \frac{1}{10000} \times \frac{50000}{1} = 5
\end{aligned}$$

   This indicates that the elevation of the cross-section drawn has been magnified 5 times more than reality.

2. Suppose the vertical scale for drawing a cross profile is 1 cm to 200 feet (thus if the elevation is measured in feet), and the representative fraction (R.F.) of the horizontal scale is 1:50000, we can calculate the vertical exaggeration as follows:

$$\begin{aligned}
\text{Vertical Scale} &= 1 \text{ cm to } 200 \text{ feet} \\
&= 1{:}\ 200 \times 12 \ \ 2.54 \\
&= 1{:}\ 6096 \text{ (in R.F). Note: } 12 \text{ inches} = 1 \text{ ft and } 1 \text{ inch} = 2.54 \text{ cm} \\
\text{Horizontal Scale} &= 1{:}\ 50000 \\
\text{Then V.E.} &= \frac{\text{Vertical Scale}}{\text{Horizontal Scale}} = \frac{1{:}6096}{1{:}50000} = \frac{1}{6096} \div \frac{1}{50000} \\
\text{V.E.} &= \frac{1}{6096} \times \frac{50000}{1} = 8.2
\end{aligned}$$

This indicates that the elevation of the cross-section drawn has been magnified 8.2 times more than reality.

Gradient

Gradient refers to the steepness of a slope. In map reading, a gradient refers to the inclination or tilt of the land surface. It describes how quickly the elevation changes over a horizontal distance as shown in Figure 8.3. It is expressed as a ratio of vertical distance to horizontal distance.

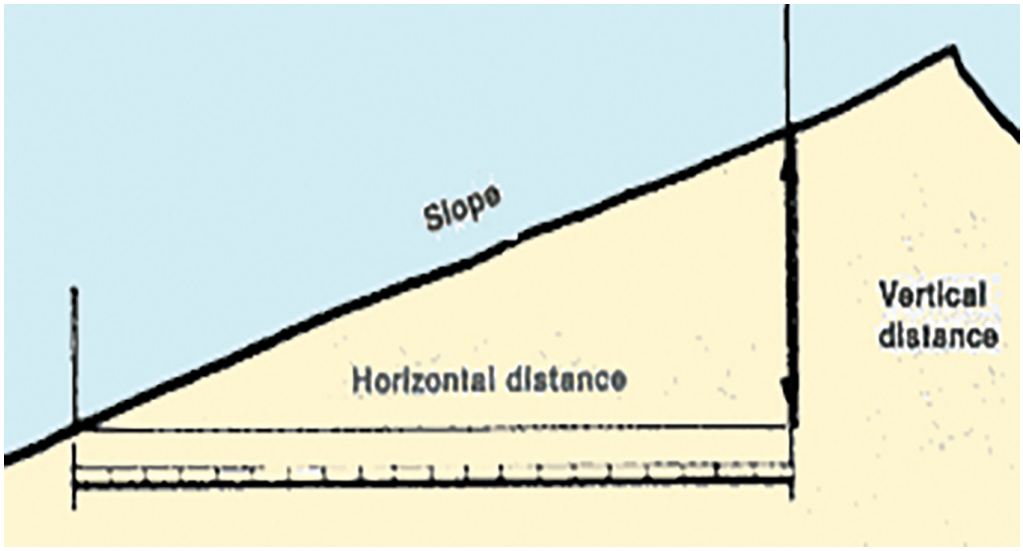

Figure 8.3: Cross-section of Slope between two points

Calculation of Gradient

The gradient is calculated by applying mathematical principles, and the formula reads as follows:

$$\text{Gradient} = \frac{\text{Vertical Interval}}{\text{Horizontal Equivalent}}$$

Vertical Interval (Distance) (V.I.) refers to the consistent difference in elevation between two neighbouring contour lines. However, in this context, vertical interval refers to the difference in elevation between two points.

The horizontal equivalent (H.E) is the horizontal distance between the two given points on the map. This is obtained by applying the principle of measuring straight distances from one point to another as indicated in Week 6.

The steepness of a slope is directly related to the fraction used to represent it. A smaller denominator in the fraction indicates a steeper slope, while a larger denominator indicates a gentler slope. For example, a gradient of 1 in 15 is steeper than a gradient of 1 in 20.

Worked Example

Calculated the gradient of the slope between points A and B as shown in the MAASE COMMUNITY map in Figure 8.4.

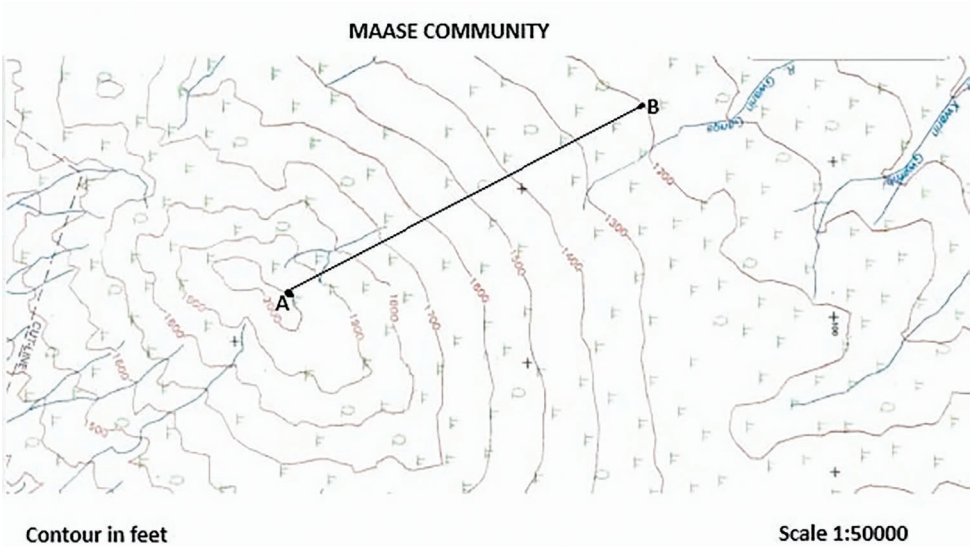

Figure 8.4: Maase Community Map

Solution

$$\text{Gradient} = \frac{\text{Vertical Interval}}{\text{Horizontal Equivalent}}$$

Vertical Interval (V.I) = Elevation of point A - Elevation of Point B

Elevation of Point A = 2000 ft

Elevation of Point B = 1200 ft

V.I. = 2000 ft − 1200 ft

= 800 ft

$$\text{Horizontal Distance} = \frac{\text{Map distance} \times \text{denominator of map scale}}{100000}$$

$$= \frac{6.5 \times 50000}{100000}$$

= 3.25 km

$$\text{Gradient} = \frac{800\ ft}{3.25\ km}$$

$$= \frac{(800 \times 12 \times 2.54)\ cm}{(3.25 \times 100000)\ \text{cm}}$$

Note: 12 inches = 1 ft, 1 inch = 2.54 cm, and 100000 cm = 1 km

$$= \frac{24384 \div 24384}{325000 \div 24384}$$

$$= \frac{1}{13.3} \text{ or 1 in 13.3}$$

This can be interpreted as; with every ascent (vertical movement) of 1 unit, there is a horizontal movement/distance of 13.3 units.

Learning Tasks

1. Discuss the processes involved in drawing an annotated cross-section between localities on a topographic map and its importance.
2. Discuss the importance of drawing a cross-section.
3. Draw an annotated cross-section from one point to another on a graph sheet and use it to calculate vertical exaggeration.
4. Calculate the gradient of a slope from one point to another.

PEDAGOGICAL EXEMPLARS

Collaborative learning

1. Using videos, maps and other relevant resources, Learners in small groups discuss the processes involved in drawing an annotated cross-section between localities on a topographic map and its importance. Share their opinion with the whole class.
2. Work in pairs to draw an annotated cross-section and calculate the vertical exaggeration of the profile.
    a. Before pairing learners, demonstrate the entire process of drawing an annotated cross-section and explain the steps involved in calculating vertical exaggeration.
    b. Ensure each pair has the necessary materials: graph paper, pencils, rulers for annotations, and a copy of the map with a chosen cross-section line marked.
    c. Prepare differentiated resources beforehand. This can include pre-measured heights for struggling learners or pre-drawn baselines on graph paper with designated starting and ending points for the cross-section.
    d. Pair learners with complementary strengths and weaknesses.
    e. Provide a partially completed formula sheet for calculating the vertical exaggeration (V.E.).
    f. Pose reflection questions to solidify learning.
    g. Offer timely and constructive feedback that highlights the learners' strengths, identifies areas for improvement, and provides suggestions for further exploration.
    h. Develop formative and summative assessments that evaluate the learners' skills and their ability to draw annotated cross sections and calculate vertical exaggeration.
    i. Provide opportunities for learners to self-assess their progress, reflect on their learning journey, and set personal goals for improvement.

Project-based Learning

Individually, calculate the gradient of a slope from one point to the other.

1. Begin by connecting the concept of gradient to real-life situations.
2. Discuss how understanding slope is important for activities like hiking, construction, or understanding water flow.

3. Clearly explain the formula for calculating the gradient.
4. Provide guided practice problems with different topographical maps and scenarios.
5. Walk learners through each step of applying the formula to calculate the gradient.
6. Offer differentiated worksheets with varying levels of difficulty.
7. Provide basic practice problems with pre-populated elevation values for struggling learners. Advanced learners can work with problems that require them to identify elevation values from the map legend and scale.
8. If the map uses different units for elevation and horizontal distance (e.g., metres/feet for elevation and kilometres for distance), provide a clear conversion table or allow learners to use calculators with unit conversion functions.
9. Use exit tickets with short questions or calculations related to slope gradient to assess learner understanding at the end of the lesson.
10. Discuss real-world applications of calculating slope gradient, such as analysing potential landslides or designing ramps for accessibility.
11. Offer timely and constructive feedback that highlights the learners' strengths, identifies areas for improvement, and provides suggestions for further exploration.
12. Develop formative and summative assessments that evaluate the learners' skills and their ability to draw annotated cross sections and calculate vertical exaggeration.
13. Provide opportunities for learners to self-assess their progress, reflect on their learning journey, and set personal goals for improvement.

Key Assessment

Level 1

1. State the two different scales in the cross-sectional drawing.
2. List three reasons why cross-sectional drawing is important to map users.

Level 2: Explain the procedures involved in cross-sectional drawing.

Level 3: Explain what is meant by vertical exaggeration and its purpose in representing landscapes.

Level 4: Using the DURUWASO COMMUNITY map, calculate the gradient of the slope along the line **A-B.**

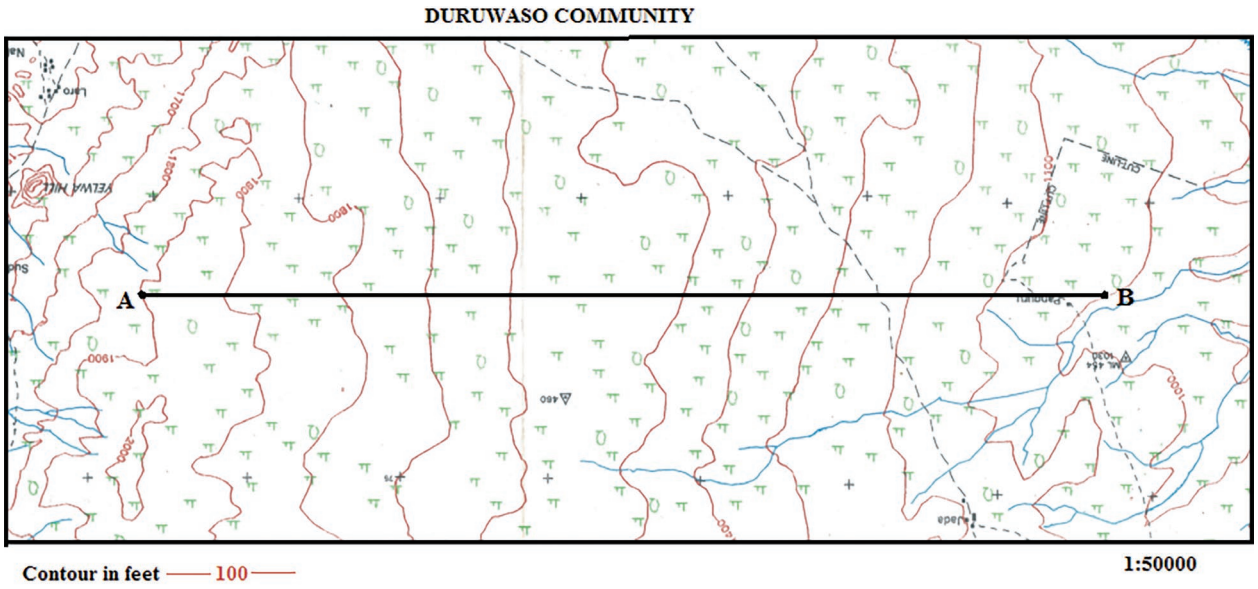

Figure 8.5: Map Extract of Duruwaso Community

SECTION 2 REVIEW

The section covered key skills for working with topographical maps. Learners explored techniques for enlarging and reducing maps to scale, accurately measuring distances, areas, directions, and bearing on topographical maps. They also learned how to draw cross-sections and determine vertical exaggeration and gradient of slopes. These foundational skills enabled a comprehensive understanding of how to interpret the structure and features depicted on topographical maps. This holistic approach allowed learners to appreciate how topographical maps convey crucial information about a region's physical and cultural attributes. Overall, the section equipped learners with a robust set of topographical mapping competencies.

APPENDIX E: TABLE OF SPECIFICATION FOR FIRST SEMESTER MID-SEMESTER EXAMINATION

Week	Focal Area(s)	Type of Question	DoK Levels				Total
			1	2	3	4	
1	The internal structure of the earth	Multiple Choice	1	1	-	-	2
		Fill-in	1	-	-	-	1
		Short answers	-	1	-	-	1
		Essay	-	1	-	-	1
2	The concept of continental drift	Multiple Choice	1	1	1	-	3
		Fill-in	1	2	-	-	3
		Essay	-	-	1	-	1
3	Mountains and their importance	Multiple Choice	-	-	1	-	1
		Fill-in	-	-	1		1
4	Plains and their importance	Multiple Choice	1	2	1	-	4
		Fill-in	-	2	1	-	3
		Short answers	-	-	1		1
5	Techniques of map enlargement and reduction	Essay	-	-	-	1	1
	Total		5	10	7	1	23

The structure of the Mid-Semester Examination (First Semester)

a. Twenty (20) objective test items (comprising multiple choice, fill-in/supply answer, definition of key terminologies, etc.)

   Questions 1-10 (Multiple choice)

   Questions 11-18 (Fill in/ supply answer)

   Question 19-20 (Definition of key terminologies)

b. One (1) compulsory practical question (Note: the practical question which falls under paper 3, has been compulsory during West African Senior School Certificate Examination) for s to answer.

c. Two (2) essay questions out of which s are to answer one (1).

APPENDIX F: RUBRICS FOR PRACTICAL WORK ON MAP REDUCTION

Criteria	Excellent (4)	Good (3)	Satisfactory (2)	Needs Improvement (1)
Map Interpretation	Demonstrates a thorough understanding of the original map; accurately identifies key features like the river Ankobra, railway under construction, and the Prestea township.	Shows good understanding with minor errors in identifying features.	Basic understanding; key features misidentified.	Little to no understanding of the original map; key features missed.
Calculation of scale factor	Precisely scales the outline to 1:200,000; all dimensions are correct. Scale Factor (SF) = New Scale (NS) ÷ Old Scale (OS) From the assessment task, NS = 1:200000 OS = 1:50000 Hence, SF = 1/200000 ÷ 1/50000 SF = 1/200000 ×50000/1 SF = ¼ Alternatively, SF = Denominator of the Old Scale (DOS) ÷ Denominator of the New Scale (DNS) SF = DOS ÷ DNS Hence, SF = 50000/200000 SF = ¼	Minor scaling errors; most dimensions are accurate.	Noticeable scaling errors; some dimensions are unclear.	Scale is incorrect; outline lacks clarity.
Outline or Dimension	New Length (NL) = Old or Original Length × Scale Factor NL = 36.8 × ¼ NL = 9.2cm New Breadth (NB) = Old Breadth or Original Breadth × Scale Factor NB = 36.8 × ¼ NB = 9.2cm Note: Margin of error: (± 0.2 cm)			

Criteria	Excellent (4)	Good (3)	Satisfactory (2)	Needs Improvement (1)
Insertion of Key Features	River Ankobra is clearly and accurately traced from the northeastern to the southern part of the map. The railway under construction is precisely marked, showing correct alignment towards Prestea township. Prestea township is distinctly labelled and positioned accurately based on its geographic context.	Two key features are inserted; mostly accurate labelling.	One key feature is inserted; labelling is unclear or incorrect.	No key features inserted or inaccurately represented.
Drawing skills/ Clarity and Presentation	The overall presentation is neat and well-organized, enhancing readability.	Map is generally clear and organized; minor visual clutter.	Map is somewhat cluttered or unclear; organization needs improvement.	Map is disorganized and difficult to read.
Title	Title highlights the key features of the map while providing a clear context for the content. E.g., Map of the Ankobra River and Infrastructure Development in the Prestea Region Map of the Ankobra River and Emerging Infrastructure in the Prestea Region	Title highlights some key features of the map while providing a clear context for the content.	Title highlights some key features of the map and lacks clear context for the content.	Title does not highlight key features of the map with unclear context for the content.
Use of Symbols/ Legend	Appropriate symbols are used with a clear, concise legend that enhances understanding.	Symbols are mostly appropriate, but the legend has minor clarity issues.	Legend is present but lacks clarity; inconsistent symbols used.	No legend or inappropriate symbols, leading to confusion.
Accuracy of Direction	Direction is precise and accurately reflects the mapped area	Direction is accurate but with minor errors.	Direction contains several inaccuracies; some confusion.	Direction is unclear or incorrect.
Inclusion of Date	Date is clearly stated and accurately reflects the map's context.	Date is included but may have minor inaccuracies.	Date is included but lacks clarity	Date is missing or completely inaccurate.

Note

In summative terms, assessment task of this nature on map reproduction must be compulsory for all for them to have a grip of map reproduction which forms part of the core (fundamentals) of geography.

SECTION 3: PHYSICAL SETTING OF WEST AFRICA AND AFRICA

STRAND: HUMAN AND ENVIRONMENT

Sub-Strand: Physical Settings and People

Learning Outcome: *Compare and contrast the physical setting of Ghana to West Africa to Africa*

Content Standard: *Demonstrate skills of drawing and showing the physical setting of West Africa and Africa*

INTRODUCTION AND SECTION SUMMARY

This section explores the geographical and political landscapes of West Africa and Africa as a whole. The section begins by identifying the location and size of these regions, followed by an examination of their political divisions. The section then delves into the physical settings, covering relief, drainage systems, climate patterns, and vegetation zones. By the end of this section, learners should be able to accurately locate and describe the major geographical features and political boundaries of West Africa and Africa. They will understand the interplay between physical geography and human activities and be able to analyse how these factors influence the environment and societies within these regions. Additionally, learners will develop skills in map reading and geographical analysis, enabling them to interpret and present geographical data effectively.

The weeks covered by the section are:

Week 9: Location, Size and Political Divisions of West Africa and Africa

Week 10: Relief, Drainage, Climate and Vegetation of West Africa and Africa

*Refer to the "**Hint**" at the Key Assessment for each week for additional information on how to effectively administer these assessment modes.*

SUMMARY OF PEDAGOGICAL EXEMPLARS

Teachers are encouraged to adopt diverse pedagogical strategies to cater for diverse learning styles of learners. The use of collaborative learning to facilitate grouping learners into mixed abilities to use maps and atlases is also advocated. Teachers are encouraged to allow learners offer peer support and share knowledge among themselves. Moreover, the use of digital learning through the integration of smartphones or computers to allow learners to access interactive maps and geographical data is suggested. Again, the use of talk-for-learning strategy which involves inclusive discussions where all learners participate to foster a deeper understanding through dialogue is suggested. Finally, activity-based learning is suggested to help learners sketch maps of West Africa and Africa, reinforcing spatial awareness and

geographical skills can be adopted by teachers. These methods will ensure that all learners, regardless of their learning abilities, can actively participate and benefit from the lessons.

ASSESSMENT SUMMARY

Teachers should use a mix of formative and summative assessments to cater to diverse learning abilities. For DoK Level 1, individual tasks like identifying, listing, and describing can be used to assess basic knowledge. DoK Level 2 should involve comparing, contrasting, and discussing, both individually and in groups, to foster deeper understanding. DoK Level 3 can be assessed through group research and presentations, encouraging critical thinking and application. These strategies will ensure inclusivity by addressing different learning styles. Formative assessment strategies will provide continuous feedback and help learners achieve the intended learning. Summative assessment strategies will gauge the overall understanding of the content concepts, and the application skills learnt. These diverse assessment strategies will not only assess the academic progress of the learner, but it will also serve as pointers to support individual growth and promote collaborative skills. Teachers can refer to the Teacher Assessment Manual and Toolkit (TAMK) for further guidance on implementing these assessment strategies effectively.

WEEK 9

Learning Indicator: *Describe the geographic location, size and political divisions of West Africa and Africa*

FOCAL AREA: LOCATION, SIZE AND POLITICAL DIVISIONS OF WEST AFRICA AND AFRICA

Location and Size of West Africa

The West African sub-region is located in the western part of the African continent. It lies between latitude 4° and latitude 20° North of the Equator and extends from longitude 15° West to 18° East of the Prime Meridian.

The sub-region is bounded by the expansive Atlantic Ocean to the west. Its southernmost point reaches the Gulf of Guinea, which is an extension of the Atlantic Ocean. To the north, the vast Sahara Desert forms a substantial geographical barrier, transitioning into the Sahel belt further south. The eastern boundary is less clearly defined. It is usually delineated by the geological Benue Trough feature, or a line drawn from Mount Cameroon to Lake Chad. The eastern border separates West Africa from Central Africa.

In terms of size, West Africa encompasses an extensive landmass of approximately six million square kilometres. This substantial area makes it one of the largest subregions on the African continent. Its north-south expanse stretches nearly 2,000 kilometres, stretching from the arid Sahara in the north to the tropical Gulf of Guinea coastline in the south. Additionally, the east-west breadth is quite extensive, measuring around 3,000 kilometres from the Atlantic Ocean in the west to the border with Central Africa in the east.

Political Divisions of West Africa

Presently, there are 16 independent countries making up West Africa. Each country has its own unique system of governance. Figure 9.1 shows the of the 16 countries and their capital cities.

Table 9.1: *West African countries and their capital cities (Manual writers, 2024)*

Country	Capital City
1. Ghana	Accra
2. Nigeria	Abuja
3. Senegal	Dakar
4. Côte d'Ivoire	Yamoussoukro
5. Guinea	Conakry
6. Burkina Faso	Ouagadougou
7. Mali	Bamako

Country	Capital City
8. Niger	Niamey
9. Benin	Porto-Novo
10. Togo	Lomé
11. Liberia	Monrovia
12. Sierra Leone	Freetown
13. The Gambia	Banjul
14. Guinea-Bissau	Bissau
15. Cabo Verde	Praia
16. Mauritania	Nouakchott

Political Map of West Africa

Figure 9.1: A map of West Africa showing Political Divisions

Location and Size of Africa

Africa is the world's second largest continent in terms of landmass after Asia. It covers about 30.3 million square kilometres which is approximately 20% of the Earth's total land surface. Its geographic location can be precisely defined by its absolute coordinates.

The northernmost extremity of the African continental mainland is Cape Ben Sekka in Tunisia, located on latitude 37°21' North of the Equator. Conversely, the southernmost point is Cape Agulhas in South Africa, located on latitude 34°51' South of the Equator, with the equatorial line intersecting the continent near its central region. This vast north-south expanse exceeds 8,000 kilometres in extent. The easternmost point of Africa is Ras Hafun in Somalia, positioned on longitude 51°27' East of Prime Meridian. On the other hand, the

westernmost point of the African continental landmass is Pointe des Almadies in Senegal, located on longitude 17˚31' West of Prime Meridian. However, if one includes the surrounding island territories, the westernmost point becomes Ponta Cais dos Navios on the island of Boa Vista in Cabo Verde on longitude 22˚54' West.

At its widest point, the African continent measures approximately 7,400 kilometres from Cabo Verde islands off the west coast to the Socotra Islands off the southern coast of the Arabian Peninsula. The continent's east-west expanse is around 7,000 kilometres from the Senegal-Mauritania border to the Somalia-Kenya border.

Africa is the only continental landmass that extends significantly across both the Northern and Southern Hemispheres, an attribute that contributes to its remarkable geographic diversity and strategic significance. Geologically the continent is located on the African tectonic plate and is bordered by the Mediterranean Sea to the north, the Suez Canal and the Red Sea to the northeast, the Indian Ocean to the east and southeast, and the Atlantic Ocean to the west. The continent is connected to Asia by the Isthmus of Suez in Egypt, which is generally considered the boundary between Africa and Asia.

Political Divisions of Africa

Africa comprises 54 countries. These countries are grouped regionally by the African Union, based on geographic proximity, historical ties, and cultural similarities. These regional divisions are:

1. **West Africa:** This region is home to 16 countries, known for its vibrant cultures and rainforests. Senegal, Nigeria, Ghana, and Côte d'Ivoire are some prominent examples. This region's economic community affiliation is the Economic Community of West African States (ECOWAS).
2. **North Africa:** There are five countries in North Africa, and these are Egypt, Algeria, Morocco, Tunisia, and Libya. These countries are characterised by the Sahara Desert and its proximity to the Mediterranean Sea. This region's economic community affiliation is the Arab Maghreb Union (AMU).
3. **Central Africa:** This central belt has 10 countries dominated by lush rainforests and the Congo River Basin. The Democratic Republic of Congo, Cameroon, Gabon, and the Central African Republic are some of the countries. This region's economic community affiliation is the Economic and Monetary Community of Central Africa (CEMAC).
4. **East Africa:** There are 13 countries in East Africa. The subregion is known for its Great Rift Valley, unique highlands, savannas, and diverse wildlife. Kenya, Ethiopia, Tanzania, Uganda, and Rwanda are some of the well-known countries. This region's economic community affiliation is the East African Community (EAC).
5. **Southern Africa:** Ten countries make up the Southern Africa subregion. South Africa, Namibia, Botswana, Zimbabwe, and Mozambique are some of the countries. The landscapes range from deserts to savannas and lavish coastal areas as well as. This region's economic community affiliation is the Southern African Development Community (SADC).

Figure 9.2: The Sub-regions of Africa

Figure 9.3: Political Map of Africa

Learning Tasks

1. Describe West Africa and Africa in terms of its location and size.
2. Research on the position, size and political divisions of West Africa and Africa.

PEDAGOGICAL EXEMPLARS

Collaborative Learning

Using maps, atlases, and other relevant information in mixed ability, different cultural and gender-sensitive groups discuss and compare the position, size and political divisions of West Africa and Africa.

1. Divide the class into small, mixed-ability groups, ensuring each group has a balance of learners with varying strengths and learning needs.
2. Provide a range of tasks with varying levels of complexity, allowing learners to engage with the content at their own pace and skill level.
3. Incorporate visual aids, such as maps, diagrams, and infographics, to support learners' understanding of the position, size, and political divisions of West Africa and Africa.
4. Guide the group discussions with prompts and questions that encourage critical thinking, analysis, and comparison of the geographic features and political dynamics of West Africa and the African continent.
5. Assign group presentations, where each team can highlight their findings and insights, allowing for peer-to-peer learning and the exchange of diverse perspectives.
6. Provide individualised support and feedback to learners based on their learning needs, such as offering clarification, extra examples, or alternative explanations for struggling learners.
7. Acknowledge and celebrate the strengths and contributions of all learners, fostering an inclusive and supportive learning environment.

Digital Learning

Use smart phones or computers or laptops to search for the position, size and political divisions of West Africa and Africa.

1. Provide a range of digital tasks with varying levels of complexity, allowing learners to engage with the content at their own pace and skill level.
2. Start with simple tasks, such as locating the countries of West Africa and Africa on an interactive map, and gradually progress to more challenging activities.
3. Curate a selection of reputable digital resources, such as interactive maps, infographics, and educational websites, which cater to different learning preferences and abilities.
4. Provide clear instructions and guidelines to help learners navigate the digital resources effectively.
5. Assign group-based digital projects, where learners can collaborate on tasks like creating multimedia presentations, interactive timelines, or virtual tours to highlight

their understanding of the position, size and political divisions of West Africa and Africa.

6. Encourage peer-to-peer learning and the exchange of ideas within the groups.
7. Offer individualised support and scaffolding for learners who may need extra assistance in navigating the digital tools.
8. Provide alternative digital options or assistive technologies for learners with specific learning needs or disabilities.
9. Incorporate activities that help develop learners' digital literacy skills, such as effective online research, data analysis, and digital presentation creation.
10. Utilise digital assessment tools, such as online quizzes, interactive maps, or virtual simulations, to provide formative feedback and gauge learners' understanding of the position, size, and political divisions of West Africa and Africa.
11. Use the data from these assessments to inform instructional modifications and targeted support.

Learners should be able to manage their emotional reactions and behaviours using techniques such as mindfulness strategies, breathing, and self-talk

Key Assessment

Level 1: Describe the global location of Africa with reference to latitude and longitude, compass points, and other features such as continental land masses, oceans, and particular boundaries.

Level 2

1. Draw an outline map of Africa and on it, name and insert the following countries Nigeria, Morocco, and Kenya.
2. With the aid of a map, describe the geographic location of West Africa

WEEK 10

Learning Indicator: *Describe the relief, drainage, climate and vegetation of West Africa and Africa*

FOCAL AREA: RELIEF, DRAINAGE, CLIMATE AND VEGETATION OF WEST AFRICA AND AFRICA

Relief of West Africa

West Africa encompasses a diverse range of landscapes, from lowlands to highlands. The key features of its relief are:

1. **The Lowlands:** These areas lie below 300 metres above sea level and consist of sedimentary rocks. The lowlands can be divided into two categories:
    a. Coastal Plains
        i. Stretch along the western coast of Africa, bordering the Atlantic Ocean.
        ii. Low-lying and relatively flat terrain along the coastline.
        iii. Gradual slope from the inland areas towards the ocean.
        iv. Wide sandy beaches and coastal dunes. Examples of wide sandy beaches can be found in places like Dakar, Senegal, or Cape Coast, Ghana.
    b. Inland Basins
        i. Encompasses countries such as Mali, Niger, Nigeria and spans across the Sahel and Sudan regions of West Africa.
        ii. Vast, low-lying areas with relatively flat or gently sloping terrain.
        iii. Surrounded by higher elevation landforms such as plateaus and inselbergs.
        iv. Alluvial plains formed by deposition of sediment carried by rivers.
2. **Plateaus and Uplands:** The interior uplands of West Africa are mostly composed of ancient rocks. Notable plateaus and highlands include:
    a. The Akuapem-Togo Ranges

Note

Refer to the Relief of Ghana in the Year One Geography Manual.

    b. **The Fouta Djallon Plateau:** It is located in Guinea, West Africa and extends into neighbouring countries such as Senegal, Guinea-Bissau, and Sierra Leone. It has an average elevation of around 1,500 metres above sea level.
    c. **Jos Plateau:** It is located in central Nigeria, specifically in Plateau State and has an average elevation of around 1,200 metres above sea level.

d. **Adamawa Highlands:** It is located in northeastern Nigeria and extends into parts of Cameroon and Chad. It has an average elevation of around 1,500 meters above sea level.

3. **The Sahara Plains:** The Sahara Plains, a vast relief region in West Africa, form part of the larger Sahara Desert, the world's largest hot desert. Stretching across countries such as Mauritania, Mali, Niger, and parts of Chad, these plains are characterised by their expansive sandy and rocky landscapes. The region's topography is predominantly flat with occasional dunes, plateaus, and scattered mountain ranges.

Drainage of West Africa

West Africa is covered by a complex network of water courses. From major rivers carving their paths across the land to lakes and lagoons.

Major Rivers

1. **Niger River:** The Niger River is one of Africa's longest rivers, stretching over 4,100 kilometres. Originating in the Guinea Highlands in southeast Guinea, it flows through Mali, Niger, Benin, and finally Nigeria. The Niger River ultimately drains into the Gulf of Guinea.
2. **Senegal River:** The Senegal River spans about 1086 kilometres and serves as the border between Mauritania and Senegal. It eventually drains into the Atlantic Ocean.
3. **The Volta River:** This major river system originates from Burkina Faso and Ghana, eventually draining into the Gulf of Guinea. The Volta basin is home to Lake Volta, the largest artificial lake in the world by surface area.
4. **Gambia River:** The Gambia River is a significant river in West Africa that runs for about 1,120 kilometres through The Gambia and Senegal. It begins in the Fouta Djallon plateau in Guinea and flows westward to the Atlantic Ocean.

Major Lakes

While West Africa is not known for extensive natural lakes, there are some notable examples.

1. **Lake Chad**: It is located on the eastern periphery of the region. It is a large endorheic lake (having no outlet to the ocean) shared by several countries. However, due to climate change and water diversion, the lake has shrunk significantly.
2. **Lake Volta:** It is located in the South-Eastern part of Ghana, is the largest human-caused lake in the world. Covering 8,502 km^2, it is the biggest reservoir by surface area.

Major Lagoons

Lagoons are also prominent features along the West African coastline. Examples include the Ebrie Lagoon in Côte d'Ivoire and Lagos Lagoon in Nigeria, both of which are critical for local fisheries.

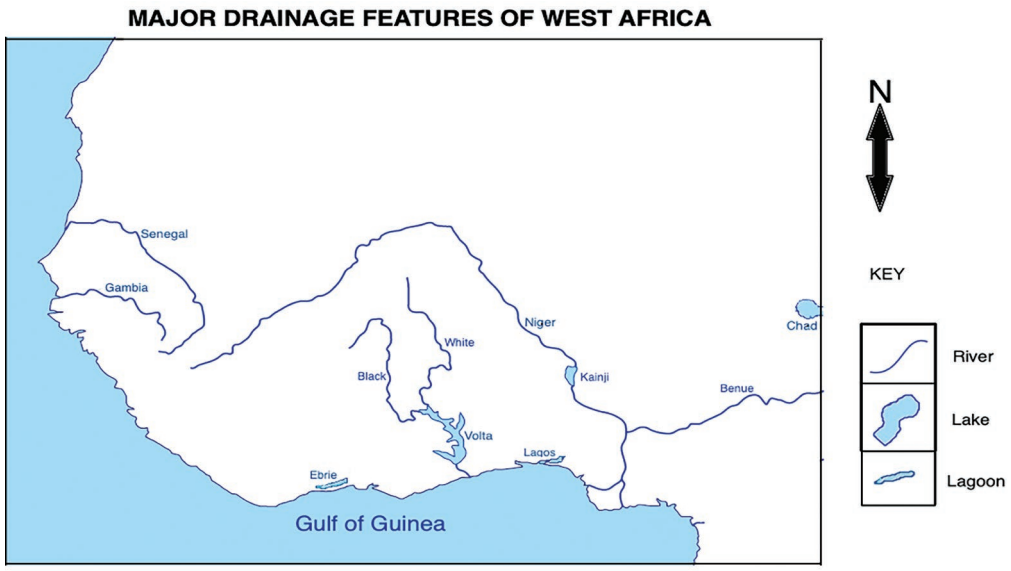

Figure 10.1: Major drainage features of West Africa Source: Manual writers, 2024

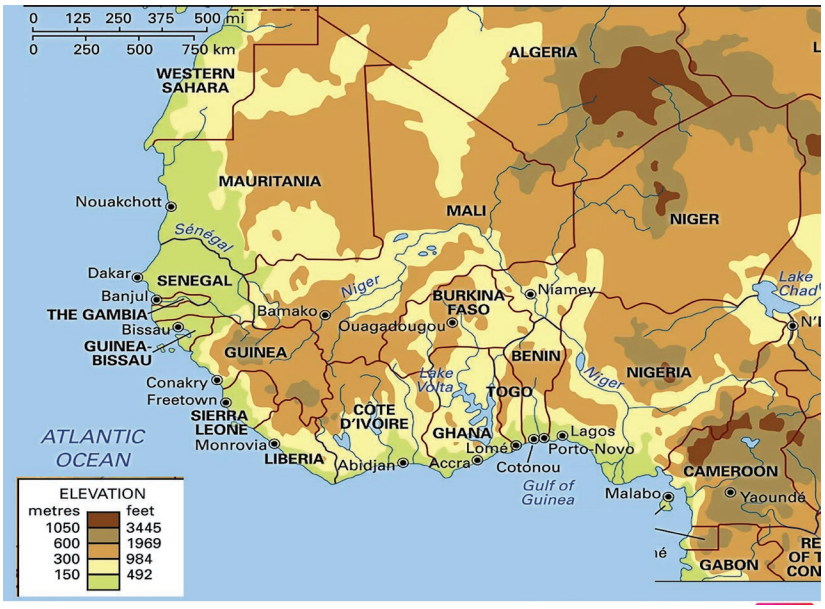

Figure 10.2: Relief and Drainage features of West Africa

Climate of West Africa

West Africa boasts a diverse climate. The climatic conditions in this region are primarily influenced by factors like latitude, proximity to the Atlantic Ocean, and atmospheric circulation patterns. West Africa can be broadly divided into five major climatic regions namely:

- Tropical Wet (Equatorial) Climate
- Tropical Monsoon Climate
- Tropical Savanna/Continental Climate
- Tropical Semi-Arid (Sahelian) Climate
- Tropical Desert (Saharan) Climate

1. **Tropical Wet (Equatorial) Climate**

   Location: It is found along the southeastern coast of Liberia. A typical station is Monrovia.

   Climatic Characteristics

   a. The average annual temperature is typically high, ranging from 26°C to 30°C. The annual temperature range of about 3°C.

   b. This region receives the highest annual rainfall in West Africa, often exceeding 2,500 mm.

   c. It usually exhibits a double maxima or bimodal rainfall pattern.

   d. This climate zone experiences very high humidity, typically exceeding 80% throughout the year, and often reaching close to 100% during peak rainfall periods.

   e. The sun's rays hit the earth's surface at a more direct angle compared to higher latitudes, leading to intense sunlight.

2. **Tropical Monsoon Climate**

   Location: It is primarily found in the coastal regions of countries such as Guinea, Sierra Leone, Liberia, Nigeria, and Ghana. Some typical stations for this climate are Conakry in Guinea, Freetown in Sierra Leone, and Axim in Ghana.

   Climatic Characteristics

   a. The zone experiences consistently high average temperatures throughout the year, often exceeding 25°C producing an annual range of typically falling between 10°C to 15°C.

   b. This region experiences distinct wet and dry seasons.

   c. It receives high annual rainfall which ranges from 1,800 mm to 2,000 mm.

   d. Humidity remains high, often above 80%, even during the dry season.

   e. Unlike equatorial regions with minimal day length variation, the tropical monsoon climate experiences more noticeable changes in daylight hours between the wet and dry seasons.

3. **Tropical Savanna/Continental Climate**

   Location: This climate is typically found between the semi-arid Sahel to the north and the more humid Guinean climate to the south. The tropical savanna zone stretches across several countries, including southern Mali, Burkina Faso, northern Ghana, northern Nigeria, and parts of Senegal and Côte d'Ivoire. Typical stations include Kano, Nigeria and Ouagadougou, Burkina Faso.

   Climatic Characteristics

   a. The region experiences consistently warm to hot temperatures with an average monthly temperature typically between 20°C and 32°C leading to an annual temperature range moderately smaller varying from 8°C to 12°C between the hottest and coldest months.

   b. The region receives a moderate amount of rainfall, typically ranging between 600 and 1,600 mm.

c. This climate has a single concentrated wet season, occurring from May to September.

d. Humidity levels can reach 70% or higher during this period during the wet season and can drop to as low as 30% or lower during this period.

e. Throughout the year, the savanna region receives a significant amount of solar radiation due to its proximity to the equator.

4. **Tropical Semi-Arid (Sahelian) Climate**

Location: The tropical semi-arid, or Sahelian, climate of West Africa is located just south of the Sahara Desert. It spans across several countries including Senegal, Mauritania, Mali, Burkina Faso, Niger, and northern Nigeria. This region forms a transitional zone between the arid Sahara to the north and the more humid savannas and forests to the south. Typical stations include Bamako, Mali and Nouakchott, Mauritania.

Climatic Characteristics

a. The Sahel experiences some of the hottest temperatures on Earth, with year-round averages exceeding 25°C and annual temperature range is relatively small, varying from 8°C to 12°C between the hottest and coldest months.

b. This region receives considerably less rain compared to wetter climates, averaging around 250-500 mm annually.

c. Rainfall can be highly unpredictable, with droughts a common occurrence. During the rainy season, rainfall can be sporadic and unevenly distributed.

d. Clear skies and minimal cloud cover allow for intense solar radiation in some areas.

e. Relative humidity levels can drop to as low as 20% or even lower during this period. The short, wet season brings a temporary increase in humidity (about 40-50%).

5. **Tropical Desert (Saharan) Climate**

Location: It is primarily located in countries such as Mauritania, Mali, and Niger. It encompasses the vast expanse of the Sahara Desert, which is the largest hot desert in the world. Two typical stations within the Tropical Desert (Saharan) Climate of West Africa are Timbuktu in Mali and Agadez in Niger.

Climatic Characteristics

a. This region experiences extremely high average annual temperatures, often exceeding 28°C.

b. This climate zone experiences a significant daily temperature variation. Nighttime lows can drop considerably, sometimes reaching as low as 15°C.

c. This region receives very little rainfall throughout the year, with annual averages typically falling below 250 mm.

d. The region's proximity to the equator translates to year-round exposure to intense sunshine.

e. Humidity levels are consistently very low, typically falling below 30% and often even dipping below 20%.

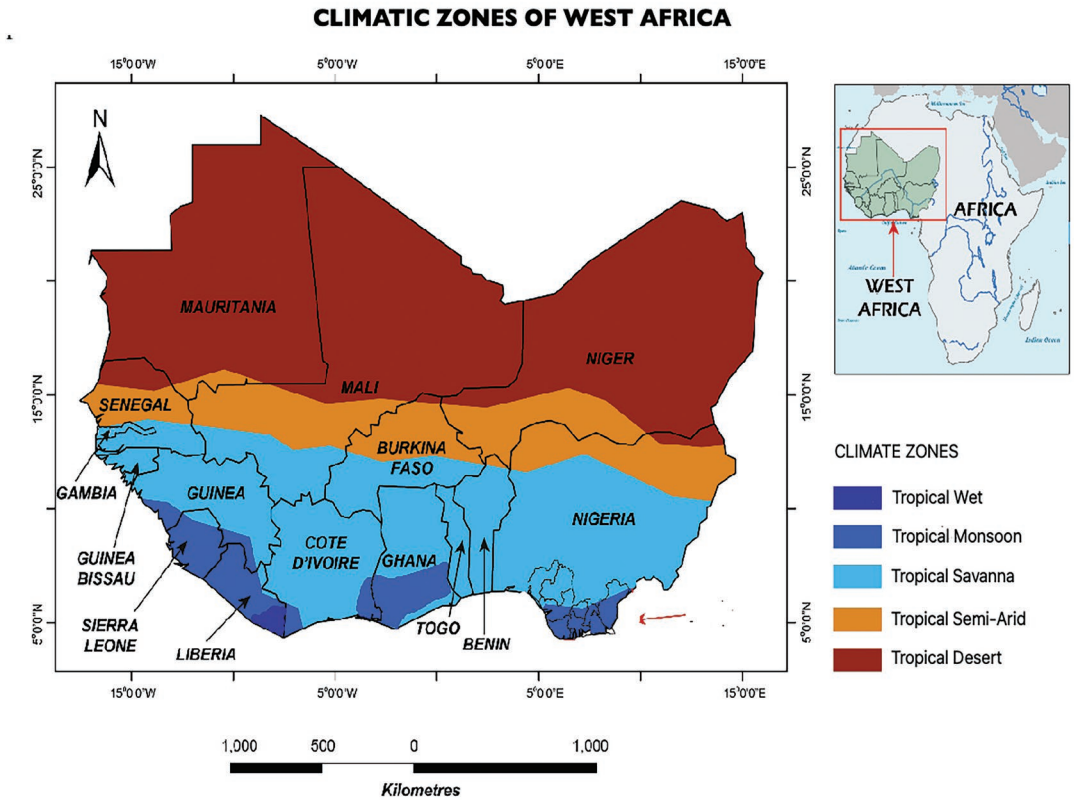

Figure 10.3: Climate Map of West Africa Manual writers, 2024

Vegetation of West Africa

There are several vegetational zones in West Africa. These vegetational zones provide unique characteristics that define the forest landscape. They are affected by factors such rainfall, nature of the soil, time, and activities of humans, among others. The vegetational zones are:

- Tropical Rainforest
- Deciduous forest
- Savanna vegetation
- Sahel vegetation
- Desert vegetation

1. **Tropical Rainforest Vegetation**

   a. This zone coincides with the Tropical Wet climatic region.

   b. Multi layered canopy dominated by tall, emergent trees reaching heights of 45-60 metres (150-200 feet).

   c. Extremely diverse tree species, with over 200 tree species per hectare.

   d. Prominent presence of species such as mahogany, iroko, and various hardwood and softwood trees.

   e. Abundant epiphytes (plants growing on other plants), lianas, and woody vines in the understory.

2. **Deciduous Forest Vegetation**
    a. The zone coincides with the Tropical monsoon climatic region.
    b. Trees shed their leaves during the dry season.
    c. Trees are generally shorter compared to tropical rainforests.
    d. There is a diverse understory vegetation with shrubs and smaller plants.
    e. Variety of tree species, including mahogany, iroko, African teak, shea nut tree and Baobab exist.
    f. Trees have thicker bark and often deep root systems to access water during the dry season.
3. **Savanna Vegetation**
    a. This zone lies within the Tropical savanna/continental climatic region.
    b. Dominated by tall grasses, which can grow up to several metres in height.
    c. There are Few trees and shrubs, often widely spaced apart.
    d. Green and lush during the rainy season, dry and brown during the dry season.
    e. Most plants are pyrophytes adapted to survive periodic fires.
    f. Common plant species include Baobab, acacia and combretum.
4. **Sahel Vegetation**
    a. This zone lies within the tropical semi-arid climatic region.
    b. Most plants are pyrophytes adapted to survive periodic fires.
    c. Most plants are xerophytes adapted to survive extreme drought conditions.
    d. Presence of thorny shrubs and bushes to reduce water loss and protect against herbivores.
    e. Dominated by hardy grasses that can survive with little water.
    f. Many plants have shallow root systems to quickly absorb moisture.
5. **Sahara Vegetation**
    a. This zone coincides with the Tropical desert climatic region.
    b. There are very few plants due to extreme arid conditions.
    c. Low-growing shrubs and bushes to minimise water loss.
    d. Most plants are xerophytes adapted to survive extreme drought conditions.
    e. There are other plants like ephemeral (plants that grow, flower, and die quickly after rainfall) that grow within this vegetative belt.
    f. Plants with deep root systems to access underground water also exist in this belt.
    g. Hardy grasses that can survive with minimal water are found in the Sahara vegetation.

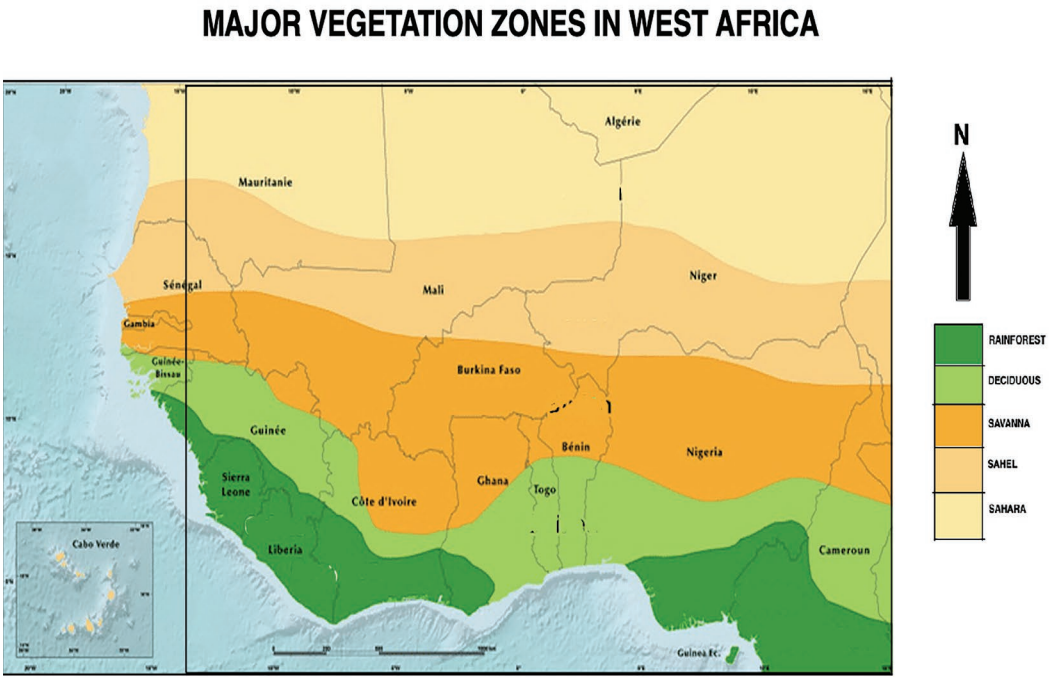

Figure 10.4: Vegetation zones of West Africa

Relief of Africa

Africa has diverse relief features that shape its unique landscapes. These relief features are grouped into highlands, plains, and lowlands.

The Highlands

1. **Ethiopian Highlands:** Located in Ethiopia, this vast mountainous region includes the Semien Mountains and the Bale Mountains, reaching elevations over 4,000 metres. It is a rugged terrain with deep valleys and unique biodiversity.
2. **Kenya Highlands:** Found in Kenya, this region includes the central highlands around Nairobi and Mount Kenya (5,199 metres high), Africa's second-highest peak.
3. **Atlas Mountains:** Located primarily in Morocco, Algeria, and Tunisia, the Atlas Mountains are the longest mountain range in North Africa. They include several high peaks, with Mount Toubkal in Morocco being the highest at over 4,000 metres.
4. **Mount Kilimanjaro:** Located in northeastern Tanzania, close to the Kenyan border. Its highest peak ascends to 5,895 metres above sea level, making it the highest mountain in Africa.
5. **The Drakensberg Mountain Range:** Located in Eastern South Africa, along the border with Lesotho and extends roughly from northeast to southwest. It has a maximum elevation of 3,482 metres.
6. **Mount Cameroon:** Located near the Gulf of Guinea in the Southwest Region of Cameroon. It stands at approximately 4,040 metres, making it the highest mountain in West Africa.

The Plains

1. **Sahara Desert:** While primarily known for its arid and desert landscapes, the Sahara also includes extensive areas of flat and sandy plains known as ergs. These are vast stretches of sand dunes and interdune sand flats that cover much of North Africa.
2. **Serengeti Plains:** Located in Tanzania, the Serengeti Plains are part of the broader Serengeti ecosystem and are famous for their grasslands. These plains support a diverse array of wildlife, including the annual migration of millions of wildebeest and other herbivores.
3. **Savannah Plains:** Savannahs cover large parts of Africa, characterised by grasslands with scattered trees and bushes. These plains are found in regions such as East Africa (example, Maasai Mara in Kenya, Kruger National Park in South Africa), Southern Africa, and parts of West Africa.
4. **Sudanese Plains:** Also known as the Sahel region, this transitional zone between the Sahara Desert and the savannah of West Africa consists of semi-arid plains with sparse vegetation and seasonal rivers.
5. **Kalahari Desert:** Although technically a desert, the Kalahari includes vast plains with scrubby vegetation and occasional dunes. It spans Botswana, Namibia, and South Africa.

Lowlands

1. **Nile Delta:** Located in Egypt, the Nile Delta is one of the world's largest river deltas. It is a low-lying area formed by the Nile River as it empties into the Mediterranean Sea, known for its fertile soils and agricultural productivity.
2. **Niger Delta:** Situated in Nigeria, the Niger Delta is another significant river delta in Africa. It is formed by the Niger River as it flows into the Gulf of Guinea. The delta region is known for its biodiversity, oil reserves, and mangrove forests.
3. **Lake Chad Basin:** The Lake Chad Basin is a large, shallow, and low-lying area in central Africa, spanning parts of Chad, Niger, Nigeria, and Cameroon. Lake Chad itself has been shrinking in recent decades due to climate change and human activities, affecting the surrounding low-lying plains.
4. **The Congo Basin:** It is one of the largest and most important low-lying areas in Africa. It is located in the central part of Africa, encompassing parts of several countries including the Democratic Republic of Congo (DRC), Republic of Congo, Central African Republic, Cameroon, Gabon, Equatorial Guinea, and Angola. It covers approximately 3.7 million square kilometres, making it the second-largest rainforest in the world after the Amazon Rainforest.
5. **Okavango Delta:** Located in Botswana, the Okavango Delta is a unique inland delta and wetland system. It is a low-lying area where the Okavango River spreads out and forms a maze of channels, lagoons, and islands, supporting a diverse array of wildlife.
6. **Sudd:** The Sudd is a vast swampy region in South Sudan, situated in the floodplain of the White Nile. It is one of the largest wetlands in Africa, characterised by low-lying plains that flood seasonally, influencing the region's hydrology and ecology.

Drainage of Africa

Major River Basins

1. **Nile Basin:** The Nile River is one of the longest rivers in the world, flowing northwards through northeastern Africa. Its basin covers parts of several countries including Egypt, Sudan, South Sudan, Ethiopia, Uganda, Kenya, Tanzania, Rwanda, Burundi, and the Democratic Republic of Congo.
2. **Zambezi River Basin:** The Zambezi Basin, spanning approximately 1.39 million square kilometres across eight countries, contains the Zambezi River, Africa's fourth-longest river. Notable for diverse ecosystems and rich wildlife, the basin includes landmarks like Victoria Falls and Lake Kariba. It supports agriculture, fisheries, and hydroelectric power from the Kariba and Cahora Bassa dams. Key challenges include deforestation, pollution, and climate change impacts.
3. **Congo Basin:** Also known as the Congo River Basin, it is the second-largest river basin in the world by area, covering about 3.7 million square kilometres in Central Africa. The Congo River and its tributaries flow through countries such as the Democratic Republic of Congo, Republic of Congo, Central African Republic, Angola, Zambia, and Tanzania.
4. **Niger Basin:** The Niger River Basin spans several countries in West Africa, including Guinea, Mali, Niger, Benin, Nigeria, and Burkina Faso.

Major River in Africa

1. **The Nile River:** It stretches approximately 6,650 kilometres in length, courses through multiple nations including Egypt, Sudan, South Sudan, Uganda, and Ethiopia, among others. This makes it the longest river in the world. The river originates from Lake Victoria and empties into the Mediterranean Sea through a vast fan-shaped delta.
2. **The Congo River:** It spans a length of approximately 4,700 kilometres. Its runs through the Democratic Republic of Congo, Republic of Congo, Central African Republic, Angola, Zambia, and Tanzania.
3. **Niger River:** The Niger River is one of Africa's longest rivers, stretching over 4,100 kilometres. Originating in the Guinea Highlands in southeast Guinea, it flows through Mali, Niger, Benin, and finally Nigeria.
4. **The Zambezi River:** It has a length of approximately 2,574 kilometres, winds its way through multiple nations. Its waters flow through the countries of Zambia, Angola, Namibia, Botswana, Zimbabwe, and Mozambique. The river drains into the Indian Ocean coast of Mozambique. Victoria Falls is found on the Zambezi River.
5. **The Orange River:** It with a length of approximately 2,200 kilometres, traverses the countries of Lesotho, South Africa, and Namibia. It is a vital watercourse in southern Africa. Notably, the river is home to Augrabies Falls. Its source is located in the Drakensberg Mountain range and empties into the Atlantic Ocean on the west coast of South Africa.
6. **The Limpopo River:** It spans approximately 1,750 kilometres and traverses the countries of Botswana, South Africa, Zimbabwe, and Mozambique. The river, like the Zambezi River, also drains into the Indian Ocean coast of Mozambique.

Major Lakes in Africa

Africa has some of the world's most significant lakes, each with unique characteristics, ecological and economic value. These lakes play vital roles in shaping and changing the continent's topography, climate, and biodiversity. These lakes are:

1. **Lake Victoria**: Located in East Africa, Lake Victoria is the largest lake on the continent and the second-largest freshwater lake in the world by surface area, covering approximately 68,800 square kilometres. It is bordered by three countries: Tanzania, Uganda, and Kenya. Lake Victoria is a crucial resource for fishing, transportation, and supporting the livelihoods of millions of people in the region. It is a shallow, tropical lake with an average depth of about 40 metres.
2. **Lake Tanganyika:** It stretches along the borders of Tanzania, the Democratic Republic of Congo, Burundi, and Zambia, Lake Tanganyika is the second-largest lake in Africa by surface area and the second-deepest lake in the world. It covers approximately 32,900 square kilometres and reaches depths of over 1,470 metres. This rift valley lake is known for its extraordinary biodiversity, hosting numerous endemic species of fish and other aquatic life.
3. **Lake Malawi:** Lake Malawi, also known as Lake Nyasa, is located between Malawi, Mozambique, and Tanzania. It covers an area of about 29,500 square kilometres and has a maximum depth of approximately 706 metres. This rift valley lake is renowned for its high species diversity, particularly its cichlid fish population, making it a key location for scientific research and ecological studies.
4. **Lake Turkana:** Lake Turkana, the world's largest permanent desert lake, lies primarily in Kenya, with its northern tip extending into Ethiopia. It spans around 6,405 square kilometres and has a maximum depth of about 109 metres. The lake is an important resource for the semi-arid region, supporting local fishing communities and providing water for livestock. It is an alkaline lake, which influences its unique ecosystem.
5. **Lake Albert:** It is located on the border between Uganda and the Democratic Republic of Congo, Lake Albert covers approximately 5,300 square kilometres. It is part of the Albertine Rift, the western branch of the East African Rift. Lake Albert plays a vital role in regional hydrology, connecting the Victoria Nile to the Albert Nile, and supports local fishing and agricultural activities.
6. **Lake Chad:** Lake Chad is a historically significant lake located in the Sahel region, bordered by Chad, Cameroon, Nigeria, and Niger. Its surface area varies significantly with seasonal rainfall, but it can cover up to 25,000 square kilometres during periods of high water. Lake Chad is a shallow, endorheic lake, meaning it has no outlet to the sea, and its size fluctuates due to climatic changes and human activities. It is crucial for local agriculture, fishing, and water supply.
7. **Lake Kivu:** Lake Kivu is situated on the border between Rwanda and the Democratic Republic of Congo, covering an area of about 2,700 square kilometres. This rift valley lake is notable for its significant methane gas reserves, which are harnessed for energy production. It has a maximum depth of around 485 metres and supports diverse fish species and local fisheries.

Major Lagoons in Africa

The African continent is distinguished by the presence of a multitude of lagoons. They are:

1. Ebrie Lagoon: It is located in Côte d'Ivoire, Ebrie Lagoon is one of the largest lagoons in West Africa. It covers an area of approximately 566 square kilometres. This lagoon is situated near the economic capital, Abidjan, making it crucial for fishing, transportation, and as a habitat for diverse aquatic species. Its proximity to urban areas has also led to challenges such as pollution and habitat degradation.
2. Lagos Lagoon: Lagos Lagoon is a significant water body in Nigeria, situated in the city of Lagos, one of the largest and most populous cities in Africa. It spans an area of about 635 square kilometres. This lagoon is integral to the city's economy, supporting activities like fishing, sand dredging, and transportation. The lagoon also faces environmental pressures due to urbanisation and industrial activities.
3. Aby Lagoon: Aby Lagoon, located in southeastern Côte d'Ivoire, covers an area of approximately 424 square kilometres. It is part of a complex system of lagoons and estuaries, playing a vital role in the region's biodiversity. The lagoon supports local fishing communities and serves as a habitat for various bird species, making it important for both the economy and the environment.
4. Keta Lagoon: Keta Lagoon is located in the Volta Region of Ghana, along the eastern coast near the border with Togo. It is the largest lagoon in Ghana, covering an area of approximately 300 square kilometres.

Characteristics of African Rivers

1. Africa has diverse river systems, including the Nile and Congo rivers which flow through many countries on the continent.
2. Seasonal Variability: Some of the rivers like the Niger river experiences significant seasonal changes in water levels, especially in its inland delta in Mali. Also, the Limpopo River, which flows through South Africa shows marked seasonal variations in flow.
3. Large Deltas: Longer African reaching the sea have large deltas. Examples are the Nile Delta in Egypt and inland Niger delta in Mali.
4. Varied Watersheds: most rivers on the continent have dense river networks, supporting vast rainforests, typical examples include rivers Congo and the Volta.
5. Another characteristic of rivers in Africa is that they exhibit the presence of waterfalls and rapids: The Victoria falls on the Zambezi River is one of the biggest in the world as well as the Blue Nile Falls on the Nile River in Ethiopia.
6. Presence of floating vegetation: many African rivers feature floating vegetation, which plays a crucial role in the riverine ecosystems. Examples include the presence of water hyacinth on rivers Congo and the Niger.

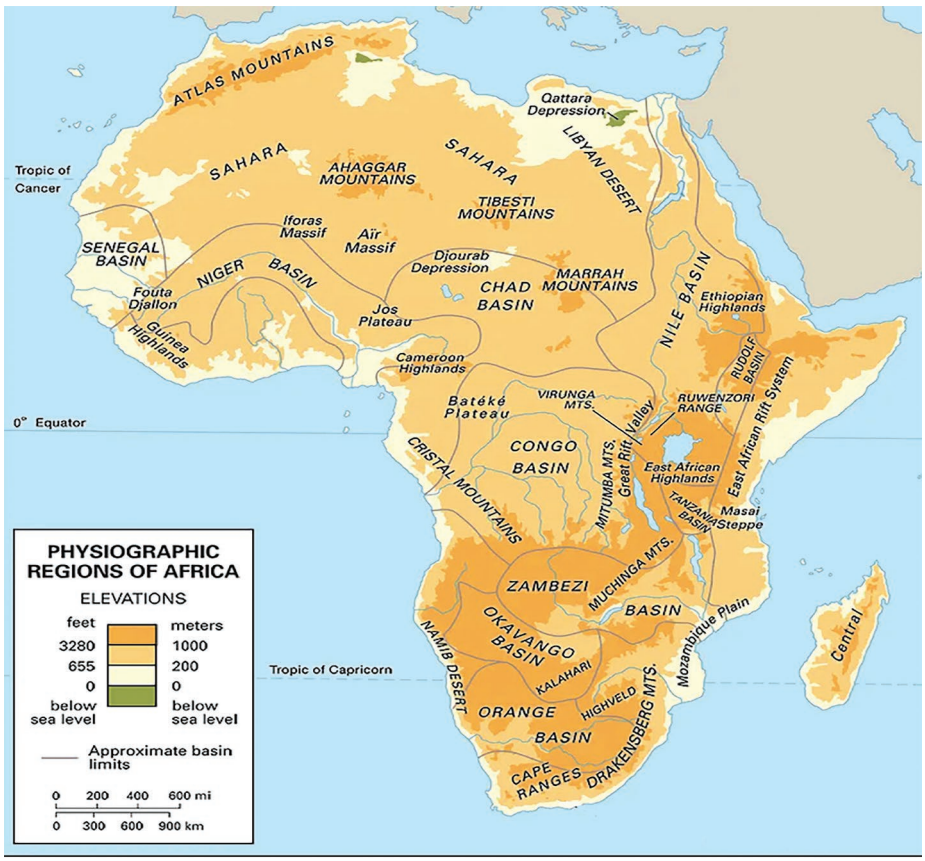

Figure 10.5: Physical (Relief and Drainage) map of Africa

Climate of Africa

Africa is a continent with diverse climatic regions, each influenced by its latitude, proximity to the ocean, and geographical features. The climatic regions are:

1. **Equatorial Climate**

   Location: This climatic zone is located between latitudes 5°N and 5°S of the equator. Countries that are located in this climatic zone include Gabon, Congo, the Democratic Republic of Congo, and parts of Uganda and Kenya. A typical weather station is Kisangani.

   Climatic characteristics

   a. Average annual temperature is around 24°C to 30°C.

   b. Annual range of temperature is typically very small, usually between 2°C to 3°C.

   c. High annual rainfall, usually exceeding 2500 mm, with no distinct dry season.

   d. Rainfall is heavy and mainly convectional which often comes in the afternoon and generally accompanied by lightning and thunder.

   e. Relative humidity is always high exceeding 80%.

2. **Tropical Monsoon Climate**

   Location: The tropical monsoon climatic zone is primarily found along the coastal regions of West Africa, extending from approximately 5°N to 10°N in terms of latitude. A typical station is Freetown in Sierra Leone.

Climatic characteristics

a. Temperature is consistently high throughout the year, averaging around 25°C to 30°C.

b. The annual temperature range of the tropical monsoon climate in Africa varies between 5°C to 7°C

c. There is high annual rainfall, between 1500mm to 2000mm, characterised by distinct wet and dry seasons. This is driven by the seasonal shifts of the Intertropical Convergence Zone (ITCZ) and the monsoon winds.

d. Rainfall can be very heavy, often in the late afternoon or early evening occurring in the form of intense thunderstorms.

e. Relative humidity is high especially during the wet season, often exceeding 80%.

3. **Tropical Savanna/Continental Climate**

Location: This climatic zone is typically found between latitude 5° and 15° north and south of the equator. It covers countries such as Nigeria, and Chad in the northern hemisphere and Tanzania and Zambia in the southern hemisphere. Two typical stations are N'djamena and Lusaka.

Climatic characteristics

a. The zone is characterised by high temperatures throughout the year. Average temperatures typically range from 20°C to 30°C.

b. During the wet season, which corresponds to summer in the respective hemisphere (for instance, June to September in the Northern Hemisphere and December to March in the Southern Hemisphere), temperatures are generally higher and more consistent due to increased cloud cover and humidity.

c. Rainfall is highly seasonal, characterised by alternating wet and dry seasons.

d. During the wet season, there is significant rainfall, often in the form of intense thunderstorms and occasional cyclones in coastal areas.

e. In the Northern Hemisphere, the wet season spans from May to October, while in the Southern Hemisphere, it occurs from November to April. On the other hand, in the Northern Hemisphere, the dry season generally lasts from November to April, and in the Southern Hemisphere, from May to October.

f. The annual rainfall varies from 500 mm to 1,500 mm with higher amounts closer to the equator and decreasing amounts toward the margins of this climatic zone.

g. In the wet Season, relative humidity often ranges from 70% to 90% while in the dry season it typically drops to 40% to 60%.

4. **Semi-arid Climate**

Location: The semi-arid climatic zone is located between latitude 10° to 20° north and south of the equator. Examples of semi-arid regions in Africa include the Sahel in northern Africa and parts of southern Africa, such as the Kalahari Desert region. A typical weather station is Luanda and Bamako.

Climatic Characteristics

a. This zone experiences some of the hottest temperatures on Earth, with year-round averages exceeding 25°C and annual temperature range varying from 8°C to 12°C between the hottest and coldest months.

b. The average annual temperature typically ranges between 20°C to 30°C.

c. This region receives considerably less rain compared to wetter climates, averaging around 250-500 mm annually.

d. In the northern hemisphere (Sahel region) the Wet Season typically occurs during the summer months (June to September) while the dry Season extends from October to May, with very little to no rainfall. In the southern hemisphere (Kalahari region) the wet Season generally occurs from November to March while extending from April to October, with little to no rainfall.

e. Rainfall can be highly unpredictable, with droughts a common occurrence. During the rainy season, rainfall can be sporadic and unevenly distributed.

f. Relative humidity levels can drop to as low as 20% or even lower during this period. The short, wet season brings a temporary increase in humidity (about 40-50%).

5. **Desert Climate**

Location: The desert climatic zone is located between latitude 20° to 30° north and south of the equator. It mostly covers the Sahara Desert in the northern hemisphere and the Kalahari and Namib deserts in the southern hemisphere. Countries that are located in these zones include Egypt, Libya, and Morocco in the northern hemisphere and Namibia in the southern hemisphere. Typical weather stations are Tripoli and Windhoek.

Climatic characteristics

a. Temperature differences between day and night can be large, often exceeding 40°C during day and drooping to as low as 0°C.

b. The average annual temperature ranges from 20°C to 30°C in the Sahara region and 15°C to 25°C in the Kalahari and Namib deserts.

c. Annual rainfall is extremely low, often less than 250 mm per year.

d. Rainfall is highly unpredictable and irregular, with long periods of drought punctuated by occasional, brief, and intense rain showers or thunderstorms.

e. Rainfall is concentrated in short, irregular bursts during specific seasons, often during the summer months in the northern hemisphere (June to September) and winter months in the southern hemisphere (December to March).

f. Rainfall events are often localised and sporadic, leading to highly variable amounts of precipitation over small distances.

g. High rates of evaporation due to intense sunlight and low humidity levels further contribute to the arid conditions.

6. **Mediterranean Climate**

Location: The Mediterranean climatic zone is primarily located along the northern and southern coastlines of the continent, spanning latitudes roughly between 30° and 40° both north and south of the equator. In northern Africa, it includes coastal regions of countries such as Morocco, Algeria, Tunisia, and Libya. In southern Africa, it encompasses the southwestern coast of South Africa, including areas around Cape Town.

Climatic Characteristic

a. Winter temperatures are generally mild, with average temperatures ranging from 10°C to 20°C.

b. Summers are hot and dry, with average temperatures ranging from 25°C to 35°C or higher.

c. Coastal areas experience milder temperatures due to the moderating influence of the Mediterranean Sea or Atlantic Ocean.

d. Rainfall primarily occurs during the winter months (November to March) in the northern hemisphere while in the southern hemisphere, it occurs May to September.

e. The total annual rainfall ranges from 200 mm to 600 mm in northern Africa and from 500 mm to 1,000 mm in southern Africa.

f. Higher relative humidity, often ranging from 70% to 90% during wet season and from 60% to 80% during the dry season.

7. **Montane Climate**

Location: The montane climatic zone found in mountainous regions covering areas around the Ethiopian highlands, Kenyan highlands, Drakensberg, and the Atlas Mountains, among others. It can be found in countries such as Kenya, Tanzania, Ethiopia, Lesotho, and South Africa.

Climatic Characteristics

a. Mountainous regions generally receive higher annual precipitation compared to the surrounding lowlands.

b. Annual rainfall totals in mountainous areas can range from 1,000 mm to over 2,000 mm, depending on the specific location and elevation.

c. The regions experience a distinct wet season, often corresponding to the summer months, when moisture-laden air masses are prevalent.

d. Higher elevations generally receive more precipitation, as the orographic effect is most pronounced at the higher slopes.

e. The rain shadow effect can create drier conditions on the leeward side of the mountains, leading to distinct precipitation patterns across the landscape.

f. Relative humidity varies with elevation and seasons in these regions.

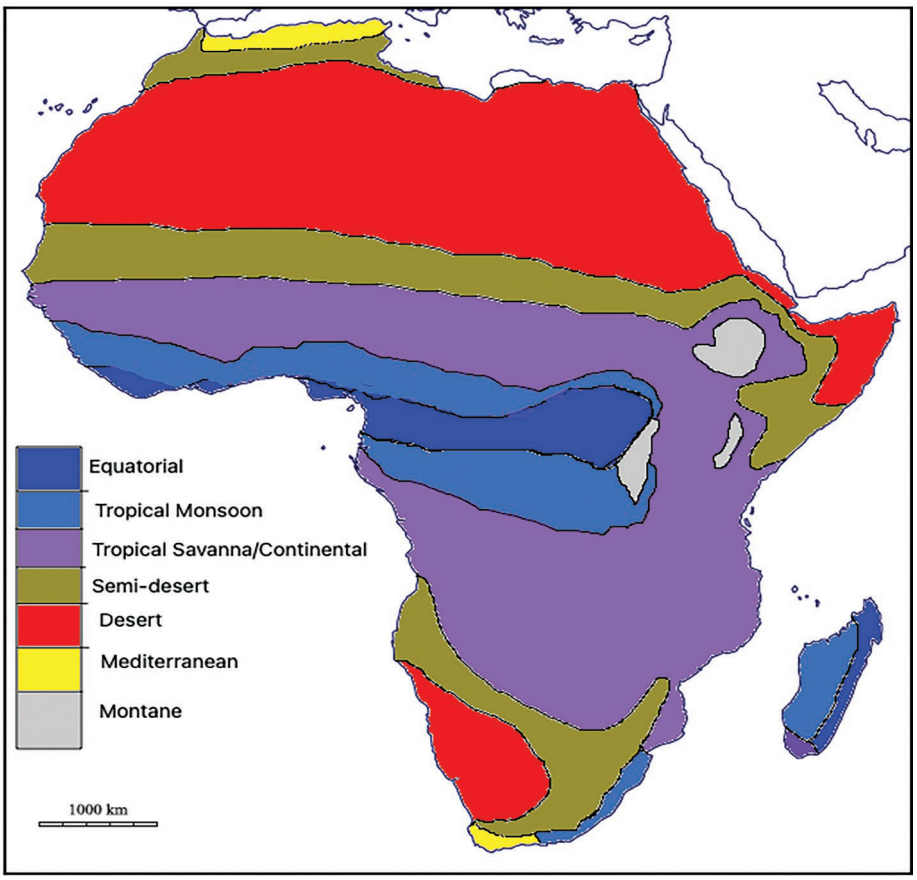

Figure 10.6: Climate zones of Africa (Manual writers, 2024)

Vegetation of Africa

Africa has distinct vegetational zones, each influenced by factors such as precipitation, soil composition, human activities, and temporal variations. They are:

- Tropical rainforest vegetation
- Deciduous forest vegetation
- Savanna vegetation
- Steppe vegetation
- Desert vegetation
- Mediterranean vegetation
- Montane vegetation

1. Tropical Rainforest Vegetation

Location: This zone coincides with the Tropical Equatorial climate.

Vegetation Characteristics

a. It features a diverse array of closely spaced plant species.

b. The forest is structured into three layers: emergent (tall trees with buttress roots), canopy (tree ferns, lianas, and epiphytes), and understory (ferns, herbaceous plants, and saprophytes).

c. Due to high temperatures and consistent rainfall, almost all trees are broad-leaved and evergreen, allowing year-round growth.

d. Shedding of leaves, flowering and fruiting occurs at the same time among the different plants.

e. The dense canopy formed by tall tree leaves blocks most light at ground level, limiting undergrowth.

f. Common tree species include mahogany, iroko, ebony, Okoume, African walnut, and various palm trees.

Figure 10.7: Rainforest vegetation of Equatorial Guinea

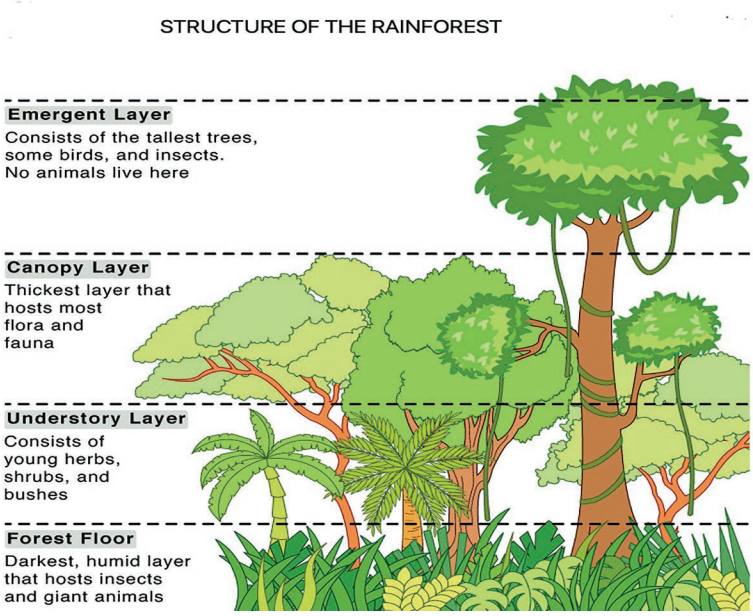

Figure 10.8: Layers of the Tropical Rainforest

2. **Deciduous Forest Vegetation**

Location: This zone coincides with the Tropical Monsoon climate.

Vegetation Characteristics

a. Most of the trees are deciduous, losing their leaves in the hot, dry season.
b. Heavy rains and high temperatures in the wet season result in rapid growth and the trees soon become covered with leaves.
c. The trees are tall, often as high as 30 metres, but they are not as close together as they are in the tropical rainforest. This results in more dense undergrowth.
d. Understory vegetation includes shrubs, grasses, and ferns that thrive in the shade of taller trees.
e. These forests have a diverse range of tree species, including mahogany, teak, African rosewood, and ebony.

3. **Savanna Vegetation**

Location: This zone coincides with the tropical Savanna/Continental climatic zone.

Vegetation Characteristics

a. Dominated by tall grasses, which can grow up to several metres in height.
b. There are Few trees and shrubs, often widely spaced apart.
c. Green and lush during the rainy season, dry and brown during the dry season.
d. The plants are pyrophytes adapted to survive periodic fires.
e. Common plant species include Baobab, acacia and combretum.

Figure 10.9: Savanna vegetation in Tanzania

4. **Steppe Vegetation**

Location: This zone coincides with the Semi-arid climate

Vegetation characteristics

a. Plants found in this zone are pyrophytes adapted to survive periodic fires.
b. Majority of the plants are xerophytes adapted to survive extreme drought conditions.
c. Presence of thorny shrubs and bushes to reduce water loss and protect against herbivores.
d. Dominated by hardy grasses that can survive with little water.
e. Many plants have shallow root systems to quickly absorb moisture.

Figure 10.10: Steppe vegetation of Mauritania

5. **Desert Vegetation**

Location: This zone coincides with the Desert climate.

Vegetation Characteristics

a. There are very few plants due to extreme arid conditions.
b. Low-growing shrubs and bushes to minimise water loss.
c. Most plants are xerophytes adapted to survive extreme drought conditions.
d. There are other plants like ephemeral (plants that grow, flower, and die quickly after rainfall) that grow within this vegetative belt.
e. Plants with deep root systems to access underground water also exist in this belt.
f. Hardy grasses that can survive with minimal water are found in the Sahara vegetation.

Figure 10.11: Sahara Desert vegetation of Morocco

6. **Mediterranean Vegetation**

Location: This zone coincides with the Mediterranean climate.

Vegetation Characteristics

a. Mediterranean vegetation includes many drought-resistant (xerophytes) plants such as evergreen shrubs, cork oak, and olive trees, which are well adapted to dry summers.

b. Plants often have small, hard leaves (sclerophyllous) that reduce water loss and withstand harsh, sunny conditions.

c. Vegetation shows rapid growth during the mild, wet winters and goes dormant during the hot, dry summers.

d. The region is home to a diverse range of plant species, including aromatic herbs like thyme, rosemary, and lavender, which thrive in the dry climate.

e. Many plants have adapted to periodic wildfires (pyrophytes), with some species requiring fire for their seeds to germinate and others having thick bark to protect against fire damage.

Figure 10.12: Mediterranean vegetation of Northern Africa

7. **Montane Vegetation**

Location: This zone coincides with the Montane climate

Vegetation Characteristics

a. They are characterised by dense forests with tall, evergreen trees that thrive in cooler, moist conditions.

b. These areas often have a diverse understory of shrubs, ferns, and mosses due to the high humidity and regular cloud cover.

c. Bamboo thickets are common in some montane regions, particularly in East Africa, providing important habitats for various wildlife species.

d. Grasslands and heathlands can be found at higher elevations, where the temperature drops, and tree growth is limited.

e. Montane zones support a wide range of endemic plant species adapted to the unique climatic conditions and elevation. Examples are giant lobelia and giant groundsel.

Figure 10.13: Montane vegetation of East Africa highlands

Learning Tasks

1. Discuss the characteristics of the relief, drainage, climate and vegetation of West Africa and Africa.
2. Sketch the map of West Africa and Africa on the following physical elements: relief, drainage, climatic and vegetation zones.

PEDAGOGICAL EXEMPLARS

Talk-For-Learning

In an all-inclusive and interactive learning process, discuss the characteristics of the relief, drainage, climate and vegetation of West Africa and Africa.

1. Use a combination of visuals (maps, pictures, diagrams) and clear explanations to introduce the key geographical features. For struggling learners, break down complex concepts into smaller, manageable parts. Encourage more confident learners to take notes, ask clarifying questions, and make connections between the characteristics of West Africa and other regions they have learned about.
2. Divide learners into small, mixed-ability groups to complete an interactive activity. In the group, provide struggling learners with guiding questions and sentence starters to help them analyse data or participate in discussions while encouraging more confident to take the lead in group discussions, present their findings to the class, or create their own visual representations on the various physical setting of West Africa and Africa.
3. Engage learners in a creative activity that allows them to demonstrate their understanding of the task. Offer struggling learners' options like writing a simple paragraph about one geographical feature. Challenge more confident learners with a more complex task like writing a short report comparing and contrasting West Africa's physical setting with other regions.
4. Incorporate activities that cater to different learning styles (visual, auditory, kinaesthetic) throughout the lesson.
5. Provide scaffolding and support for struggling learners while offering enrichment opportunities for more confident learners.
6. Utilise educational apps, simulations, or online resources to enhance the learning experience.
7. Acknowledge participation and celebrate the achievements of all learners.

Activity-Based Learning

Using videos, maps, atlas, or relevant materials and in pairs, sketch the map of West Africa and Africa on the following physical elements: relief, drainage, climatic and vegetation zones.

1. Sketch a map of West Africa and Africa, including relief, drainage, climatic, and vegetation zones and identify the relationships between physical features.
2. Consider pairing struggling learner with a more confident learner.
3. In pairs, learners explore labelled wall maps and atlases of Africa. The teacher can provide guiding questions: "*Can you find West Africa/Africa on the map? What are the major mountain ranges in Africa? or What large river flows through Africa*?"
4. Provide additional support to struggling learners by pointing out key features on the map and offering prompts and challenge them to identify additional geographical features.

5. Working in pairs, learners sketch a basic map of West Africa on a blank sheet of paper. Encourage them to use a light pencil for easy corrections. For struggling learners, provide a pre-drawn outline of Africa or West Africa to guide their sketching. The more confident partner can assist with labelling and adding details. Challenge them to include a compass rose and a legend for different symbols representing relief, drainage, climate, and vegetation zones.
6. Using the information gathered from the videos, maps, and atlases, let learners collaboratively add details to their maps. Circulate and offer specific prompts based on their observations for struggling learners (e.g., "*Where would the Sahara Desert be located?*"). Encourage more confident learners to research specific features and share their findings with their partner (e.g., average rainfall in the Sahel region).
7. Allow each pair to present their map to the class, highlighting the physical features of West Africa/Africa. The more confident partner can take the lead in presenting, while the struggling learner can point to specific features on the map. Encourage more confident partners to explain the relationships between the physical features and potential human activities in the region (e.g., farming along riverbanks, nomadic life in deserts).
8. Provide additional scaffolding throughout the activity, including pre-labelled maps, prompts, and graphic organisers and challenge the more confident learners with higher-order thinking questions and encourage them to support their struggling partners.
9. Observe learner participation during discussions and sketching of maps.
10. Collect and review the completed maps, assessing the accuracy and detail of the physical features.

Learners should be able to manage their emotional reactions and behaviours using techniques such as mindfulness strategies, breathing, and self-talk

Key Assessment

Level 1: Name any three climate types in Africa and describe their location using latitudes and longitudes.

Level 2: Describe the relief of West Africa.

Level 3: Explain three ways in which the following vegetation zones in Africa are influenced by their respective climates.

a. Tropical Rainforest
b. Savanna Vegetation

SECTION 3 REVIEW

The section delved into the political and physical geography of West Africa and Africa. Week 9 examined the location, size, and political divisions of West Africa and Africa. In Week 10, the relief, drainage, climate, and vegetation of West Africa and Africa was discussed. The section offered learners the opportunity to identify and describe the geographical location and political boundaries of West Africa and Africa. They also learned the physical features, including the relief and drainage systems, and developed knowledge of the climatic conditions and vegetation types prevalent in these regions. This has given learners a comprehensive understanding of how physical factors influence human activities and the environment in West Africa and Africa.

ADDITIONAL READING

1. Goh Cheng Leong. (1995). *Certificate Physical and Human Geography* (2nd ed). Oxford University Press.
2. Bunnett, R,B., & Parihar, S.M. (2019). *Physical Geography in Diagrams* (4th ed). Pearson India
3. Bunnett, R,B. (1997). *General Geography in Diagrams* (4th ed). Pearson Education
4. Dickson, K.B. & Acheampong P. K. (1991). *Geography for Senior Secondary Schools*. Macmillan Press
5. Owusu Tawiah, H. (2021). *Understanding Geography (Physical & Practical).* Accra

SECTION 4: MANUFACTURING INDUSTRIES IN GHANA

STRAND: HUMAN AND ENVIRONMENT

Sub-Strand: Economic Activities

Learning Outcome: *Examine the types, distribution, characteristics, importance, and challenges of manufacturing industries in Ghana*

Content Standard: *Analyse the manufacturing sector in Ghana*

Hint

The End of First Semester Examination will be conducted in Week 12. Refer to ***Appendix H*** *for a Table of Specification to guide you to set the questions. Set questions to cover all the indicators covered for at least weeks 1 to 11.*

INTRODUCTION AND SECTION SUMMARY

In this section, learners will explore the manufacturing industries in Ghana, focusing on their significance and the challenges they face. By the end of this section, learners should be able to name key manufacturing industries, their location in Ghana and describe their roles in the economy. They will understand the importance of these industries in terms of employment, economic growth, and technological advancement. Additionally, learners will critically analyse the challenges these industries meet, such as infrastructure deficits, financial constraints, and competition from imports. Learners will engage in discussions, research, and presentations to deepen their understanding and develop their analytical skills. This comprehensive approach aims to equip learners with the knowledge and skills to appreciate the complexities of the manufacturing sector in Ghana and its impact on the nation's development.

The weeks covered by the section are:

Week 11: Manufacturing Industries in Ghana

Week 12: Importance and Challenges of Manufacturing Industries in Ghana

SUMMARY OF PEDAGOGICAL EXEMPLARS

This section uses a range of pedagogies to cater to various learning styles while exploring Ghana's manufacturing sector. It begins with collaborative learning by using videos and maps to start discussions on Ghana's manufacturing industries. In addition, engage learners in activity-based learning by having them produce detailed maps highlighting key manufacturing regions. Provide templates for struggling learners and encourage confident

learners to add complex data layers. Furthermore, incorporate experiential learning through a field trip to a nearby industry. During the visit, learners should observe, take notes, and later a report. To support this process, offer guided questions to help struggling learners focus, while encouraging confident learners to conduct interviews or gather more data. Moreover, implement talk for learning with think-pair-share sessions, where learners discuss manufacturing challenges and solutions, promoting critical thinking and verbal skills. Finally, assign a problem-based learning project on improving Ghana's manufacturing sector. Support struggling learners with structured outlines and resources, and challenge confident learners to develop innovative proposals. These multifaceted approaches ensure all learners can engage with the content of Ghana's manufacturing sector in a way that best suits their individual needs.

ASSESSMENT SUMMARY

The assessment for the section on Manufacturing Industries utilises DoK Levels 1 to 3, promoting a progressive understanding of the subject. At Level 1, students will state the categories of manufacturing industries and provide examples, ensuring a clear recall of key facts through written tests or quizzes. Level 2 assessments will include a group project where students explore a nearby manufacturing industry or engage with videos highlighting Ghana's industries. This collaborative activity encourages differentiation and active learning by facilitating discussions on small-scale versus large-scale operations. Students will also explain the contribution of manufacturing industries to Ghana's economic growth, encouraging them to articulate their understanding through essays or presentations. Level 3 involves group work where students design a mind map connecting the challenges faced by manufacturing industries in Ghana with suggested remedies, fostering critical thinking and synthesis of information. These strategies promote knowledge retention and collaborative learning. Teachers can refer to the Teacher Assessment Manual and Toolkit (TAMK) for detailed implementation guidance.

WEEK 11

Learning Indicator: *Discuss the distribution, types, and characteristics of manufacturing industries in Ghana.*

FOCAL AREA: MANUFACTURING INDUSTRIES IN GHANA

Manufacturing industries play a crucial role in the economic development of Ghana. Manufacturing involves the transformation of raw materials into finished or semi-finished goods through mechanical, physical, or chemical processes for human consumption or utilisation. These industries are vital for the diversification of the economy, reducing reliance on primary commodities, and fostering economic resilience. In Ghana, manufacturing consists of a range of activities, from small-scale production to large-scale industrial operations.

The Distribution of Manufacturing Industries in Ghana

Ghana's manufacturing sector plays a significant role in the country's economic development, contributing around 10% to its GDP (Gross Domestic Product – the total market value of all finished goods and services produced within a country during a specific period). However, the location and distribution of these industries across the nation are uneven, influenced by various geographic, economic, and policy factors.

Historically, the coastal regions, particularly the Greater Accra and Western regions, have been the hubs of manufacturing activities in Ghana. The availability of infrastructure, proximity to ports, and access to the country's main consumer markets have attracted a concentration of industries, including food processing, textiles, and basic metal production. In contrast, the northern regions have a less developed manufacturing base, often relying on agricultural and natural resource-based processing.

Recent government initiatives, such as the establishment of industrial parks and special economic zones, have aimed to promote a more balanced spatial distribution of manufacturing. Efforts to improve transportation networks, energy supply, and other supporting infrastructure in the hinterland regions have also contributed to the gradual dispersal of industrial activities. Nonetheless, addressing the persistent regional inequalities in Ghana's manufacturing landscape is still an ongoing challenge for policymakers.

Types of Manufacturing Industries in Ghana

Ghana's manufacturing sector can be divided into two main categories. They are the small-scale manufacturing industries and the large-scale manufacturing industries.

Characteristics of Small-scale Manufacturing Industries in Ghana

1. These industries employ relatively few workers.
2. They are widespread and usually found in rural and peri-urban areas.
3. They usually use a small amount of power, such as firewood, charcoal, or LPG.
4. Their production capacity is relatively small.
5. They mostly employ family members, friends, and other close associates.

6. They mostly use unskilled labourers in their manufacturing activities.
7. It is less capital intensive.
8. They normally rely on indigenous technologies such as cassava grater and hydraulic press extractor for palm oil processing.

Examples of Small-scale Manufacturing Industries in Ghana

1. **Food Processing and Beverages**

   Examples

   a. **Palm Oil Processing:** Small-scale palm oil mills producing palm oil for cooking and other uses.
   b. **Gari Production:** Processing raw cassava into finished product like gari.
   c. **Soobolo processing:** Local leaves and fruits such as lemon grass, hibiscus leaves, galbanum (Prɛkɛsɛ), cloves (pɛprɛ), ginger, and pineapples.
   d. **Honey Production:** Beekeeping and processing honey for local consumption and export.

Figure 11.1: Palm oil processing using simple machines

2. **Textile and Cosmetics Production**

   Examples

   a. **Kente Weaving**: Artisanal production of kente cloth, a traditional Ghanaian textile.
   b. **Tie and Dye**: Small businesses producing tie-dyed fabrics and batik for local and export markets.
   c. **Soap making:** Local production of indigenous soap such as *alata samena*.
   d. **Shea Butter Production:** Processing of shea nuts into shea butter, which is often done by women's cooperative association in northern Ghana.

Figure 11.2: Shea butter production

3. **Woodworking and Furniture Making**

   Examples

   a. **Carpentry Workshops:** Producing furniture such as chairs, tables, and cabinets from local timber.

   b. **Wood Carving:** Crafting wooden artefacts, sculptures, and souvenirs for tourists and local markets.

Figure 11.3: Wood carving at Ahwia, Kumasi

4. **Crafts and Handicrafts**

   Examples:

   a. **Bead Making:** Creating beads from recycled glass and other materials for jewellery and decoration.

   b. **Basket Weaving:** Producing baskets, mats, and other woven products from local materials like straw and reeds.

   c. **Pottery and Ceramics:** Crafting clay pots, vases, and decorative items.

Figure 11.4: Pottery making at Tanoso, Sunyani

General Characteristics of Large-scale Manufacturing Industries in Ghana

1. They are found in large urban centres like Accra, Tema and Takoradi.
2. They employ a considerable number of workers.
3. They make use of advanced technologies and skilled labourers like engineers, technicians, managers etc.
4. They make use of more power like hydro-electric, thermal plants and coal for production
5. It is capital intensive
6. The total output is high with the cost of output per worker being low.

Examples of Large-scale Manufacturing Industries in Ghana

1. **Food and Beverage Processing:** This sector includes the processing of agricultural products such as cocoa, palm oil, fruits, and fish. Major products include chocolate, fruit juices, canned fish, and alcoholic beverages. Examples include Cocoa Processing Company, Blue Skies Company Ltd, and Guinness Ghana Breweries.
2. **Textile and Apparel:** Involves the production of fabrics, garments, and traditional clothing such as kente. The industry combines modern techniques with traditional weaving and dyeing methods. Examples are Akosombo Textiles Limited, Printex, and Ghana Textiles Printing Company Ltd (GTP).
3. **Chemical and Pharmaceuticals:** Includes the production of industrial chemicals, fertilisers, paints, and pharmaceuticals. This sector is crucial for the agricultural and health sectors. Examples include Ghana Chemicals, Tobinco Pharmaceuticals Limited.
4. **Building Materials:** Encompasses the manufacture of cement, bricks, roofing materials, and steel products. This industry supports the construction sector, which is vital for infrastructure development. Examples are Ghacem, Diamond Cement Ghana Limited, and B5 Plus Limited.

5. **Automotive and Electronics Assembly:** Involves the assembly of vehicles and electronic products. This sector is relatively emerging but growing, with increasing investment and government support. Examples are Kantanka Automobile, Toyota Ghana, and Samsung Electronics.

Figure 11.5: Ghana Textiles Company Limited

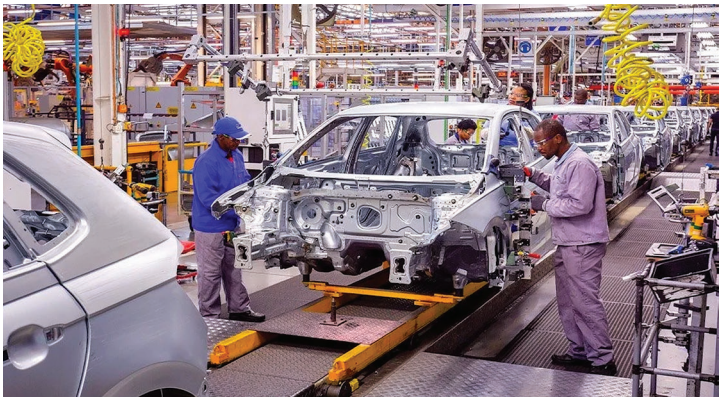

Figure 11.6: Vehicle Assemblage in Accra.

Reasons for the Concentration of Manufacturing Industries in Some Parts of the Country

Several factors contribute to the concentration of manufacturing industries in specific regions of Ghana:

1. **Proximity to Raw Materials:** Manufacturing industries often locate near sources of raw materials to minimise transportation costs and ensure a steady supply. For example, GHACEM and the Tema Oil Refinery are located in Tema because the raw material is imported through the Tema harbour.
2. **Access to Markets:** Industries tend to concentrate in urban areas with high population densities, such as Accra and Kumasi, to be close to large consumer markets. This proximity reduces distribution costs and enhances market access.
3. **Availability of Infrastructure:** Regions with better infrastructure, including roads, ports, electricity, and water supply, attract more manufacturing activities. For example, Tema, with its port facilities and industrial zones, is a major hub for manufacturing industries.

4. **Skilled Labor Force:** The availability of a skilled and educated labour force is crucial for manufacturing industries. Areas with higher concentrations of educational institutions, such as Accra and Kumasi, provide a steady supply of skilled workers.
5. **Government Policies and Incentives:** Government policies and incentives, such as tax breaks, industrial zones, and support programs, often influence the location of industries. The establishment of free zones and industrial parks in specific regions aims to attract investment and promote industrial growth.
6. **Historical and Economic Factors:** Some regions have a historical advantage due to early industrialisation and existing economic activities. These areas continue to attract new industries due to established networks, experience, and support services.

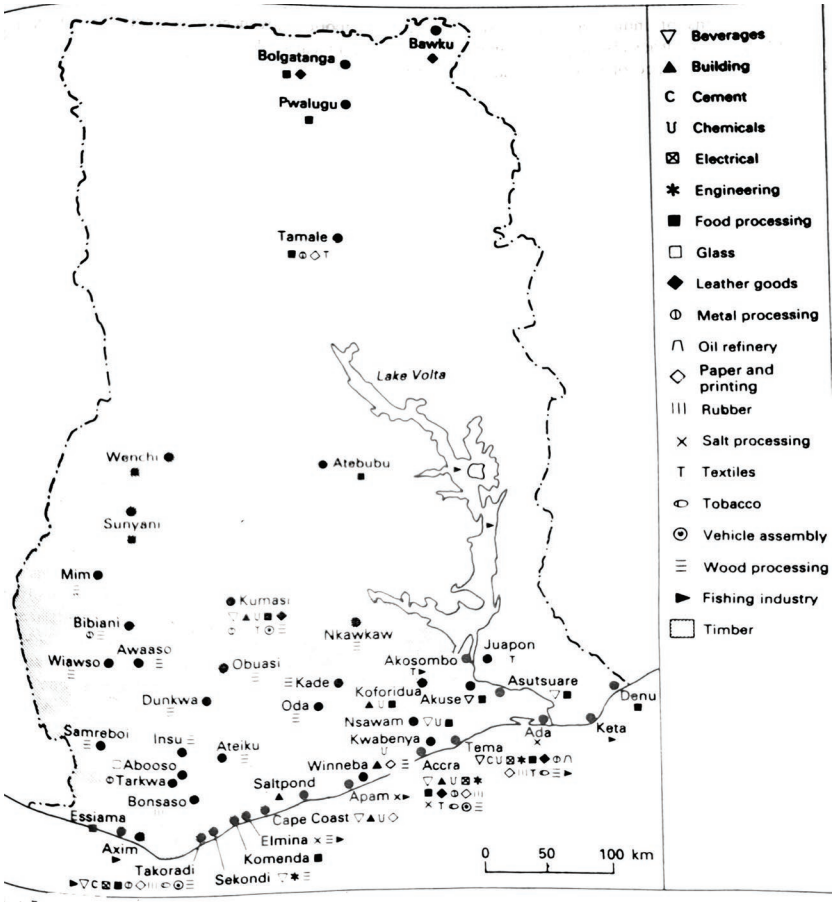

Figure 11.7: Distribution of Manufacturing industries in Ghana (Dickson & Acheampong, 1991)

Learning Tasks

1. Discuss the distribution of manufacturing industries, types, and their characteristics in Ghana, and explain the reasons for their concentration in some parts of the country.
2. Produce a map on the distribution of manufacturing industries in Ghana.
3. Embark on a field trip to a nearby industry and give a report on the reasons for its establishment in that locality.
4. Choose two types of large-scale manufacturing industries in Ghana. Complete a presentation which describes the process and products of each industry and a map to show locations. Explain why each industry is located at the places shown on the map.

PEDAGOGICAL EXEMPLARS

Collaborative Learning

Using videos, maps and other relevant resources discuss the distribution of manufacturing industries, types, and their characteristics in Ghana, and explain the reasons for their concentration in some parts of the country.

1. Start with a captivating video highlighting a finished product made in Ghana (e.g., clothing, processed foods). Ask learners what they think goes into making the product and where it might be manufactured.
2. Introduce a "Know-Want-Learn" chart. Brainstorm what learners already Know about manufacturing, what they Want to know about Ghana's industries, and what they will Learn throughout the lesson.
3. Use a digital map tool (e.g., Google Maps) or physical maps to locate major industrial centres in Ghana. Explore these locations virtually through street view or satellite imagery, discussing potential reasons for their development.
4. For struggling learners, present a simplified chart or infographic with key manufacturing types in Ghana (e.g., food processing, textiles) and their basic characteristics (e.g., raw materials used, products produced). Encourage learners to identify these industries on the map.
5. Divide learners into groups of mixed ability and assign different regions with known manufacturing activity. Using the atlas and any provided resources, each group investigates factors contributing to industry concentration in their assigned region (e.g., availability of labour, proximity to ports). Groups then share their findings with the class.
6. Throughout the lesson, use clear visuals like pictures, diagrams, or flowcharts to explain complex concepts and manufacturing processes.
7. Incorporate kinaesthetic activities like simulations or role-playing to enhance engagement.

Activity-Based Learning

Produce a map on the distribution of manufacturing industries in Ghana.

1. Distribute data sheets or cards with various manufacturing industries. learners can work individually or in pairs to explore the information.
2. Provide additional support and vocabulary definitions to struggling learners if needed.
3. Ask learners to use markers, coloured pencils, or stickers to represent different manufacturing industries on the map.
4. For struggling Learners, provide colour-coded symbols for each industry category and offer clear instructions on map placement. Encourage more confident learners to use different symbols or colours to differentiate between large and small-scale industries.
5. Let learners present their maps and explain the distribution of industries in Ghana. Provide sentence starters or prompts to help struggling learners explain their map.

Encourage more confident learners to analyse regional variations in industrial concentration.

6. Offer learners a choice in how they represent the data on the map (e.g., symbols, colours, drawings).
7. Observe learner participation in discussions and map creation.
8. Assess the accuracy and completeness of the information presented on the map.

Experiential Learning

Embark on a field trip to a nearby industry and give a report on the reasons for its establishment in that locality

1. Discuss the chosen industry, its location, and its products. This can be done a week or two before the field trip.
2. Conduct a guided tour focusing on key aspects of the industry and its operations. Encourage learners to take notes, pictures, or ask questions.
3. For struggling learners, provide a checklist of key reasons for the establishment of industry. Challenge more confident learners to identify specific factors for locating the industry during the tour and encourage them to interview employees about their roles and how location plays a part in their work.
4. Facilitate a class discussion about the observed location factors and their relevance to the industry.
5. Provide a clear report structure or template, outlining key sections like introduction, industry overview, factor influencing its location and conclusion.
6. Offer learners options for report format (written, infographic, video presentation).
7. Allow struggling learners to work in pairs or small groups for report writing.
8. Evaluate the completeness and accuracy of information in the reports.
9. Assess learner understanding of location factors and their application to the specific industry.
10. Consider incorporating creativity and presentation skills in the report format chosen by learners.

Experiential Learning

Research about the types and characteristics of manufacturing industries in Ghana

1. Distribute research guides or worksheets with prompts about different aspects of manufacturing industries. These prompts could include *types of manufacturing industries found in Ghana; raw materials used by each industry; products manufactured by each industry and examples of major manufacturing companies in Ghana.*
2. Provide a list of some common manufacturing industries in Ghana for struggling learners and guide them to find specific information about each. Offer websites with understandable language and visuals. Encourage more confident learners to research independently using various resources and delve deeper into specific industries that interest them.

3. Learners share their findings with the class. This can be done through individual presentations, small group discussions, or a class chart.
4. Encourage more confident learners to create presentations with deeper analysis. They can discuss the importance of specific industries for Ghana's economy or the impact of manufacturing on the environment.
5. Offer options for learners to present their research in ways that suit their strengths (e.g., drawing, writing, creating a model).
6. Evaluate the completeness and accuracy of the information gathered during research.
7. Assess the clarity and organisation of learner presentations or written work.
8. Observe learner participation in discussions and their ability to explain the characteristics of different manufacturing industries.

Learners in group discussions should not forget the emotions people attached to religious, political, and ethnic issues

Key Assessment

Level 1

1. State the categories of manufacturing industries.
2. State two examples of each category.

Level 2 (Group Project)

1. In mixed ability groups, explore a nearby manufacturing industry or watch videos of manufacturing industries in Ghana to distinguish between small-scale and large-scale manufacturing industries based on their modes of operation.
2. Evaluate a group presentation on the characteristics of small-scale manufacturing industries in Ghana

WEEK 12

Learning Indicator: *Discuss the importance and challenges of manufacturing industries in Ghana.*

FOCAL AREA: IMPORTANCE AND CHALLENGES OF MANUFACTURING INDUSTRIES IN GHANA

Importance of Manufacturing Industries in Ghana

1. **Economic Growth and Diversification:** Manufacturing industries contribute substantially to Ghana's Gross Domestic Product (GDP), fostering economic growth and diversification away from over reliance on primary commodities like agriculture and mining. Encouraging industrialisation through manufacturing contributes to building a stronger and more diversified economic framework, thereby lessening susceptibility to external shocks in global commodity markets.
2. **Creation of Employment**: Manufacturing industries provide a wide range of employment opportunities, from unskilled labour to highly skilled technical and managerial positions. The sector generates jobs and helps reduce unemployment rates and improves the standard of living for many Ghanaians.
3. **Increase in the Value of Products:** Manufacturing industries add value to raw materials, such as cocoa, minerals, and agricultural produce, transforming them into finished or semi-finished products. Value-added products command higher prices on the international market, boosting export earnings and improving the trade balance.
4. **Development of Infrastructure:** The establishment of manufacturing industries needs the development of supporting infrastructure such as roads, electricity, water supply, and telecommunications.
5. **Generation of Revenue to the Government:** Manufacturing industries contribute to government revenues through taxes, duties, and levies, which can be used to fund public services and development projects.
6. **Improvement in the Standards of Living:** Manufacturing industries produce a variety of consumer goods, improving access to essential products and enhancing the quality of life for the population. Again, the incomes earned by workers in the manufacturing sector help to increase household incomes and reduce poverty.

Challenges Faced by Manufacturing Industries in Ghana

1. **Inadequate Infrastructure:** Frequent power outages, unreliable electricity supply, poor road networks and inadequate transportation infrastructure increase operational costs and disrupt production processes.
2. **Limited Access to Finance:** High interest rates on loans make it difficult for manufacturers to access affordable credit for expansion and modernisation. Particularly, Small-scale manufacturing industries often struggle to secure funding due to stringent lending criteria and lack of collateral.

3. **Inadequate Skilled Labour:** There is a shortage of skilled labour with the technical expertise required for modern manufacturing processes. In addition, the insufficient investment in training and development programs limit the ability to upgrade the skills of the existing workforce.
4. **High Costs of Production:** Fluctuations in the cost of raw materials can significantly affect production costs and profitability. Reliance on imported raw materials and machinery increase production costs and expose manufacturers to unstable exchange rates.
5. **Market Access and Competition:** The relatively small domestic market limits the scale of production and the ability to achieve economies of scale. Again, the influx of cheaper imported goods can outcompete locally manufactured products, affecting sales and profitability.
6. **Low Level of Technology:** Many manufacturing firms operate with outdated technology, leading to inefficiencies and lower productivity. They are also characterised by limited investment in research and development which impedes innovation and the development of new products and processes.

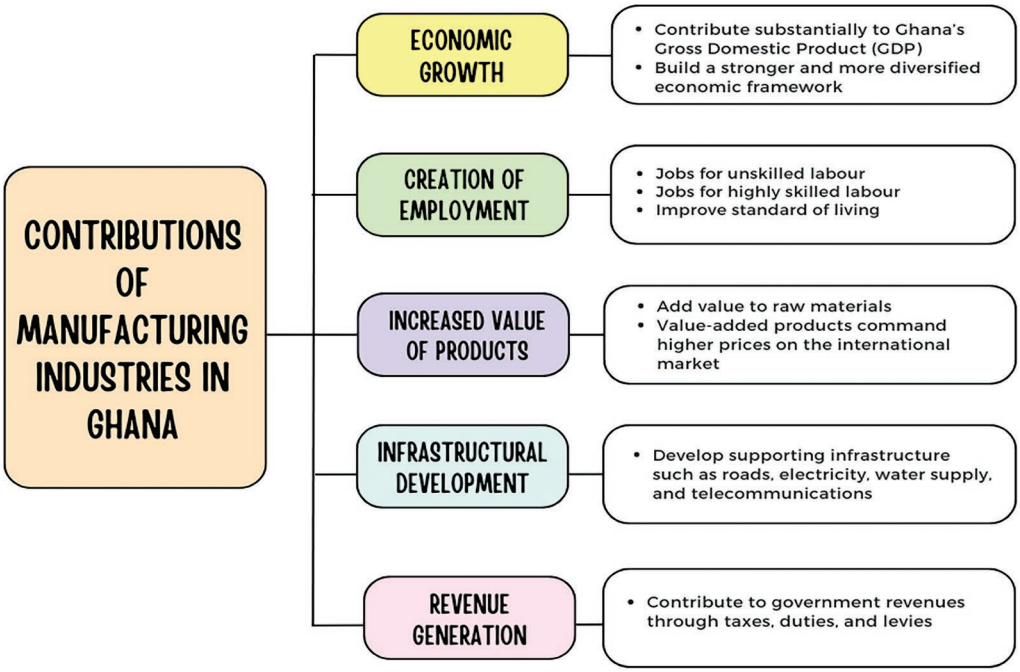

Figure 12.1: Mind map showing contributions of Manufacturing Industries to the Ghanaian economy

Solutions to the Challenges faced by Manufacturing Industries in Ghana

1. Inadequate Infrastructure
    a. Invest in sustainable energy sources like solar, wind, and hydroelectric power to reduce dependence on unreliable electricity grids.
    b. Upgrade road networks and transportation infrastructure to improve the movement of goods and raw materials.
    c. Encourage collaborations between the government and private sector to fund infrastructure projects.

2. Limited Access to Finance
    a. Advocate for lower interest rates and more favourable loan terms for manufacturers, particularly for small-scale industries.
    b. Provide access to microfinance institutions and government grants specifically tailored for small and medium-sized enterprises (SMEs).
    c. Implement credit guarantee schemes to help SMEs secure loans by reducing the risk for lenders.
3. Inadequate Skilled Labour
    a. Develop and invest in comprehensive training and development programs to enhance the skills of the existing workforce.
    b. Promote technical and vocational education to ensure a steady supply of skilled labour for the manufacturing sector.
    c. Encourage apprenticeship programs that provide hands-on experience and training in manufacturing processes.
4. High Costs of Production
    a. Promote the use of locally sourced raw materials to reduce reliance on imports and exposure to exchange rate fluctuations.
    b. Encourage bulk purchasing and collaborative buying among manufacturers to lower raw material costs.
    c. Implement lean manufacturing techniques and other efficiency improvements to reduce production costs.
5. Market Access and Competition
    a. Explore and enter new markets, both domestic and international, to increase the scale of production.
    b. Focus on improving the quality of locally manufactured products to compete with imported goods.
    c. Advocate for government policies that protect local industries, such as tariffs on imported goods and incentives for local manufacturing.
6. Low Level of Technology
    a. Invest in sustainable energy sources like solar, wind, and hydroelectric power to reduce dependence on unreliable electricity grids.
    b. Upgrade road networks and transportation infrastructure to improve the movement of goods and raw materials.
    c. Encourage collaborations between the government and private sector to fund infrastructure projects.

Learning Tasks

1. Outline the importance of manufacturing industries in Ghana and possible challenges that may confront them.
2. Use mind maps to structure contributions of manufacturing industries to the Ghanaian economy.
3. Investigate the challenges facing manufacturing industries in Ghana.
4. Investigate to find out solutions to the challenges of the industry and/or recommend solutions to the possible challenges.

PEDAGOGICAL EXEMPLARS

Talk for Learning

Learners think pair share and outline some reasons for the manufacturing industries in Ghana and possible challenges that may confront them and use mind maps to structure contributions of manufacturing industries in Ghana.

1. Provides pictures depicting manufacturing processes in Ghana (e.g., textile weaving, cocoa processing). Help struggling learners write down what they see and what products might be made. Give opportunity for confident learners to research diverse types of manufacturing industries in Ghana and jot down key points about their function and significance.
2. Consider pairing struggling learners with confident learners. Let struggling learners discuss with their partners the pictures and brainstorm how these industries might benefit Ghana. Use prompts with questions like: "*Do you think these products are used in Ghana or exported?*" "*How might these industries create jobs?*". Let confident learners share their research findings with their partners and discuss with them the potential challenges these industries might face.
3. Facilitates a class discussion, encouraging learners to share their ideas from the pair activity and highlights the importance of manufacturing. Confident learners can lead a short class discussion on the identified challenges and brainstorm potential solutions or government initiatives that could support manufacturing.
4. Provides a mind map template with the central topic: "*Contributions of Manufacturing Industries in Ghana.*" for struggling learners to brainstorm with their partner and contribute single words or short phrases related to product categories (e.g., food processing, textiles, building materials). Allow the more confident pair independently develop a more detailed mind map.
5. Remember to use visuals throughout the activity (pictures, videos of manufacturing processes) and incorporate a short role-play activity simulating a specific manufacturing process. Also, conduct a class discussion where learners share their ideas verbally.

Problem-Based Learning

Either in a field tour to a local industry or researching using internet or relevant information sources, investigate the challenges facing manufacturing industries in Ghana find out solutions to the challenges of the industry/recommend solutions to the possible challenges

Option 1: Field Trip to a Local Industry

1. Preparations

   Provides a pre-visit worksheet with simple questions and pictures. These can include: "*What products are made here?" "What materials do they use?" "Do you see any challenges?*" Let confident learners research the chosen industry beforehand. Prepare specific questions to ask during the visit.

2. During Field Trip

   Let struggling learners focus on observing the manufacturing process and workers' tasks. Allow confident learners to actively engage with industry personnel, asking prepared questions and taking notes on challenges mentioned. Pictures could also be taken to support discussions.

3. Post Field Trip

   Let struggling learners review pictures and notes from the visit and lead a discussion to brainstorm challenges based on observations. Let them suggest simple solutions with teacher guidance. Confident learners can analyse notes and research to identify key challenges, present their findings to the class, highlighting the impact on production or costs and eventually propose solutions based on industry insights and research.

Option 2: Research Project using Internet or Information Sources

1. Provides a list of relevant websites or libraries with curated resources on manufacturing industries in Ghana for struggling learners as well as graphic organisers with categories like "Challenges" and "Possible Solutions". Confident learners can choose specific industries to research using credible internet sources or library databases to take notes in the form of mind maps or outlines.
2. Let struggling learners work with a partner to research and identify challenges. Provides support and clarifies any complex information. Learners can focus on 1-2 key challenges. Let confident Learners independently research and analyse the challenges faced by their chosen industry.
3. Facilitate learners to make a presentation on recommendation to the challenges facing manufacturing industries of Ghana. Struggling learners can develop a short presentation with pictures and simple explanations of solutions to the challenges identified. Teachers can guide them in structuring their presentation. Confident learners can create a more detailed presentation analysing challenges and proposing solutions. They can include data or graphs to support their findings and present to the class or create a short video explaining their research.

After Field Trip or Research and Presentation Activity

1. Provide constructive feedback that highlights the strengths of the field trip/ presentation and offers suggestions for improvement.
2. Allow time for the groups to reflect on their learning process, the challenges they faced, and the strategies they used to overcome them.
3. Offer clarification, answer questions, and provide personalised support as needed.

Learners should be conscious of resolving interpersonal conflicts with each other if they arise in group discussions.

Key Assessment

Level 1: Identify three challenges faced by the manufacturing industries in Ghana.

Level 2: Explain how manufacturing industries contribute to economic growth in Ghana.

Level 3: **Group Work:** Design a mind map to show connections between challenges faced by manufacturing industries in Ghana and the suggested remedies.

Hint

*The Recommended Mode of Assessment for Week 12 is **End of Semester Examination.** Refer to **Appendix H** for a Table of Specification to guide you to set the questions. Set questions to cover all the indicators covered for at least weeks 1 to 11. Items 1, 2and 3 under DoK levels 3 are examples of the End of Examination questions.*

SECTION 4 REVIEW

By the end of this two-week section, learners will have a comprehensive understanding of manufacturing industries in Ghana, including their significance and the challenges they face. They will be able to identify key manufacturing regions on a map and explain the types of industries present. Learners will demonstrate the ability to discuss and critically analyse the importance of manufacturing to the economy, as well as articulate the various challenges these industries encounter. Skills and competencies developed will include collaborative research, critical thinking, effective communication through presentations and reports, and practical mapping skills. Additionally, through experiential learning, they will gain first-hand insights into industrial operations and develop problem-solving abilities by proposing solutions to real-world industrial challenges. This integrated approach ensures that learners are well-equipped with both theoretical knowledge and practical skills relevant to Ghana's manufacturing sector.

APPENDIX H: SAMPLE TABLE OF SPECIFICATION FOR END OF FIRST SEMESTER EXAMINATION

Week	Focal Area(s)	Type of Question	DoK Levels				Total
			1	2	3	4	
1	The internal structure of the earth	Multiple Choice	1	1	1		3
		Essay	-	-	1	-	1
2	The concept of continental drift	Multiple Choice	2	2	2	-	6
3	Mountains and their importance	Multiple Choice	2		2	-	4
4	Plains and their importance	Multiple Choice	1	3	3	-	7
		Essay	-	-	-	-	-
5	Techniques of map enlargement and reduction	Multiple Choice	1	1	1	-	3
		Essay	-	-	-	1	1
6	Measurement of distances and areas on topographical maps	Multiple Choice	2	2	1	-	5
7	Directions and bearings	Multiple Choice	1	2	1	-	4
		Essay	-	-	-	-	-
8	Sectional Profile Drawing and Calculation of Gradient	Multiple Choice	-	-	-	-	-
		Essay	-	-	-	1	1
9	Location, Size and Political Divisions of West Africa and Africa	Multiple Choice	1	1	-	-	2
10	Relief, Drainage, Climate and Vegetation of West Africa and Africa	Multiple Choice	1	3	1	-	5
		Essay	-	-	1	-	1
11	Manufacturing Industries in Ghana	Multiple Choice	1	3	-	-	4
12	Importance And Challenges of Manufacturing Industries in Ghana	Multiple Choice	2	2	3	-	7
		Essay	-	-	1	-	1
	Total		15	20	18	2	55

The structure of End-of-semester examination

1. Set 50 objective test items
2. Set one compulsory question on mapwork
3. Set four (4) essay questions for a learner to answer maximum of two (2) in addition to the compulsory question.

SECTION 5: SOIL FORMATION

STRAND: THE EARTH'S AND ITS NEIGHBOURHOODS

Sub-Strand: Rocks, Weathering, Soils and Mass Wasting

Learning Outcome: *Discuss the factors of soil formation, soil types and importance*

Content Standard: *Demonstrate knowledge and understanding of soils*

Hint

Individual Project Work *should be assigned to learners by the end of Week 14. Ensure that the project covers several learning indicators and spans over several weeks. Also, develop a detailed rubric and share with learners. Refer to* ***Appendix I*** *for the rubric and structure of the individual project work.*

INTRODUCTION AND SECTION SUMMARY

This section on soils aims to provide learners with a comprehensive understanding of the fundamental concepts related to soil composition, profile, formation, types, and its importance. By the end of this section, learners are expected to understand the basic components that make up soil and explore the distinct layers that make up a soil profile, including the topsoil, subsoil, and bedrock, and how these layers are formed and interact. Moreover, learners will delve into a range of factors and processes involved in the formation of different soil types and identify the different soil types found in various regions and their unique characteristics, as well as the importance of these soils for agriculture, ecosystems, and human activities. Through a combination of theoretical knowledge and practical applications, learners will develop a deeper appreciation for the complexities and significance of soil as a vital natural resource.

The weeks covered by the section are:

Week 13: Soils

Week 14: Types and Importance of Soils

SUMMARY OF PEDAGOGICAL EXEMPLARS

This section utilises a blend of strategies to cater to diverse learning styles. It begins with "Talk for Learning" through brainstorming and "Think-Pair-Share." Brainstorming allows all learners to contribute ideas, while "Think-Pair-Share" fosters individual reflection and communication in mixed-ability pairs. This caters to auditory learners who benefit from verbal processing and kinaesthetic learners who thrive on interaction. Collaborative learning then takes centre stage, with learners engaging in mixed-ability, small-group discussions. This fosters teamwork, peer learning, and the exchange of diverse perspectives, benefiting both visual learners who gain from shared ideas and auditory learners who solidify knowledge through explanation. Finally, the lesson culminates in an "Experiential Learning" activity where learners perform experiments in mixed-ability groups. This hands-on approach caters to kinaesthetic learners and allows all learners to engage with soil properties directly, solidifying their understanding through practical experience.

ASSESSMENT SUMMARY

This section employs a tiered approach catering to diverse learning styles. Formative assessments target DoK 1 & 2 through individual tasks like listing and explaining soil components and soil formation. Summative assessments target DoK 2 & 3. Individual projects allow learners to design experiments (DoK 2) or create presentations (DoK 3), catering to visual and kinaesthetic learners. Group research and presentations (DoK 2 & 3) promote collaboration, communication, and deeper understanding, benefiting auditory and visual learners through discussions and presentations. This multi-faceted approach ensures learners highlight their knowledge in a way that aligns with their strengths. Teachers can refer to the Teacher Assessment Manual and Toolkit (TAMK) for further guidance on implementing these assessment strategies effectively.

WEEK 13

Learning Indicator: *State and explain the factors of soil formation.*

FOCAL AREA: SOILS

Meaning of Soil

Soil can be defined as the unconsolidated mineral and organic material on the surface of the Earth that serves as a medium for plant growth. It is a fundamental natural resource essential for sustaining life on Earth. Soil is not just a static substance; it is a dynamic system that interacts with the atmosphere, biosphere, lithosphere, and hydrosphere. It is a habitat for many organisms, a reservoir of nutrients and water, and a medium for the decomposition and recycling of organic matter.

Composition of Soil

Soil composition is a complex mixture of mineral particles, organic matter, water, air, and living organisms. The primary components of soil include:

1. **Mineral Particles:** These are derived from the weathering of rocks and are categorised into sand, silt, and clay based on particle size. Sand particles are the largest, followed by silt, and then clay, which has the smallest particles.
2. **Organic Matter:** This includes decomposed plant and animal residues, known as humus, which contribute to soil fertility, structure, and water-holding capacity.
3. **Water:** Soil water, or soil solution, occupies the pore spaces between soil particles and is essential for the survival of plants and soil organisms.
4. **Air:** Soil air fills the gaps between soil particles not occupied by water. It is crucial for the respiration of plant roots and soil microorganisms.
5. **Living Organisms:** A diverse community of organisms, including bacteria, fungi, earthworms, insects, and other fauna, live in the soil. These organisms play vital roles in nutrient cycling, decomposition, and soil structure maintenance.

Soil Profile

Soil profile refers to the vertical section of soil that reveals the different layers or horizons present within the soil. Each horizon has distinct physical and chemical properties:

1. **O Horizon:** This is the topmost layer, also called the organic horizon. It consists mainly of decomposed organic matter, such as fallen leaves and other plant remains. The O horizon enriches the soil with nutrients and contributes to its fertility.
2. **A Horizon:** The A horizon is often referred to as the topsoil. It is characterised by a dark colour due to the presence of organic matter and minerals. This layer is crucial for plant root development and nutrient absorption.
3. **E Horizon:** The E horizon, also known as the eluviation horizon, is typically found in soils with good drainage. It is lighter in colour than the A horizon and is characterised by the leaching or removal of minerals and organic matter.

4. **B Horizon:** The B horizon, commonly known as the subsoil, is enriched with minerals and nutrients that have been leached from the upper layers. It often displays a reddish or yellowish colour due to the accumulation of iron, clay, or other minerals. The B horizon can vary in thickness and composition depending on the specific type of soil.
5. **C Horizon:** The C horizon is the layer of weathered parent material or bedrock from which the soil has formed. It consists of partially weathered rock fragments and has little organic matter content.
6. **R Horizon:** The R horizon, also known as bedrock, is the non-weathered solid rock beneath the soil layers. It serves as the foundation from which the soil is derived but is not considered a part of the soil profile.

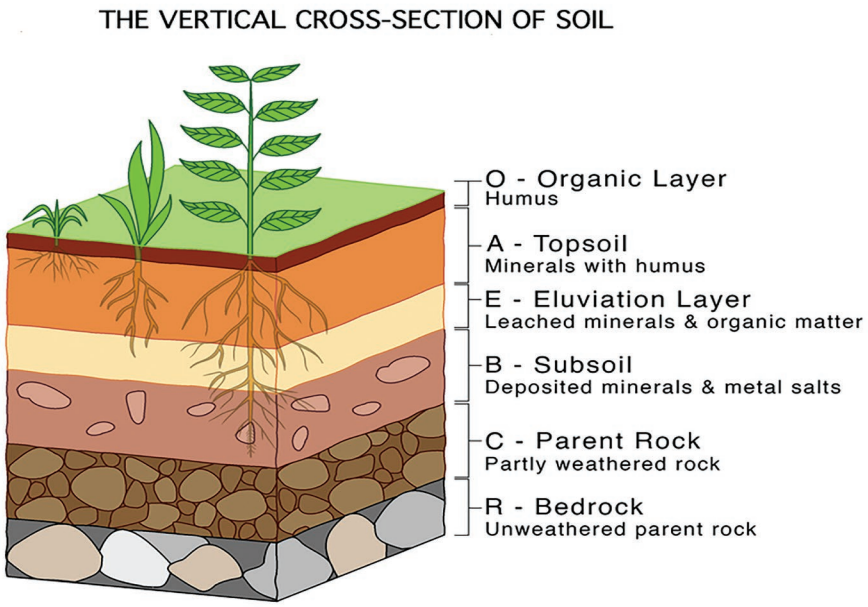

Figure 13.1: Vertical cross-section of Soil

Factors of Soil Formation

1. **Climate:** The climatic conditions of a region, including temperature, precipitation, and humidity, play a pivotal role in soil formation. Temperature influences the rate of weathering, while precipitation regulates the leaching and translocation of minerals within the soil profile. Humid, tropical climates, for instance, typically produce deeply weathered, highly leached soils rich in kaolinite clay minerals. In contrast, arid and semi-arid environments often develop soils with accumulations of calcium carbonate, gypsum, or other soluble salts.
2. Parent Material: The composition and properties of the underlying bedrock, glacial deposits, or other geological formations, provide the initial raw materials from which soils develop. The mineralogy, texture, and chemical composition of the parent material largely determine the inherent fertility and physical characteristics of the resulting soil.
3. **Organisms:** The presence and activity of living organisms, including plants, animals, fungi, and bacteria, significantly shape the formation of soil. Plant roots, for example, can physically and chemically weather parent material, while decomposing organic matter adds nutrients and alters soil structure. Burrowing animals mix and aerate the

soil, while microorganisms drive crucial biogeochemical processes that transform and translocate soil components.

4. **Relief:** The topography or relief of the land also impacts soil formation. Steep slopes are prone to increased erosion, limiting soil depth, while gentle slopes and depressions tend to accumulate weathered materials. Aspect, the direction a slope faces with respect to the sun, can influence soil moisture and temperature, leading to variations in soil characteristics even within a small geographic area.
5. **Time:** The duration over which soil-forming processes operate is a critical factor. Soil formation is a gradual, incremental process, with the youngest soils exhibiting simple profiles and the oldest soils displaying complex, highly differentiated horizons. Time allows for the accumulation of organic matter, the leaching of soluble minerals, and the development of distinct soil horizons.

Learning Tasks

1. Brainstorm on the definition, composition, and profile of soil.
2. Discuss the factors of soil formation.

PEDAGOGICAL EXEMPLARS

Talk for Learning

Brainstorm on the definition, composition and profile of soils ensuring gender responsiveness and different abilities.

1. Use visual aids (images, diagrams) to introduce the topic of soil and provide a simple, clear definition of soils. Encourage confident learners to research the meaning of soils.
2. Provides a sentence starter: "Soil is..." for struggling learners to complete individually, focusing on what they already know (e.g., "Soil is where plants grow"). Let confident learners explain soils from using information obtained from their research.
3. Struggling can work in pairs to observe and feel different soil samples provided by the teacher. Prompts discussion using relatable questions like: "*What do you see?*" "*Does it feel the same?*" Confident learners can independently analyse the provided soil samples and use magnifying glasses to observe the different components (mineral particles, organic matter). Briefly describe their observations.
4. Provides a large sheet of paper with a pre-drawn soil profile outline (horizons not labelled) for struggling learners. Let them use crayons or markers to colour different sections based on observations of the soil samples and labelled horizons. Encourage confident learners to create their own soil profile diagrams, label the different soil horizons (topsoil, subsoil, bedrock) and include details about their composition and texture.
5. Facilitates a discussion, prompting learners to share observations and what they learned about soil composition. Support struggling learners to contribute verbally. Encourage confident learners to present their detailed soil profile diagrams to the class, explaining the characteristics of each horizon and its importance.

6. Let learners display their completed soil profile diagrams or brainstorming lists around the classroom and then rotate and provide written or verbal feedback on each other's work.
7. Remember to use scaffolding is key for struggling learners and offer extension activities for confident learners if possible. Again, ensure a positive and inclusive learning environment where all learners feel comfortable contributing their ideas.

Collaborative Learning and Talk for Learning

Using mixed ability and interactive small groups, discuss the factors of soil formation.

1. Provide a short, age-appropriate reading passage highlighting the main factors of soil formation. Encourage confident learners to research the factors of soil formation in more depth, taking notes on their impact and interactions.
2. Create mixed-ability groups with a good balance of struggling and confident learners. Assign roles (e.g. facilitator, notetaker).
3. Encourage the facilitators (confident learners) to lead the group through a discussion using prompts provided by the teacher.
4. Let each group present their findings of factors of soil formation to the class and provide support and prompts.
5. Briefly discuss within groups what worked well and how they could improve their collaboration on future activities. This allows the teacher to gauge group dynamics and identify areas for improvement.
6. Encourage learners to answer a short question on a notecard, such as: "*Which factor of soil formation surprised you the most and why?*"
7. Foster peer interaction by encouraging feedback and discussions, guiding learners to give constructive comments and ask insightful questions.
8. Create both formative and summative assessments to evaluate learners' observational skills, understanding of formation processes, and ability to effectively communicate their findings.
9. Provide prompt and constructive feedback that highlights learners' strengths, identifies areas for improvement, and offers suggestions for further exploration.

Learners should be able to manage their emotional reactions and behaviours using techniques such as mindfulness strategies, breathing, and self-talk.

Key Assessment

Level 1

1. Define soil.
2. Identify 3 components of soil.

Level 2: Discuss the factors of soil formation.

Level 3: Individual Project: Draw a model of the soil profile and explain three factors influencing soil formation in your locality.

WEEK 14

Learning Indicator: *Differentiate between the soil types and discuss the importance of soil*

FOCAL AREA: TYPES AND IMPORTANCE OF SOILS

Types of Soils

Soils are classified based on their physical and chemical properties, particularly the size of their mineral particles. The primary types of soil are clay soil, loamy, and sandy soils, each with distinct characteristics that influence their suitability for various agricultural and construction purposes.

Clay Soils

Clay soils are a type of soil known for their fine particle size and specificity.

Characteristics of Clay Soils

1. **Particle Size:** Clay soils have very fine particles, less than 0.002 millimetres in diameter.
2. **Texture:** They have a smooth and sticky texture when wet and harden when dry.
3. **Water Retention:** High water-holding capacity due to the small particle size and large surface area.
4. **Drainage:** Poor drainage, leading to waterlogging and slow permeability.
5. **Nutrient Holding:** High nutrient retention, as clay particles can adsorb and hold onto essential minerals and nutrients.
6. **Structure:** Often compact and dense, with low porosity and aeration.

Advantages of Clay Soils

1. High nutrient content makes clay soils fertile and suitable for growing nutrient-demanding crops for example wheat, rice, and barley.
2. Good water retention benefits plants during dry periods.

Limitations of Clay Soils

1. Poor drainage can lead to waterlogging, root rot, and limited oxygen availability for plant roots.
2. Difficult to work with due to its heavy, sticky nature, especially when wet.

Loamy Soils

Loamy soil refers to a type of soil that is a mixture of sand, silt, and clay. They are known for their ideal texture and composition for plant growth.

Characteristics of Loamy Soils

1. **Particle Size:** Loamy soils are a balanced mixture of sand, silt, and clay particles.
2. **Texture:** Soft, crumbly texture that is easy to work with.

3. **Water Retention:** Moderate water-holding capacity, providing good moisture availability for plants.
4. **Drainage:** Good drainage with adequate aeration, reducing the risk of waterlogging.
5. **Nutrient Holding:** Sufficient nutrient retention, combining the advantages of clay and sandy soils.
6. **Structure:** Well-structured, with good porosity and aeration.

Advantages of Loamy Soils

1. Ideal for most agricultural purposes due to its balanced properties.
2. Easy to work with and provides a stable environment for plant roots.
3. Support a wide variety of crops and plants.

Disadvantages of Loamy Soils

1. Require regular management to maintain its fertility and structure.
2. May be subject to erosion if not properly managed.
3. The good drainage properties of loamy soils can sometimes lead to the leaching of nutrients, especially in areas with heavy rainfall or excessive irrigation.

Sandy Soils

The sandy type of soil is characterised by a high proportion of sand particles (between 65% and 85%) and a low proportion of clay and silt particles.

Characteristics of Sandy Soils

1. **Particle Size:** Sandy soils have large particles, ranging from 0.05 to 2 millimetres in diameter.
2. **Texture:** Gritty and coarse texture that feels rough to the touch.
3. **Water Retention:** Low water-holding capacity, leading to quick drainage and drying out.
4. **Drainage:** Excellent drainage, with high permeability and low water retention.
5. **Nutrient Holding:** Poor nutrient retention due to the large particle size and low surface area.
6. **Structure:** Loose and well-aerated, with high porosity.

Advantages of Sandy Soils

1. Light and easy to work with, making it simpler to till, plant, and weed.
2. Good drainage reduces the risk of waterlogging and root diseases.
3. Suitable for plants that prefer well-drained conditions, such as root crops and certain vegetables.

Disadvantages of Sandy Soils

1. Require frequent watering and fertilisation due to low water and nutrient retention.
2. Susceptible to erosion and leaching of nutrients.

Differences between clay, loamy and sandy soils

Table 11.1: *Soil types and their properties*

Property	Type of Soil		
	Clay	Loam	Sandy
Particle Size	Fine particles, less than 0.002 millimetres in diameter.	Balanced mixture of sand, silt, and clay particles.	Large particles, ranging from 0.05 to 2 millimetres in diameter.
Texture	Smooth and sticky when wet and hard when dry.	Soft and crumbly.	Gritty and coarse.
Water Retention	High water-holding capacity.	Moderate water-holding capacity, providing good moisture availability for plants.	Low water-holding capacity leading to quick drainage and drying out.
Drainage	Poor drainage, leading to waterlogging and slow permeability.	Good drainage with adequate aeration, reducing the risk of waterlogging.	Excellent drainage, with high permeability and low water retention.
Nutrient Holding	High nutrient retention, as clay particles can adsorb and hold onto essential minerals and nutrients.	Sufficient nutrient retention, combining the advantages of clay and sandy soils.	Poor nutrient retention due to the large particle size which gives the soil greater porosity and hence water moves down the profile quicker picking up and removing nutrients.
Structure	Often compact and dense, with low porosity and aeration.	Well-structured, with good porosity and aeration.	Loose and well-aerated, with high porosity.

Importance of Soils

1. **The Foundation of Plant Life:** Soil provides the physical support and nutrients that plants need to grow. It acts as an anchor for roots, stores water and essential minerals, and houses beneficial microorganisms that break down organic matter and make nutrients available to plants. Without healthy soil, plant life would struggle to survive.
2. **Food Security:** Healthy soils are fundamental for food production. They provide the base for agriculture, sustaining crops that feed billions of people worldwide. Fertile soil allows for efficient use of water and nutrients, leading to higher crop yields and contributing to global food security.
3. **Water Filtration and Regulation:** Soil acts as a natural filter, cleaning water as it percolates through the different layers. It removes pollutants and contaminants, helping to purify groundwater supplies. Healthy soil also plays a crucial role in regulating water flow, preventing floods, and reducing erosion.
4. **Climate Change Mitigation:** Soils store a massive amount of carbon, acting as a significant carbon sink. Healthy soil practices that promote organic matter retention

can help mitigate climate change by capturing atmospheric carbon dioxide and storing it in the soil.

5. **Habitat and Biodiversity:** Soil is teeming with life, from microscopic organisms like bacteria and fungi to larger creatures like earthworms and insects. This rich biodiversity is essential for maintaining healthy ecosystems. The diversity of soil life also contributes to soil fertility and decomposition processes.

Learning Tasks

1. Outline some reasons for the importance of soils.
2. Perform an experiment using real or simulated soil samples to differentiate between clay, loam, and sandy soils.

PEDAGOGICAL EXEMPLARS

Experiential Learning

In mixed ability groups, perform an experiment using real objects to differentiate between clay, loam, and sandy soils.

1. Form mixed ability groups, ensuring each group has a balance of struggling and more confident learners and assign confident learners as group leaders to help guide and support their peers.
2. Provide a brief explanation of the types of soil (clay, loam, sandy) and their characteristics. Use visuals and simple explanations to aid struggling learners understanding and encourage confident learners to ask questions and provide explanations to their group.
3. Provide real or simulated samples of clay, loam, and sandy soils for each group to observe and handle. In the groups struggling learners can focus on tactile learning by feeling the texture of each soil type and discussing their observations while confident learners lead the discussion, encouraging detailed descriptions and comparisons of soil types.
4. Perform a water absorption test by adding water to each soil type and observing the results. Struggling learners can assist with measuring and pouring water and observe changes while confident learners explain the scientific basis of water absorption in different soil types and record the observations.
5. Let learners record the observations and results in a table or chart. Guide the group in creating detailed and organised records. Provide templates and examples to help struggling learners accurately record their observations.
6. In their groups, let learners discuss the findings of their experiment. Encourage learners to share their observations and thoughts as the leader facilitates the discussion, ensuring everyone's input is valued and considered.
7. Let each group present their findings to the class. With the support from group members, let the leader lead the presentation, ensuring it is comprehensive and engages the audience.

8. Provide feedback on the experiment and the presentations by offering positive reinforcement and specific suggestions for improvement and give constructive feedback that challenges them to deepen their understanding and skills.
9. Have learners reflect on what they learned and how they worked together as a group. Use guided questions to help struggling learners articulate their learning experiences while encouraging confidence to reflect on their leadership roles and how they can support their peers better.

Talk for Learning

Learners think pair share and outline some reasons for the importance of soils.

1. Ask learners to think individually about the importance of soils for a few minutes. Provide prompts or guiding questions to help struggling learners generate ideas and encourage confident learners to think of multiple aspects of soil benefits.
2. Pair struggling learners with more confident peers who can guide the discussion and help articulate their thoughts. Encourage confidence to take on a mentoring role, encouraging their partner to share ideas and contributing their own insights.
3. Bring pairs together to share their ideas with the larger group or class. Encourage confident learners to present their ideas clearly and support their partner in sharing.
4. Facilitate a class-wide discussion on the importance of soils, synthesising ideas from all pairs.
5. Ask learners to reflect on what they learned about soils and the think-pair-share process.

Learners should be conscious of resolving interpersonal conflicts with each other if they arise in group discussions

Key Assessment

Level 1

1. Identify the three types of soil.
2. List two characteristics each of the 3 types of soil.

Level 2: Explain the differences between the 3 types of soil in terms of

1. Drainage
2. Nutrient holding

Level 3: Explore the role of loamy soil in agricultural practice (Individual project).

Hint

Assign the individual project in week 14. Refer to Appendix I for rubrics for individual project). The item under DoK level 3 is a task example.

SECTION 5 REVIEW

This section covered two weeks. By the end of this two-week section on soils, learners will have a developed a comprehensive understanding of soil composition and formation, as well as the types and importance of soils. In Week 13, learners discovered the key components of soil, including minerals, organic matter, water, and air, and understand the processes of soil formation. They demonstrated their learning through practical activities such as soil sample analysis and collaborative discussions. In Week 14, learners explored various soil types and discussed their significance in agriculture, ecosystems, and construction. They learned how different soils supported different plant life and influenced land use. Throughout these weeks, learners developed skills in observation, data collection, critical thinking, and scientific reporting, enhancing their competencies in environmental science and practical research methods.

APPENDIX I: RUBRIC FOR INDIVIDUAL PROJECT

Task

Exploring the Role of Loamy Soil in Agricultural Practices

Criteria	Excellent (4)	Good (3)	Fair (2)	Poor (1)
Definition of Loamy Soil	Clear and accurate definition; demonstrates a strong understanding of loamy soil.	Accurate definition; shows good understanding but lacks detail.	Definition is vague or partially incorrect; limited understanding.	No clear definition or incorrect; minimal understanding.
Composition	Thorough explanation of loamy soil's composition (sand, silt, clay) with specific percentages.	Good explanation of composition; some specifics may be missing.	Limited explanation; lacks clarity on composition.	Poor or incorrect explanation of composition.
Physical Properties	Detailed explanation of texture, drainage, and moisture retention; uses relevant examples.	Good explanation of properties; minor details may be missing.	Limited explanation; some properties are unclear or missing.	Poor explanation; lacks understanding of physical properties.
Examples	Provides multiple, relevant examples of loamy soil in agricultural practices.	Provides relevant examples, but may lack variety or depth.	Few examples given; relevance may be unclear.	Lacks examples or provides irrelevant examples.
Importance	Comprehensive discussion on the importance of loamy soil in agriculture; connects to real-world applications.	Good discussion on importance; some connections to applications may be missing.	Limited discussion; importance is unclear or vague.	Poor discussion; minimal or no relevance to agriculture.
Organization and Clarity	Information is very well organized; logical flow enhances understanding; ideas are expressed clearly.	Generally well organized with good clarity; minor lapses in flow.	Some organization; ideas may be disjointed or unclear.	Poorly organized; difficult to follow overall; unclear expression.
Creativity and Engagement	Highly original approach; engaging presentation with thought-provoking insights.	Some originality; provides interesting perspectives but lacks depth.	Limited creativity; relies heavily on common ideas.	Lacks creativity; little to no original thought presented.

Total Score - 28

ADDITIONAL READING

1. Petersen, J. F., Sack, D., & Gabler, R. E. (2011). *Fundamentals of Physical Geography (*2nd ed). Cengage Learning.
2. Tsibu, B. (2022). *Human and Regional Geography for Senior High Schools*. Abundance of Grace Ent: Kumasi
3. Bunnett, R,B. (1997). *General Geography in Diagrams* (4th ed). Pearson Education
4. Bunnett, R,B., & Parihar, S.M. (2019). *Physical Geography in Diagrams* (4th ed). Pearson India
5. Dadson I.Y Adu-Boahen K., & Owusu B.A (2022). Essentials of Physical Geography. UCC Press, Cape Coast.
6. Dickson, K.B. & Acheampong P. K. (1991). *Geography for Senior Secondary Schools*. Macmillan Press
7. Goh Cheng Leong. (1995). *Certificate Physical and Human Geography* (2nd ed). Oxford University Press.
8. Owusu Tawiah, H. (2021). *Understanding Geography (Physical & Practical).* Accra

SECTION 6: WORLD CLIMATIC AND VEGETATION ZONES

STRAND: THE EARTH AND ITS NEIGHBOURHOODS

Sub-Strand: The Earth Atmosphere

Learning Outcome: *Examine factors that influence the elements of climate, the world climatic zones and the associated vegetation zones*

Content Standard: *Demonstrate understanding of the factors that influence the elements of climate, the world climatic zones and associated vegetation types*

INTRODUCTION AND SECTION SUMMARY

In this section, learners will explore the fundamental elements of climate, the various forms of precipitation, and the diverse climatic zones of the world along with their associated vegetation. By the end of this section, learners are expected to understand the key components that influence climate. They should be able to identify and describe different forms of precipitation. Additionally, learners will examine the major climatic zones and understand how these zones determine the types of vegetation that thrive within them. Learners will demonstrate their knowledge through the ability to classify different climatic zones and explain the relationship between climate and vegetation, highlighting a comprehensive understanding of how climatic factors shape the natural environment.

The weeks covered by the section are:

Week 15: Elements of Climate

Week 16: Precipitation

Week 17: World Climatic Zones and the Associated Vegetation

SUMMARY OF PEDAGOGICAL EXEMPLARS

This section discusses the pedagogical strategies teachers can employ to cater for different learning abilities. Inquiry-Based Learning such as individual research can foster independent critical thinking. Talk for Learning will encourage learners to share perspectives and brainstorm on climate elements and world climatic zones, promoting verbal articulation and peer learning. Exploratory Learning can facilitate GESI-responsive group research on precipitation forms, ensuring inclusivity. Collaborative Learning involving group discussions on rainfall types as well as mixed-ability group interactions can enhance cooperative skills. Activity-Based Learning such as designing posters on vegetation within climatic zones, can also be employed. These diverse pedagogies will ensure that all learners, regardless of their abilities, are engaged and able to show their understanding effectively.

ASSESSMENT SUMMARY

The range of assessment strategies that the teacher can employ to cater for different learning abilities are discussed here. The assessment strategies are aligned with DoK levels 1, 2, and 3. The assessment strategies include individual tasks such as stating, listing, and describing, which help gauge learners' basic understanding and recall (DoK level 1). Role play activities can be used to assess learners' ability to apply knowledge in practical scenarios (DoK level 2). Group work, including designing posters and presentations can serve as both formative and summative assessments, encouraging collaboration and deeper analysis (DoK levels 2 and 3). These strategies can ensure that learners can show their understanding through various means, accommodating diverse learning styles. Teachers can refer to the Teacher Assessment Manual and Toolkit (TAMK) for further guidance on implementing these assessment strategies effectively.

WEEK 15

Learning Indicator: *Discuss the factors influencing the various climatic elements*

FOCAL AREA: ELEMENTS OF CLIMATE

Climate is determined by several key elements that interact to create the diverse climatic conditions observed across the globe. Some of the elements are:

- Temperature
- Precipitation
- Humidity
- Wind

1. TEMPERATURE

Temperature measures the degree of hotness or coldness of a place. The instrument for measuring temperature is the thermometer. On the thermometer, the temperature is measured either in Degree Fahrenheit (°F) or in Degree Celsius.

A temperature taken in open daylight is very high, because it measures the direct insolation of the sun. It is better described as *temperature in the sun.* Such extreme temperatures are not used when describing climates. The thermometer used to measure climatic temperatures is enclosed in a special glass tube and the bulb is embedded in paraffin wax, so that they are less sensitive to abrupt temperature changes.

Thermometers for measuring climatic temperatures are found in a standard meteorological structure known as the Stevenson Screen (Fig. 15.1a and b).

Figure 15.1a: Stevenson's Screen (Exterior) **Figure 15.1b:** Stevenson's Screen (Interior)

A typical Stevenson Screen holds the maximum and minimum thermometers and dry and wet bulb thermometers. These thermometers are positioned inside the structure, so they are screened from the influence of the sun and record only actual temperatures not extremes. The maximum thermometer records the highest temperature reached during the day. The minimum thermometer records the lowest temperature. Wet and dry bulb thermometers are

used together to measure relative humidity and dew point temperature. Lines joining places of equal temperature on climate maps are called *isotherms*.

Factors Influencing Temperature

1. **Latitude**: The primary driver of temperature variation is latitude. Solar radiation intensity exhibits a latitudinal gradient, with regions closer to the equator receives more direct sunlight and consequently experiencing warmer temperatures. Conversely, polar regions experience cooler temperatures because they receive sunlight at oblique angles.
2. **Continentality**: Distance from large water bodies like oceans significantly impacts temperature. Oceans act as thermal reservoirs, moderating temperature fluctuations due to their high heat capacity. Continental interiors, further from this moderating influence, experience greater seasonal temperature variations.
3. **Altitude**: Temperature generally decreases with increasing altitude, a phenomenon known as the environmental lapse rate. This occurs due to the diminishing atmospheric mass with increasing elevation, leading to a decrease in air pressure and its ability to trap heat.
4. **Ocean Currents**: Global Ocean circulation patterns play a crucial role in regional temperature distribution. Warm currents transport heat from equatorial regions, influencing the climates of coastal areas at higher latitudes (Example, the Gulf Stream influencing Western Europe). Conversely, cold currents can significantly lower coastal temperatures (Example, the Peru Current).
5. **Prevailing Winds**: Dominant wind patterns redistribute heat across the globe. Warm winds carry heat from lower latitudes, influencing regional temperatures. Conversely, cold winds can bring significant cooling effects (Example, Siberian winds impacting eastern Asia).

2. PRECIPITATION

Precipitation includes all forms of water that fall from clouds to the Earth's surface. Precipitation can take various forms, including rain, snow, sleet, and hail. Precipitation is measured in millimetres (mm) or inches using the rain gauge. A rain gauge is often placed alongside a Stevenson Screen so data can be collected from a number of instruments at once.

Factors that Influence Precipitation

1. **Atmospheric moisture:** High levels of atmospheric moisture are essential for precipitation formation. Warm air can hold more water vapour, leading to higher potential for precipitation. Oceans, seas, and large bodies of water are significant sources of atmospheric moisture through evaporation.
2. **Temperature:** The temperature of the air determines whether precipitation will fall as rain, snow, sleet, or hail. Warmer temperatures generally produce rain, while colder temperatures can lead to snow or other forms of solid precipitation. A significant temperature difference between air masses can enhance the formation of precipitation through processes such as convection and orographic lifting.

3. **Topography:** When moist air is forced to rise over mountain ranges, it cools and condenses, resulting in precipitation on the windward side of the mountains. The leeward side often experiences a rain shadow effect, receiving significantly less precipitation. Higher altitudes generally receive more precipitation due to the cooling of rising air masses.
4. **Atmospheric Pressure Systems:** Low-pressure systems are associated with rising air, cloud formation, and increased precipitation. Conversely, high-pressure systems are linked to descending air, which inhibits cloud formation and leads to drier conditions. Cyclonic systems (low-pressure) can bring substantial precipitation, while anticyclonic systems (high-pressure) usually result in clear skies and minimal precipitation.
5. **Wind Patterns:** Wind patterns influence the movement of moist air masses. Prevailing winds that blow from the ocean to the land often carry more moisture, leading to higher precipitation. Areas where different wind patterns converge, such as the Intertropical Convergence Zone (ITCZ), typically experience high levels of precipitation due to the rising and cooling of air masses.

3. RELATIVE HUMIDITY

Relative humidity refers to the quantity of water vapour present in the air. However, it is more crucial to understand the relationship between the actual amount of vapour in the air and the maximum amount of vapour the air can hold at a specific temperature. This measurement is known as Relative Humidity (R.H.). Therefore, if the Relative Humidity (R.H.) is 90 percent at a temperature of 26°C, the air contains nine-tenths of the water vapour it can hold at that temperature. When the air reaches its maximum capacity for holding water vapour, it is said to be saturated, and its R.H. is 100 percent. Humidity is measured using a hygrometer. An example of a hygrometer is shown in Figure 15.2 and comprises two standard thermometers.

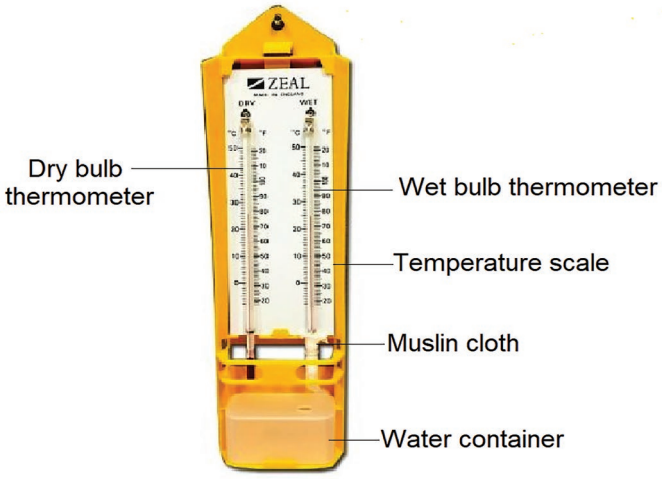

Figure 15.2: Hygrometer (Dry and Wet bulb thermometer)

One of the thermometers, known as the wet bulb thermometer, has its bulb wrapped in a piece of muslin that is immersed in a container of water. As the water evaporates it cools the thermometer and the temperature drops. The dry bulb thermometer just measures the ambient air temperature resulting in different readings between the two thermometers. The

difference between the dry bulb and wet bulb temperatures can be used to calculate the relative humidity of the air. The larger the difference, the lower the relative humidity. A small difference indicates a high relative humidity or close to the maximum amount of water vapour the air can hold at dry bulb temperature.

Factors Influencing Humidity

1. **Temperature:** Temperature is one of the primary factors affecting humidity. Warmer air can hold more water vapour compared to cooler air. Thus, as temperature rises, the air's capacity to hold moisture increases, potentially raising humidity levels.
2. **Water Bodies:** Proximity to water bodies, such as oceans, seas, lakes, and rivers, can significantly influence humidity. Evaporation from these water surfaces adds moisture to the air, increasing humidity levels in the surrounding areas.
3. **Vegetation:** Vegetation plays a crucial role in modulating humidity through the process of transpiration, where plants release water vapour into the air. Forested and vegetated areas generally have higher humidity levels due to this continuous release of moisture.
4. **Atmospheric Wind Patterns and Circulation:** Wind patterns and atmospheric circulation also affect humidity levels. Moist air masses transported from oceanic regions can raise humidity when they move over land. Conversely, dry air masses from deserts can reduce humidity levels.
5. **Altitude:** Altitude impacts humidity, with higher altitudes generally experiencing lower humidity levels. This is because the air pressure decreases with elevation, reducing the air's capacity to hold moisture.

4. WIND

Wind constitutes the horizontal movement of air from areas of high pressure to areas of low pressure within the Earth's atmosphere. Wind is measured in terms of speed, typically in kilometres per hour (km/h) or metres per second (m/s), and direction is given by reference to compass points or degrees (only the direction a wind blows from is used when describing winds, for examples a southerly wind comes from the south). The instrument used to measure the speed of wind is called an anemometer while the direction is measured with wind vane.

Factors that influence Wind Patterns

1. **Pressure Gradients:** Atmospheric pressure differences, known as pressure gradients, are the fundamental drivers of wind. Wind flows from regions of high pressure to regions of low pressure. The greater the pressure difference, the stronger the wind. These gradients are often caused by uneven heating of the Earth's surface, resulting in varying air densities and pressures.
2. **Coriolis Effect:** The Coriolis effect, caused by the Earth's rotation, influences wind direction. In the Northern Hemisphere, it deflects winds to the right, while in the Southern Hemisphere, it deflects them to the left. This deflection impacts large-scale wind patterns, such as the trade winds, westerlies, and polar easterlies.
3. **Temperature Differences:** Temperature variations between different regions create pressure differences that drive wind movements. Warm air rises, creating areas of low

pressure, while cool air descends, forming high-pressure areas. This thermal circulation leads to local wind systems, such as sea breezes and land breezes.

4. **Friction:** Surface friction slows down wind speed and alters wind direction near the Earth's surface. The roughness of the terrain, including mountains, forests, and buildings, affects the degree of friction. Over smooth surfaces, such as oceans, friction is minimal, resulting in faster and more consistent wind speeds.

Learning Tasks

1. Conduct individual research on the four (4) elements of climate.
2. Discuss the factors influencing the each of the four (4) elements of climate.

PEDAGOGICAL EXEMPLARS

Inquiry-Based Learning

Conduct individual research on the four (4) elements of climate

1. Provide a brief overview of the elements of climate, using visuals, videos, and simple explanations to help struggling learners understand the basic concepts, while encouraging confident learners to ask questions and explore additional factors beyond the basics.
2. Assign individual research tasks on different elements of climate and challenge confident learners to use a variety of sources, including academic journals, books, and online databases, to conduct more in-depth research.
3. Instruct learners to take notes on their findings. Offer templates or graphic organisers to structure their notes and highlight key points. Encourage confident learners to summarise information in their own words and make connections between different factors.
4. For the presentation task, provide struggling learners with templates and support to create simple presentations highlighting key points and visuals, while encouraging confident learners to develop detailed and engaging presentations using advanced tools and multimedia elements.
5. During the class presentation session, offer struggling learners the option to present in pairs or small groups for added confidence and allow the use of notes or prompts, while encouraging confident learners to present without notes, engage with the audience, and answer questions.
6. Have learners reflect on what they learned and the research process itself, using guided reflection questions to help struggling learners articulate their thoughts and experiences, while asking confident learners to reflect on their learning strategies and how they could improve future research.

Talk for learning

Learners share perspectives on the factors influencing the various elements of the climate through a whole class discussion.

1. Provide a brief overview of the factors influencing climate elements by using visuals, videos, and simple explanations to introduce the topic for struggling learners, while encouraging confident learners to read additional materials or articles on climate factors to deepen their understanding.
2. Implement a think-pair-share activity, providing guiding questions and prompts for struggling learners, while encouraging critical thinking and consideration of multiple interacting factors for confident learners.
3. Have learners pair up to discuss their thoughts and ideas, pairing struggling learners with more confident peers who can guide the discussion and help them articulate their ideas, while confident learners take on a mentoring role to facilitate the discussion and encourage deeper exploration of the topic.
4. Facilitate a whole class discussion where pairs share their perspectives, providing opportunities for struggling learners to share simpler points first, while encouraging confident learners to elaborate on their points, ask questions, and engage with other learners' contributions.
5. Use interactive tools like a whiteboard or digital polling to gather and display ideas, involving struggling learners by asking them to write or draw their ideas, while challenging confident learners to summarise group ideas and highlight key points from the discussion.
6. Organise a role-playing or debate session where learners take on different perspectives or roles related to climate factors, assigning simpler roles, or providing scripts to help struggling learners participate confidently, while giving confident learners more complex roles that require deeper analysis and critical thinking.
7. Summarise the key points discussed in class, providing a summary handout or visual aid for struggling learners while asking confident learners to help summarise and synthesise the discussion points for the class.
8. Have learners reflect on what they learned during the discussion and how their perspectives may have changed, using guided reflection questions and a template to help struggling learners articulate their thoughts, while encouraging confident learners to write a more detailed reflection on how the discussion deepened their understanding.

Learners in group discussions should not forget the emotions people attach to religious, political, and ethnic issues.

Key Assessment

Level 1: State the instruments used to measure the following elements of weather

a. Precipitation
b. Wind
c. Temperature
d. Humidity

Level 2: Explain how these elements influence the climate in your locality.

a. Temperature
b. Precipitation
c. Humidity
d. Wind

Level 3: Role Play

a. As a meteorologist working for the Ghana Meteorological Agency of journalists, develop a presentation (oral or written or slides) to explains the key factors influencing precipitation and humidity in Ghana, and provide a handout summarising the main points covered.
b. Debate on the motion "Human activity is the primary driver of climate change".

WEEK 16

Learning Indicator: *Identify the forms of precipitation and the types of rainfall*

FOCAL AREA: FORMS OF PRECIPITATION

1. **Rain:** Rain is the most common form of precipitation, consisting of liquid water droplets that fall when atmospheric water vapour condenses and coalesces into droplets heavy enough to overcome air resistance.
2. **Drizzle:** Drizzle is a form of precipitation characterised by very light raindrops that fall steadily from the sky. Drizzle differs from rain in terms of intensity and duration. While raindrops are larger and fall more heavily, drizzle consists of smaller droplets that fall gently and can persist for an extended period. It is often accompanied by overcast or foggy conditions.
3. **Snow:** Snow forms when atmospheric water vapour sublimates directly into ice crystals at temperatures below freezing. These ice crystals aggregate to form snowflakes, which fall to the ground if the entire atmospheric column through which they pass remains below freezing. Snow is most common in polar and temperate regions during the winter months and can accumulate to significant depths, influencing various ecological and human activities.
4. **Sleet:** Sleet, or ice pellets, occurs when raindrops freeze into ice before reaching the ground. This typically happens when a layer of warm air lies above a sub-freezing layer near the surface. The raindrops initially melt in the warm layer and then refreeze as they pass through the cold layer. Sleet can create hazardous travel conditions due to its tendency to accumulate as a layer of ice.
5. **Hail:** Hailstones are solid pellets of ice that form within strong convective thunderstorms, particularly those with intense updrafts. These updrafts carry raindrops upward into extremely cold areas of the cloud, where they freeze. The hailstones grow as additional layers of ice accumulate from repeated upward and downward movements within the storm cloud. Hailstones can vary significantly in size, with large hailstones capable of causing substantial damage to property and crops.

Types of Rainfall

Rainfall can be categorised into three main types: convectional, orographic/relief, and frontal/cyclonic. Each type has distinct characteristics and formation mechanisms.

1. **Convectional/Thermal Rainfall**: This occurs when warm, moist air rises, cools, and condenses into clouds, leading to the formation of rain.

   Characteristics of Convectional Rainfall

   a. Occurs primarily in tropical and equatorial regions.

   b. Typically happens during the afternoon or early evening.

   c. Results from intense solar heating of the Earth's surface.

d. Involves rapid upward movement of warm air.

e. Produces cumulonimbus clouds.

f. Often associated with short, intense downpours.

g. Frequently leads to thunderstorms and lightning.

Formation of Convectional Rainfall

a. Convectional rainfall begins with intense solar heating of the Earth's surface, which primarily occurs in tropical and equatorial regions.

b. The heated surface warms the air directly above it, causing the air to become less dense and rises rapidly.

c. As the warm air rises, it expands and cools at higher altitudes.

d. Upon reaching the dew point, the cooling air condenses into water vapour, forming cumulonimbus clouds.

e. Continued condensation within these clouds leads to the development of water droplets, which grow larger as they combine.

f. When the water droplets become too heavy to be suspended in the air, they fall to the ground as precipitation, resulting in short, intense downpours often accompanied by thunderstorms.

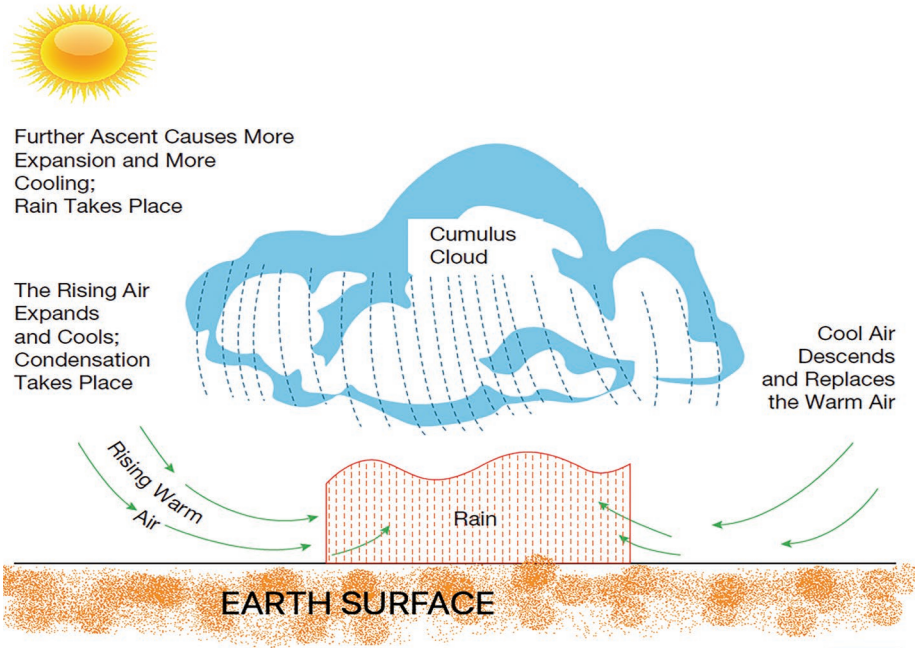

Figure 16.1: Formation of Convectional rainfall (Bunnett, R,B., & Parihar, S.M., 2019)

2. **Frontal/Cyclonic Rainfall:** This occurs in mid latitudes when warm and cold air masses meet and the warm air is forced to rise over the cooler air, leading to the formation of clouds and rain. The front is the active air movement zone between the two airmasses. The term cyclonic refers to the fact that these rainfall systems tend to rotate in an anticlockwise direction in the northern hemisphere and clockwise in the southern hemisphere. This is the result of the Coriolis effect – the deflection of air due to the Earth's rotation.

Characteristics of Frontal Rainfall

a. Frontal rainfall occurs where two air masses of significantly different temperatures meet.
b. It is common in mid-latitude regions.
c. The warm air mass is forced to rise over the cold air mass.
d. As the warm air rises, it cools and condenses to form clouds.
e. Precipitation can vary from light drizzle to heavy rain.
f. It often leads to extended periods of rainfall.
g. Weather fronts, known as cold fronts and warm fronts represent the active boundaries between air masses.
h. This type of rainfall is associated with changes in weather conditions, including temperature and wind shifts.

Formation of Frontal Rainfall

a. Frontal rainfall forms when a warm air mass meets a cold air mass.
b. The warmer, less dense air is forced by the colder denser air mass to rise.
c. As the warm air rises, it cools.
d. The cooling warm air reaches its dew point and condenses to form clouds.
e. Continued condensation leads to the formation of precipitation, resulting in frontal rainfall.
f. This process is typically associated active weather 'fronts', such as cold fronts and warm fronts.

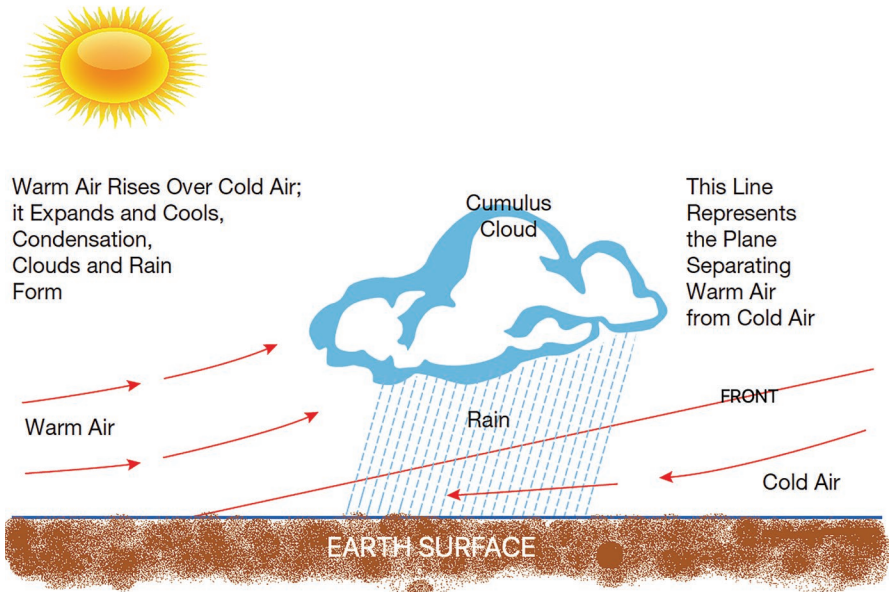

Figure 16.2 Formation of Frontal Rainfall (Bunnett, R,B., & Parihar, S.M., 2019)

3. **Orographic/Relief Rainfall:** This occurs when moist air is forced to rise over elevated terrain, causing it to cool, condense, and produce precipitation on the windward side of the mountains.

Characteristics of Orographic Rainfall

a. Orographic rainfall occurs due to the interaction of moist air with mountains or elevated terrain features.

b. It is highly dependent on prevailing wind direction, as moist air is forced upwards over the barrier.

c. Often creates a rain shadow on the leeward side of the mountain, where descending air results in dry conditions.

d. Results in enhanced precipitation on the windward side, typically in the form of heavy rainfall or snowfall.

e. The amount of rainfall increases with altitude until the air reaches its dew point and condenses moisture.

Formation of Orographic Rainfall

a. Orographic rainfall occurs when moist air is forced upwards over elevated terrain, such as mountains or hills.

b. As moving air masses encounter a mountain barrier, they are forced to rise.

c. As the air mass rises, it expands and cools adiabatically (no heat is transferred to or from its surroundings), which leads to a decrease in temperature.

d. As it continues to rise the air cools to its dew point temperature, causing condensation and clouds.

e. Clouds form on the windward side of the mountain range due to this cooling and condensation processes.

f. The condensed water droplets coalesce and fall as precipitation on the windward slope.

g. On the leeward (or other) side of the mountain, a rain shadow effect occurs, where the descending air is warmed adiabatically becomes less humid and there is little or no precipitation.

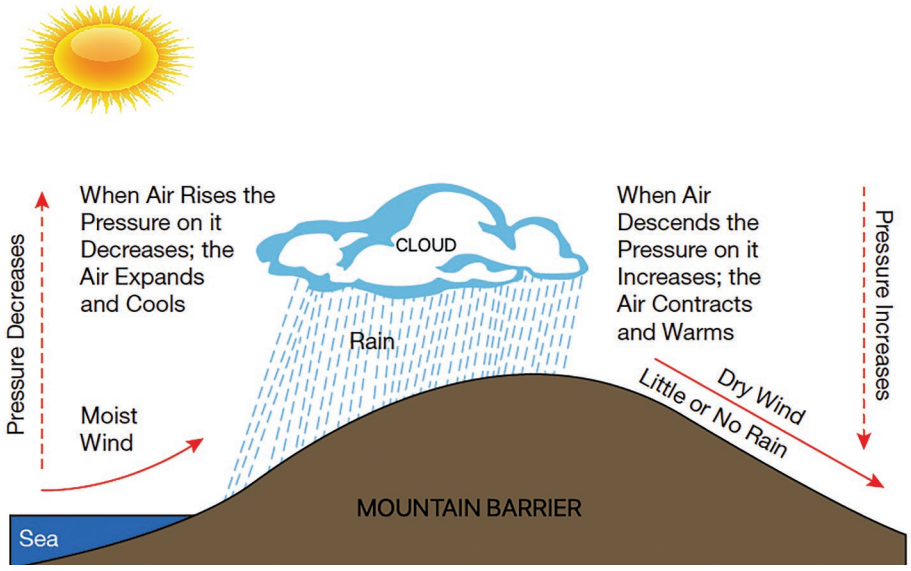

Figure 16.3: Formation of Orographic rainfall (Bunnett, R,B., & Parihar, S.M., 2019)

Learning Tasks

1. Research about the various forms of precipitation.
2. Discuss the three types of rainfall, their formation, and characteristics.

PEDAGOGICAL EXEMPLARS

Exploratory Learning

In GESI-responsive groups research about the various forms of precipitation.

1. Provide an overview of the various forms of precipitation, using simple explanations, visuals, and videos to introduce each type for struggling learners, while providing additional reading materials or articles for confident learners to gain a deeper understanding.
2. Organise groups ensuring gender balance and inclusion of diverse learning abilities, pairing struggling learners with more confident learners to ensure support and collaboration, while assigning confident learners as group leaders to facilitate and guide the research process.
3. Assign each group a specific form of precipitation to research, providing structured resources such as simplified articles, videos, and graphic organisers for struggling learners, while encouraging confident learners to use a variety of sources, including academic journals, books, and online databases, for more in-depth research.
4. Instruct learners to take notes and organise their findings, offering templates or graphic organisers to struggling learners to structure their notes and highlight key points, while encouraging confident learners to summarise information in their own words and make connections between different forms of precipitation.
5. Have groups organise their research findings into a coherent structure, providing guidance on how to categorise information and create outlines for struggling learners, while challenging confident learners to draw conclusions and identify patterns or relationships between different forms of precipitation.
6. Ask each group to prepare a presentation on their research findings, providing templates and support for struggling learners to create simple presentations with key points and visuals, while encouraging confident learners to create detailed and engaging presentations, possibly using advanced tools and multimedia elements.
7. Facilitate a session where groups present their findings to the class, offering the option for struggling learners to present in pairs or small groups for added confidence and allow the use of notes or prompts, while encouraging confident learners to present without notes, engage with the audience, and answer questions.
8. Hold a class-wide discussion to synthesise and compare the different forms of precipitation, involving struggling learners by asking specific questions related to their presentation to build confidence, while asking confident learners to elaborate on points, provide examples, and engage in deeper analysis.
9. Have learners reflect on what they learned and how they worked together in their GESI-responsive groups, using guided reflection questions and a template to help struggling learners articulate their thoughts, while encouraging confident learners to

write a more detailed reflection on how the research and group work deepened their understanding.

Collaborative Learning

Discuss the three types of rainfall, their formation, and characteristics.

1. Provide a brief overview of the three types of rainfall using simple explanations, diagrams, and short videos to introduce each type for struggling learners, while providing additional reading materials or articles for confident learners to gain a more in-depth understanding.
2. Assign small groups to research each type of rainfall, providing struggling learners with structured resources such as simplified articles, diagrams, and videos, along with guiding questions, while encouraging confident learners to use a variety of sources, including academic journals and online databases, to conduct more comprehensive research.
3. Instruct learners to take notes and organise their findings, offering templates or graphic organisers to struggling learners to structure their notes and highlight key points, while encouraging confident learners to summarise information in their own words and make connections between the types of rainfall.
4. Facilitate a whole class discussion where groups share their findings, providing opportunities for struggling learners to share simpler points first, using sentence starters or allowing them to present their partner's ideas, while encouraging confident learners to elaborate on their points, ask questions, and engage with other learners' contributions.
5. Summarise the key points discussed in class and encourage learners to take notes.
6. Have learners reflect on what they learned during the discussion and how their perspectives may have changed, using guided reflection questions and a template to help struggling learners articulate their thoughts, while encouraging confident learners to write a more detailed reflection on how the discussion deepened their understanding.

Key Assessment

Level 1: Identify the forms of precipitation and the types of rainfall.

Level 2: Explain the differences between convectional and orographic rainfall in terms of the atmospheric conditions and processes that lead to the formation of each type.

Level 3: Using well labelled diagrams explain the process of either convectional rainfall, orographic rainfall or cyclonic rainfall. Identify the key characteristics of the rainfall type you have chosen.

WEEK 17

Learning Indicator: *Describe the characteristics associated with vegetation within each climatic zone in the world*

FOCAL AREA: WORLD CLIMATIC ZONES AND THE ASSOCIATED VEGETATION

Table 17.1: *World climate zones and associated vegetation*

WORLD CLIMATIC TYPES AND ASSOCIATED VEGETATION				
Climate Zone	**Latitude (Approx.)**	**Climate Type**	**Climatic Characteristics (Approx.)**	**Associated Natural Vegetation and Characteristics**
Hot Tropical Zone	0° -30°N. and S.	Wet Equatorial Found in the Amazon and Congo Basins, West African coastal regions, Malaysia, coastal areas of Myanmar, Cambodia, Vietnam, and much of Indonesia and New Guinea.	Rainfall all year round Total annual rainfall around 2000mm-3000mm High temperature with mean annual temperature around 29°C Annual range of temperature is typically around 3°C Very high humidity ranging from 80% to 90% Typical Station: Kisangani	Equatorial/Tropical Rainforest Trees are in layers Evergreen and have broad leaves Leaves form canopy Plants species include mahogany, ebony, rosewood, ironwood, and greenheart are common trees. Palms and tree ferns also occur
		Tropical Monsoon Found in a region extending from southeastern and eastern Asia to northern Australia. Eastern Asia experiences a temperate monsoon climate.	Heavy summer rain and dry winter Total annual rainfall around 1700mm High temperature with mean annual temperature around 27°C Annual range of temperature is around 5°C High humidity ranging from 70% to 80% Typical Stations: Mumbai and Darwin	Tropical Monsoon Forest Smaller number of tree species Majority of the trees are deciduous The trees are tall, often as high as 30 metres Tree species include Teak (notably in Burma, Thailand, Cambodia, Laos, and East Java); bamboo (notably in Thailand, Cambodia, Laos, and Vietnam); Sal; sandalwood; and lianas. Acacia, eucalyptus, and casuarina are found in East Java and northern Australia.

WORLD CLIMATIC TYPES AND ASSOCIATED VEGETATION				
Climate Zone	**Latitude (Approx.)**	**Climate Type**	**Climatic Characteristics (Approx.)**	**Associated Natural Vegetation and Characteristics**
		Tropical Marine It is most prominent in the lowlands of Central America, the West Indies, the coastal lowlands of Brazil and East Africa, including eastern Madagascar, northeast Australia, and the Philippines	Heavy and frequent summer rainfall and less frequent winter rainfall Total annual rainfall around 1100mm to 1500mm Moderately high temperature with mean annual temperature around 26°C Annual range of temperature is around 8°C. High humidity ranging from 70% to 85% Typical stations: Havana and Durban	
		Tropical Continental (Sudan Type) Found in regions like Sudan, West Africa (Mali, Niger, Nigeria), parts of East Africa (Kenya, Uganda), northeastern India, and northern Australia	Rain mainly in summer and little winter rainfall Total annual rainfall around 750mm High temperature with mean annual temperature around 30°C Annual range of temperature is around 15°C Low humidity ranging from 40% to 60% Typical stations: Kayes and Bulawayo	Savanna (Tropical Grassland) Vegetation Tall grasses (2m high) dominate Grasses grow in compact tufts. Trees are deciduous. Grasslands merge with the hot deserts, the vegetation changes to clumps of scrub-like plants. E.g. mallee and mulga in Australia Tropical grasslands have different names according to their location, e.g. Campos (Brazil); Llanos (Guiana Highlands); Savanna (Africa and Australia).
		Tropical Desert: (Saharan and Mid-latitude types) *Best developed in regions such as the Sahara Desert in Africa, the Arabian Desert in the Middle East, and the Kalahari Desert in Southern Africa. Other notable locations include the Thar Desert in India and Pakistan, and parts of Australia, particularly the Great Victoria Desert.*	Rain falls once every two or three years only. But when it comes it does so as torrential downpours. Total annual rainfall around 200mm High temperature all year round with mean annual temperature around 30°C which can exceed 40°C in hottest months Annual range of temperature is around 25°C Very low humidity ranging from 10% to 30% Typical station: In Salah	Desert Vegetation and Shrub *Only small portions are without vegetation* *Most plants are **xerophytes*** *Most plants are **ephemerals*** *Many plants produce seeds which lie dormant for years until a little rain falls and then they germinate* The most common plants are cacti, thorn bushes and coarse grasses.

WORLD CLIMATIC TYPES AND ASSOCIATED VEGETATION				
Climate Zone	**Latitude (Approx.)**	**Climate Type**	**Climatic Characteristics (Approx.)**	**Associated Natural Vegetation and Characteristics**
Warm Temper-ate Zone	30°-45°N. and S.	Western Margin (Mediterranean type) Occurs in areas bordering the Mediterranean Sea, southwest Africa, central Chile, central California, and southwest to southern Australia (Adelaide to Melbourne).	Heavier winter rainfall and dry summers with little rainfall Total annual rainfall around 900mm Low temperature with mean annual temperature around 17°C Annual range of temperature is around 12°C High humidity ranging from 60% to 80% Typical stations: Sacramento and Perth	Mediterranean Evergreen Forest *Dominated by evergreen broadleaf trees like oaks, olives, and laurels.* *Many plants have tough, leathery leaves (sclerophyllous) to minimise water loss during the dry season.* *Evergreen shrubs are a common feature, often aromatic and drought tolerant.* *The shrub vegetation is called **Marquis** in France and **Chaparral** California.* *Coniferous trees like pines and cypresses might be present, particularly in drier areas or higher elevations.* *The dense canopy cover from the dominant trees can limit the growth of a thick understory in some areas.*
		Central Continental (Steppe type) This climate is most prominent in the southern continents, particularly in Australia's Murray-Darling Lowlands and Africa's High Veldt. It is also found in western Oklahoma, Texas, and northern Mexico in the USA	Light summer rain and very little to no rainfall winters, often occurring as snow. Total annual rainfall around 200mm to 500mm Temperature is generally very low, with mean annual temperature often below 0°C Annual range of temperature is extremely high, with differences often exceeding 45°C Humidity is generally low, especially during the winter months Typical Stations: Bourke and San Antonio	Steppe or Temperate Grassland *These grasslands are almost treeless, and they contrast sharply with the tropical grasslands.* *The grasses are comparatively shorter than the tropical grasses* *Summer scorches the grass, most dying by fall. But roots endure, and leaves return as spring begins.* *Temperate grasslands transition to coniferous forests in the north and semi-desert scrub in the south.* *These are widely recognised names for the same biome across continents: **steppe** (Eurasia), **prairie** (North America), **pampas** (Argentina), **veldt** (South Africa), and **down** (Australia)*

WORLD CLIMATIC TYPES AND ASSOCIATED VEGETATION				
Climate Zone	**Latitude (Approx.)**	**Climate Type**	**Climatic Characteristics (Approx.)**	**Associated Natural Vegetation and Characteristics**
		Eastern Margin (China type) Found in the Canadian prairies (Alberta, Saskatchewan, and Manitoba), the central and Midwestern United States, central and eastern Europe, and western Russia.	High summer rainfall, often heavy monsoon rains and generally dry winters with minimal rainfall Total annual rainfall around 1000mm to 2000mm Temperature is low, with mean temperature ranging between 15°C and 25°C Annual range of temperature is moderate, usually around to 15°C Humidity is generally high, often around 70% to 80% throughout the year. Typical Stations: New Orleans and Sydney	Temperate Evergreen Forest Mixture of evergreen broadleaf trees and deciduous hardwoods. Conifers (e.g. pines and cypresses) may be present in mountainous regions. Dense understory made up of ferns, lianas, and bamboos. Other trees include Camphor laurel and Chinese oak
Cool Temper-ate Zone	45°-65° N. and S.	Western Margin (British type) Occurs in cool, moist regions like northwestern Europe, coastal British Columbia, southern Chile's coast, Tasmania, and New Zealand's South Island.	Moderate rainfall all year round. autumn is the wettest season with occasional snowfall Total annual rainfall ranges between 500 mm to 1500mm Mean annual temperature ranges between 8°C and 15°C Annual range temperature is usually between 13°C Humidity is relatively high, often around 70% to 80%. Typical stations: Valencia and Hobart	Temperate Deciduous Forest Dominated by deciduous broadleaf trees trees shed their leaves in autumn to conserve energy during cold winters. Lush green foliage in summer transitions to vibrant reds, oranges, and yellows in fall before becoming bare in winter Coniferous trees like pines, spruces, and firs become more prominent at higher elevations Deciduous trees like oak, beech, and elm dominate these forests, joined by hickory and maple in North America, while conifers like cedar and spruce appear at higher elevations

WORLD CLIMATIC TYPES AND ASSOCIATED VEGETATION				
Climate Zone	**Latitude (Approx.)**	**Climate Type**	**Climatic Characteristics (Approx.)**	**Associated Natural Vegetation and Characteristics**
		Central Continental (Siberian type) Covers the central and southern regions of Russia (western Siberia), much of Canada (from Alaska eastward), and parts of northern Europe (Scandinavia and northern Russia).	Moderate summer rain often with thunderstorm and very little rain in winter but significant snowfall Total annual rainfall ranges between 150mm to 500mm Mean annual temperature ranges between -5°C and 5°C Annual range temperature is very large usually between 45°C Humidity is generally low especially in winter Typical stations: Verkhoyansk and Dawson	Evergreen Coniferous Forest Dominated by coniferous evergreen forests, also known as taiga. E.g. pine, spruce, fir, and larch. These trees have needle-like leaves to minimise water loss in cold winters and conical shapes to shed snow efficiently. The dense shade cast by conifers and short growing season limit the development of a thick understory. Mosses, lichens, and some cold-adapted shrubs might be present
		Eastern Margin (Laurentian type) This includes eastern Canada (including Newfoundland and Labrador), the northeastern United States (particularly the New England region), eastern Siberia, northern China, Korea, and Hokkaido, Japan.	Moderate summer rains with frequent thunderstorms and cold winters with significant snowfall Total annual rainfall typically ranges from 750mm to 1500mm Mean annual temperature ranges between 5°C and 15°C Annual range temperature is large usually between 25°C Humidity is relatively high ranging between 60% to 80% throughout the year Typical stations: Montreal and Bahia Blanca	Mixed Forest (coniferous and deciduous) Dominated by mixed forest both Coniferous (taiga) and deciduous broadleaf forest. Coniferous tree species include spruce, fir, larch, and pine in the north, especially at higher latitudes. These trees are adapted to cold winters with needle-like leaves and conical shapes. Deciduous trees include oak, beech, maple, and birch become more prominent further south, where winters are less severe. Lush green foliage in summer gives way to vibrant autumn colours before winter dormancy.

WORLD CLIMATIC TYPES AND ASSOCIATED VEGETATION				
Climate Zone	**Latitude (Approx.)**	**Climate Type**	**Climatic Characteristics (Approx.)**	**Associated Natural Vegetation and Characteristics**
Cold Zone	65°-90°N. and S	Polar Climate Found in Greenland, the interior of Iceland, and Antarctica.	Summers are very cold and dry with occasional snow or rain, while frigid winters experience minimal precipitation mostly as snow. Blizzards are frequent Total annual rainfall is very low, typically less than 250 mm Coldest climate with mean annual temperature very low ranging from -20°C to -40°C Annual range temperature is very large usually between 35°C Humidity is low often below 50% due to cold air holding less moisture Typical Station: Inuvik	Tundra, Mosses, and Lichens Vegetation Extremely cold temperatures and short growing seasons restrict plant life. Where some vegetation exists, it is typically low-lying tundra vegetation like mosses, lichens, grasses, sedges, and small shrubs. The ground is permanently frozen (permafrost) for much of the year, hindering plant root growth.
Alpine Zone		Montane climate It exists on mountains throughout the world, regardless of latitude. Example the Himalayas in Asia to the Andes in South America, the Rockies in North America, the Alps in Europe, to the mountains of Africa and Oceania	Generally, precipitation increases with altitude However, precipitation decreases for too high mountains because the air becomes rarefied. Total annual rainfall is highly variable The air is usually cool, and the daily temperature variation is low. Humidity is highly variable Typical Station: Pike's Peak and Quito	Alpine pastures, Conifers and Fern Vegetation These forests are dominated by broadleaf or coniferous trees, depending on the latitude and local conditions. *the trees become shorter and sparser with increasing elevation. Conifers like pines and firs become more prominent due to their tolerance for colder temperatures.* *High altitudes are characterised by a stunted, shrub-like form of trees called* ***krummholz****.*

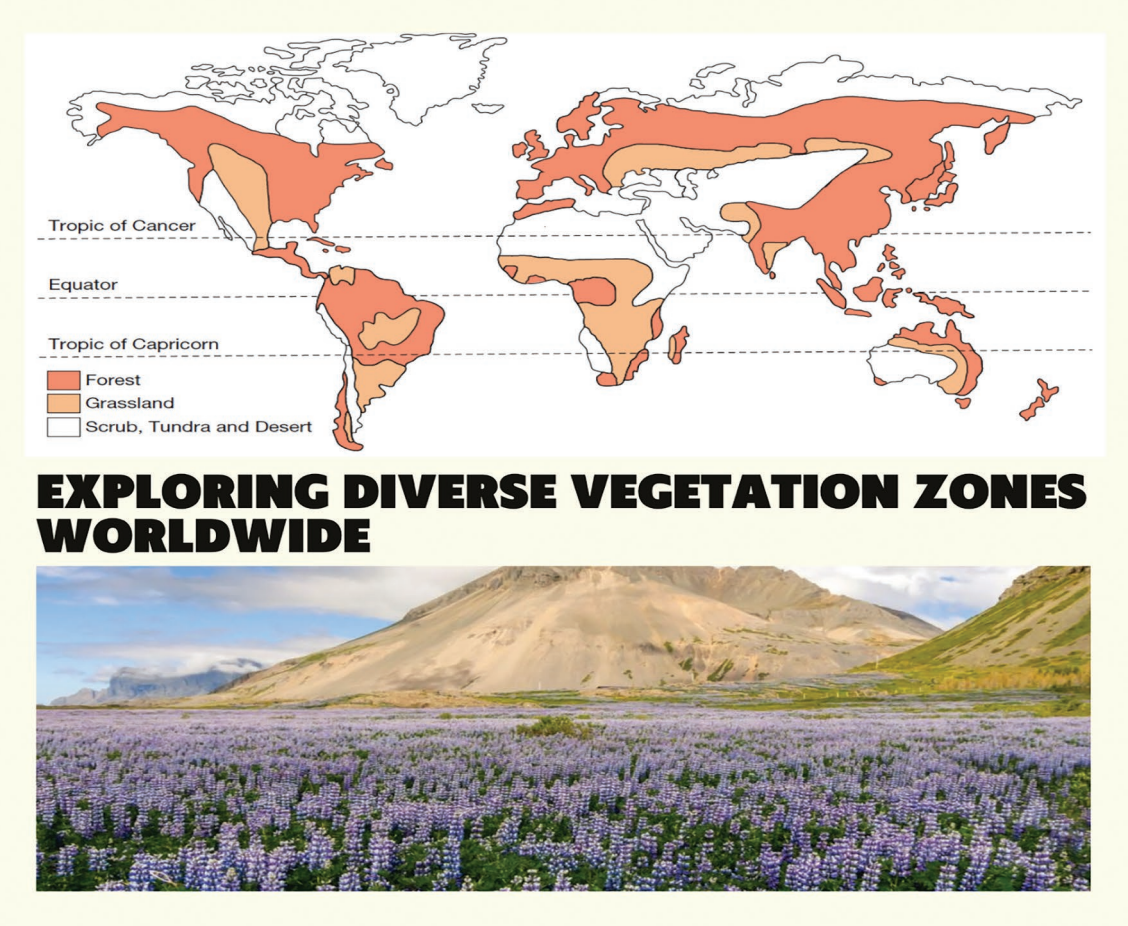

Figure 17.1: Sample poster title page for vegetation zones (Source: Manual writers, 2004)

Learning Tasks

1. Brainstorm on the world climate zones and their associated vegetation.
2. Design posters on the vegetation within each climatic zone and describe their key features.

PEDAGOGICAL EXEMPLARS

Talk for Learning

Using videos, pictures, and other relevant materials in all-inclusive and gender responsive, brainstorm as a whole class the world climate zones and their associated vegetation.

1. Start with an engaging video that provides an overview of the world's climate zones and vegetation. Ensure the video is visually appealing and easy to understand.
2. Briefly discuss the video, asking open-ended questions to gauge initial understanding and curiosity.
3. Display a world map and ask learners to come up and place markers on different climate zones. Use images of vegetation associated with each zone.
4. Facilitate a discussion with questions like, "What kind of plants do you think grow in a desert?"

5. Divide learners into small, mixing abilities groups to ensure peer learning, providing more structured tasks with clear instructions, such as matching pictures of vegetation to climate zones using a simplified worksheet, for struggling learners, while assigning tasks that require critical thinking, such as researching and presenting on a specific climate zone and its unique vegetation, for confident learners.
6. Allow each group to present their findings using the materials they have prepared. Encourage the use of videos and pictures in their presentations. Provide positive feedback after each presentation, highlighting good examples of teamwork and creative use of multimedia.
7. Have learners individually write or draw what they have learned about world climate zones and vegetation, providing prompts to guide their reflections, using sentence starters or templates to support the writing of struggling learners, while encouraging confident learners to compare and contrast different climate zones in their reflections.
8. Recap the main points discussed, reinforcing the connection between climate zones and their vegetation.
9. Allow learners to share their reflections or ask any remaining questions.
10. Note that all videos and pictures represent diverse cultures, genders, and abilities and also tailor activities to meet the needs of different learners, offering additional resources or challenges as appropriate.

Activity-Based Learning

In manageable GESI groups, design posters on the vegetation within each climatic zone and describe their key features.

1. Show a short video or slideshow of various climatic zones and their vegetation to spark interest.
2. Briefly discuss the video, focusing on the diversity of vegetation in different climates.
3. Form mixed-ability groups with a balance of genders, ensuring each group has a mix of struggling and confident learners.
4. Assign specific roles within each group (e.g., researcher, designer, writer) to ensure active participation.
5. Provide each group with resources to research their assigned climate zone and its vegetation, offering structured worksheets with guided questions to help struggling learners focus their research, while encouraging confident learners to explore additional sources and gather more detailed information.
6. During the poster design phase, supply art materials for groups to create hand-drawn posters or provide access to computers or tablets with design software (e.g. Canva) for digital poster creation. Allow the group to decide which means the poster will be designed (either physical or digital)
7. Each group should write descriptions of the key features of the vegetation in their assigned climate zone. For struggling learners, provide sentence starters or writing frames to support their descriptions. Challenge confident learners to write more detailed and complex descriptions, comparing and contrasting different plants within the climate zone.

8. Have each group present their posters to the class, explaining the key features of the vegetation in their climate zone.
9. Organise a gallery walk where learners can view and comment on each other's posters.
10. Allow learners to give positive feedback to each group, highlighting creativity and informative content.
11. Provide constructive feedback, focusing on effort and inclusivity.
12. Have learners individually reflect on what they learned from the activity and how they contributed to their group.

Learners during discussions should provide opportunities for others to practice identifying potential situations or experiences that lead to feeling overwhelmed and struggling to manage emotions.

Key Assessment

Level 1: Describe five (5) characteristics of the tropical rainforest

Level 2: Group Presentation: Design an infographic of a which contrasts two natural vegetation zones (Each group can be allocated two different natural vegetation zones).

SECTION 6 REVIEW

This section covered three weeks. Learners studied climate elements, forms of precipitation, types of rainfall, and world climatic zones with their associated vegetation. They were able to identify and describe the key elements of climate, such as temperature, humidity, and wind. Learners developed an understanding of the various forms of precipitation and the mechanisms behind different types of rainfall. Additionally, they learned how to classify and map world climatic zones and relate these to specific vegetation types. Throughout this period, learners developed skills in research, critical thinking, and collaborative learning. They section enhanced their competencies in data analysis, map production, and effective communication through group discussions and presentations.

SECTION 7: EMERGING TECHNOLOGIES AND MAPPING OF GEOSPATIAL DATA

STRAND: NAVIGATING OUR ENVIRONMENT

Sub-Strand: Geospatial Data Collection, Representation, and Interpretation

Learning Outcome: *Collect geospatial data using both traditional methods e.g., chain and compass surveying and modern methods e.g., remote sensing and Geographic Information Systems (GIS), Global Positioning System (GPS) and mobile Apps*

Content Standard: *Demonstrate skills in basic geospatial data collection methods*

Hint

The Mid-Semester Exams will be conducted in Week 18. Refer to Appendix J for a Table of Specification to guide you to set the questions. Set questions to cover all the indicators covered for at least weeks 13 to 17.

INTRODUCTION AND SECTION SUMMARY

This section delves into the fundamental methods of collecting geospatial data, examining both conventional practices and innovative approaches. Learners will gain an understanding of how to collect geospatial data, enabling them to visualise and analyse spatial information with precision. Additionally, the section highlights emerging technologies that are revolutionising the collection of geospatial data, including advancements in remote sensing, drone technology, and Geographic Information Systems (GIS). By the end of this section, learners will have a comprehensive understanding of various data collection methods, the principles of effective mapping, and the implications of cutting-edge technologies in the field of geospatial data. This foundational knowledge will empower them to engage with and apply geospatial data in practical contexts, supporting informed decision-making and analysis.

The weeks covered by the section are:

Week 18: Methods of Collecting Geospatial Data

Week 19: Mapping Geospatial Data

Week 20: Emerging Technologies for Geospatial Data Collection

SUMMARY OF PEDAGOGICAL EXEMPLARS

To effectively teach the section, teachers should adopt a multimodal approach that accommodates diverse learning abilities. Teachers should incorporate visual aids, such as pictures and videos that will engage visual learners and stimulate discussion as that can foster a deeper understanding of geospatial data collection methods. Teachers can also adopt collaborative learning such as think-pair-share activities to allow learners to articulate their thoughts and consider multiple perspectives, thus supporting social learners and enhancing critical thinking skills. Activity-based learning involving the use of computer or mobile applications for data collection and mapping can be adopted to cater for kinaesthetic learners and provides hands-on experience, reinforcing theoretical concepts. These varied pedagogical strategies, teachers can create an inclusive environment that meets individual needs, encourages active participation, and helps all learners develop proficiency in geospatial data collection methods.

ASSESSMENT SUMMARY

The assessment section has been structured using DoK Levels 1 to 4, facilitating a comprehensive understanding of geospatial data applications. At Level 1, teachers will help learners to identify essential areas of human life that utilise geospatial data, encouraging basic recall through short quizzes. Level 2 tasks will require learners to compare and contrast various geospatial data collection methods and state comparisons, promoting understanding through written descriptions and group discussions. At Level 3, learners will analyse the strengths and weaknesses of different technologies and evaluate suitable methods for varied data collection projects, enhancing critical thinking by presenting findings in reports. Level 4 will challenge learners to design a geospatial data collection system, integrating emerging technologies for urban planning and environmental monitoring, fostering creativity through group projects. These assessment strategies are anticipated to promote diverse analytical and practical skills. Teachers can refer to the Teacher Assessment Manual and Toolkit (TAMK) for further guidance on implementing these assessment strategies effectively.

WEEK 18

Learning Indicator: *Identify and discuss the methods of collecting geospatial data (surveying, remote sensing, GIS, GPS)*

FOCAL AREA: METHODS OF COLLECTING GEOSPATIAL DATA

Definition of Geospatial Data

Geospatial data refers to information that is related to a specific location on the Earth's surface and is often represented in two dimensions (2D) or three dimensions (3D). This type of data is typically associated with coordinates, making it essential for a variety of applications that require understanding geographical locations, relationships, and patterns.

Importance and Application of Geospatial Data

Geospatial data can be applied in many fields, serving a wide array of purposes:

1. **Urban Planning:** Urban planners utilise geospatial data to inform decisions on land use planning, for example, they can analyse population density and land availability to design more efficient cities.
2. **Environmental Monitoring:** In environmental science, geospatial data assists in tracking changes in ecosystems, monitoring biodiversity and assessing the impact of climate change. It helps researchers identify areas of concern and develop conservation strategies.
3. **Disaster Management:** Geospatial data plays a vital role in disaster preparedness and response. It allows for efficient mapping of areas at risk from natural disasters such as floods, earthquakes, and wildfires, facilitating emergency planning and resource allocation.

Methods of Collecting Geospatial Data

Surveying Method

Surveying is the technique of determining the relative positions of points on the Earth's surface. Surveying is essential in construction for determining land boundaries, establishing property lines, and creating topographic maps. It is also important in civil engineering projects, land development and resource management. Surveying can use latitude and longitude coordinates, or land might be divided using a grid system to help identify features like areas of forest, lakes, flat land, or slopes.

The techniques of surveying can be categorised into traditional and modern.

A. TRADITIONAL SURVEYING

1. Traditional Surveying Techniques

a. **Chain Surveying:** Involves measuring distances with a chain. It is straightforward but limited by terrain and obstructions.

b. **Compass Surveying:** Utilises a magnetic compass to determine angles and directions. This method helps in plotting the layout of an area.

c. **Levelling:** A technique used to determine the height of different points relative to a datum level, often essential in construction.

2. Surveying Instruments

a. **Theodolite:** An optical instrument for measuring angles in horizontal and vertical planes.

b. **Total Station:** A versatile instrument that integrates the capabilities of a theodolite and electronic distance measuring (EDM) technology, allowing for precise location data.

3. Steps involved in the surveying Process

a. **Planning:** Defining goals, methods, and equipment needed for the survey.

b. **Fieldwork:** Taking measurements on-site using the chosen techniques and instruments.

c. **Data Collection:** Gathering and recording measurements systematically.

d. **Data Processing:** Analysing the data collected to produce accurate maps or models.

B. MODERN SURVEYING METHODS

1. Remote Sensing Method

Remote sensing involves acquiring data about the Earth's surface from a distance, typically using satellites or aircraft. It operates on the principle of detecting reflected or emitted electromagnetic energy from various surfaces.

Types of Remote Sensing

a. **Active Remote Sensing:** This method emits its energy (e.g., radar) and measures the response from the Earth's surface.

b. **Passive Remote Sensing:** This type relies on naturally occurring energy, primarily sunlight, to collect data (e.g., photographic images).

Role of Electromagnetic Spectrum in Remote Sensing

The electromagnetic spectrum is like a rainbow that includes all the different types of light and radiation we cannot see with our eyes. It ranges from very tiny waves like gamma rays to very long waves like radio waves.

Key Parts of the Electromagnetic Spectrum in Remote Sensing

a. **Visible Light (400 nm - 700 nm)**: This is the light we can see with our eyes. It is used to make colour images of the Earth, like photos taken by satellites.

b. **Near-Infrared (NIR) (700 nm - 1.4 µm):** This part of the spectrum is just beyond what we can see. Healthy plants reflect a lot of NIR light, so it is used to check how healthy plants and forests are.

c. **Shortwave Infrared (SWIR) (1.4 µm - 3 µm):** SWIR can show us things that are not visible in regular light, like the moisture content in plants and soil.

d. **Thermal Infrared (TIR) (8 µm - 15 µm):** TIR is used to measure heat. It helps us see how hot or cold different parts of the Earth's surface are, which is useful for things like detecting forest fires or checking city temperatures.

e. **Microwaves (1 mm - 1 m):** These can see through clouds and are used in radar systems to measure things like the Earth's surface shape, soil moisture, and even ice thickness.

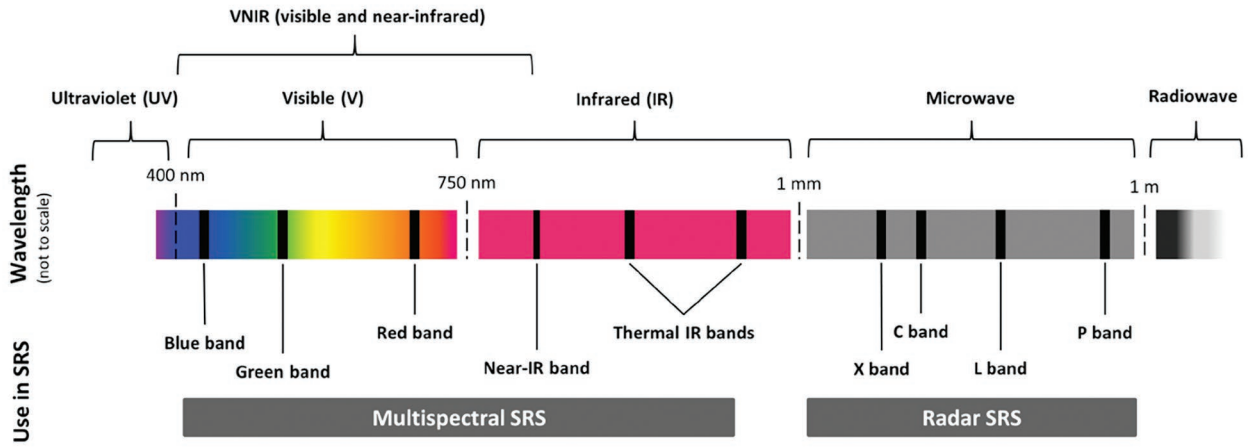

Figure 18.1: The spectrum of electromagnetic radiation (not to scale)

Remote Sensing Platform and Sensors

a. **Satellites:** Provide large-scale views and regularly monitor changes over time.

b. **Aircraft:** Offer detailed imagery for smaller areas.

c. **Drones:** Increasingly popular due to their flexibility and ability to capture high-resolution data.

Application of Remote Sensing

Applications include agriculture, where farmers use remote sensing to monitor crop health, forestry for assessing biomass, and climate monitoring to track changes in weather patterns and environments.

2. Geographic Information Systems (GIS)

Key Components

A Geographic Information System (GIS) is a framework for gathering, managing, and analysing spatial and geographic data. Key components include:

a. **Hardware:** Computers and servers where GIS software runs.

b. **Software:** Programs used for mapping and analysis. Examples include Aeronautical Reconnaissance Coverage Geographic Information System (ArcGIS) and Quantum Geographic Information System (QGIS).

c. Data: Geographic data, both spatial and attribute.

d. **People:** Specialists who manage and analyse the data.

e. **Methods:** Techniques used to analyse and visualise the data.

Data Types in GIS

There are two primary types of data in GIS:

a. **Vector Data:** Represents data using points, lines, and polygons (e.g., cities, roads, lakes).

b. **Raster Data:** Represents data in a grid format, suitable for continuous data such as elevation or temperature.

Functions of GIS

a. **Data Input:** Collecting and entering data into the system.

b. **Data Management:** Organising and storing data for easy access.

c. **Data Analysis:** Interpreting data to uncover patterns and relationships.

d. **Data Output:** Presenting results in the form of maps, reports, or visualisations.

Application of GIS

GIS finds application in urban planning (for zoning and infrastructure development), transportation (routing and logistics), and environmental management (habitat conservation and pollution tracking).

3. Global Position System (GPS) Method

The Global Positioning System (GPS) is a satellite-based navigation system that provides location and time information anywhere on Earth. GPS works on the principle of triangulating signals from satellites orbiting the Earth.

Components of GPS

a. **Satellites**: A network of at least 24 satellites orbit the Earth.

b. **Control Stations:** Ground stations that manage the satellites and ensure their accuracy.

c. **Receivers:** Devices that use satellite signals to determine the user's location.

Types of GPS

a. **Standard GPS**: Offers basic positioning services.

b. **Differential GPS (DGPS)**: Improves accuracy by utilising fixed ground reference stations to correct signal errors.

How GPS Works

GPS determines location by measuring the time it takes for signals to travel from satellites to receivers. By calculating the distance from multiple satellites, the receiver can accurately triangulate its location.

Accuracy and Limitation of GPS

While GPS can provide accurate positioning within a few metres, its accuracy can be influenced by factors such as atmospheric conditions, obstructions like buildings, and multipath effects where signals bounce off surfaces.

Application of GPS

GPS is widely used in navigation (for vehicles, bicycles, and pedestrians), in recreational activities such as geocaching, and for mapping applications in forestry, agriculture, and land surveying.

Similarities and differences among the methods of collecting geospatial data

In terms of similarities:

1. All methods can be integrated to create comprehensive geospatial data sets.
2. All methods contribute to spatial analysis and mapping.
3. All the methods can be enhanced through technological advancements.

The following table shows differences in methods of collecting geospatial data in terms of scale and coverage, accuracy, and precision, how data is collected and applications of collected data:

Table 18.1: *Differences among the Methods of Geospatial Data Collection*

Features	Method of Collecting Geospatial Data			
	Traditional Surveying	Remote Sensing	GPS	GIS
Scale and Coverage	suited for small and precise areas	covers large areas	provides point-based data global	integrates multiple scales local to global
Accuracy and Precision	offers the highest precision	less precise but offers broad coverage	varies in accuracy based on the system used	accuracy and precision is highly dependent on the quality of the input data
How data is collected	requires human physical presence to take direct measurement	collects data remotely, often from satellites, ships, or aircraft	relies on satellite signals	utilises and analyses various geospatial data
Applications	Identifying boundaries in construction and civil engineering	environmental monitoring and large-scale mapping.	Local and global navigation and data collection	supports complex spatial analyses and decision-making processes

Learning Tasks

1. Review the methods of collecting geospatial data.
2. Review the similarities and differences between different methods of collecting geospatial data.

PEDAGOGICAL EXEMPLARS

Talk for learning

Using pictures, videos, and other relevant materials in all-inclusive groupings, review the methods of collecting geospatial data treated in Year One (surveying, remote sensing, GIS, GPS etc).

1. Use short videos or slide images that illustrate each method of geospatial data collection, such as surveying techniques, remote sensing applications, GIS processes, and GPS usage. Follow up with discussions to ensure understanding.
2. Create guided viewing questions so that struggling learners can be helped to focus on key information needed and encourage confident learners to explore additional resources independently.
3. Organise learners into small groups and assign tasks based on different methods of collecting geospatial data. Each group can present their method using posters, slides, or short videos. Ensure a mix of confident and struggling learners in each group to promote peer support.
4. Supervise the activities and provide immediate feedback and support. Encourage peer feedback sessions after group presentations or projects. Ensure struggling learners have ample opportunity to voice concerns or seek clarification. Also, prompt confident learners to reflect on their learning journey and set goals for further exploration.
5. Assess learners in groups through various means such as presentations, reports, visual projects, or hands-on practical assessments to cater to different strengths.

Collaborative Learning

Through think pair share, review the similarities and differences between different methods of collecting geospatial data.

1. Before starting the Think-Pair-Share, give learners prompts or questions to ponder. Example:
    a. What are common features of these methods?
    b. In what ways are they different?
    c. Which method would be most useful for a specific task (like environmental mapping)?
2. Allocate time for learners to think quietly and jot down their responses to the prompts.
3. Pair learners thoughtfully, considering varying levels of confidence and ability to encourages peer support.
4. Give pairs time to share their thoughts and discuss their individual notes. Encourage them to identify at least one similarity and one difference between the methods.
5. Reconvene as a whole class. Invite each pair to share key points from their discussions.
6. After the class share-out, ask learners to reflect on what they learned during the activity. This could be done through a quick write-up or a class discussion.

Learners should be conscious of resolving interpersonal conflicts with each other if they arise in group discussions.

Key Assessment

Level 1

1. What is Geospatial data?
2. State any three (3) ways of applying geospatial data.

Level 2: State three (3) advantages and limitations of both traditional and modern methods of collecting geospatial data.

Level 3: Discuss three (3) potential sources of error in GPS data and how these errors can be corrected.

Level 4: Critically assess how remote sensing methods can be used to monitor the spread of urban areas in Ghana.

Hint

*The Recommended Mode of Assessment for Week 18 is **Mid-Semester Examination.** Refer to **Appendix J** for a Table of Specification to guide you to set the questions. Set questions to cover all the indicators covered for at least weeks 13 to 17.*

WEEK 19

Learning Indicator: *Collect and map geospatial data using Computer and Mobile Apps, GIS, and GPS*

FOCAL AREA: COLLECTION AND MAPPING OF GEOSPATIAL DATA

Collecting and mapping geospatial data is essential for various applications such as urban planning, environmental monitoring, and disaster management. With advancements in technology, collecting and mapping geospatial data has become more accessible through the use of digital applications (such as computer software and mobile apps).

Applications (apps) for Collecting Geospatial Data

1. **Quantum Field (Qfield):** Offline map editing, support for various spatial data formats, integration with QGIS, and custom form design.
2. **OpenStreetMap:** Can collect geospatial data in the field, adding points of interest, path details, and other relevant information directly to the map.
3. **FieldMapper:** An open-source application designed for field data collection, which can be customised for specific geospatial data collection needs.
4. **Google Maps:** Used for navigation and simple location data collection.
5. **ArcGIS Collector:** A mobile app for capturing data in the field, integrating with ArcGIS Online for analysis.
6. **ArcGIS Survey123:** Allows for the collection of data via custom surveys.

Software for Data Mapping

1. **QGIS:** An open-source GIS software for mapping and analysing spatial data.
2. **Google Earth Pro:** Allows users to create, view, and analyse maps using satellite imagery and other geospatial data.
3. **ArcGIS:** A comprehensive GIS software suite used for mapping, spatial analysis, and managing geographic data.
4. **OpenStreetMap:** Can contribute by adding and editing geographic information, such as roads, trails, buildings, and landmarks, to improve the map.

Strengths and weaknesses of using mobile apps, GPS devices, and GIS software for collecting geospatial data

1. **Mobile Apps**

   These are easy to use and widely available on smartphones, data is real-time, they are cost effective and require little training to use. However, they are not as accurate as GPS, drain smartphone batteries quickly and there are risks with data privacy and security.

2. **GPS Devices**

   These are highly accurate providing precise and reliable data, devices are built to withstand harsh environmental conditions and handling and can be used in the most rugged of terrain. However, they cost much more than mobile apps, may need special training, and are limited to collecting location data only.

3. **GIS software**

   GIS software uses a range of complex spatial data and integrates it to provide complex mapping and visual representations at all scales. However, the cost of GIS software and access to data is high, maintenance is required in terms of updates and licenses, significant training and expertise is needed to use it effectively and existing servers and computers must be powerful enough to run it.

Procedure to Collect and Map Geospatial Data

1. Planning Your Data Collection
   a. Define the purpose of your data collection (e.g., mapping trees or buildings in your school compound).
   b. Choose the appropriate tools and apps based on your needs and available resources.
2. Collecting Data with Mobile Apps
   a. Install the chosen mobile app (e.g., Google Maps, ArcGIS Collector) on your smartphone or tablet.
   b. Create a new project or survey within the app.
   c. Go to the field and start collecting data points by marking locations, taking photos, and adding notes or attributes (e.g., tree species, pothole size).
   d. Save and synchronise your data with the app's cloud service or export it for further analysis.
3. Mapping Data with Computer Software
   a. Install GIS software (e.g., QGIS, ArcGIS) on your computer.
   b. Import the collected data from your mobile app into the GIS software.
   c. Create layers for different types of data (e.g., trees, roads, buildings).
   d. Use various tools in the GIS software to analyse and visualise the data (e.g., creating maps, performing spatial analysis).
   e. Export your maps and findings for presentation or further use.

Learning Task

Collect and map geospatial data using computer software and/or specific Mobile Apps.

PEDAGOGICAL EXEMPLARS

Activity-based learning

Collect and map geospatial data using computer software and Mobile Apps, GIS, and GPS

1. Provide an overview of the specific computer software and mobile apps to be used. (e.g., Qfield, OpenStreetMap or FieldMapper for data collection and QGIS, Google Earth Pro or ArcGIS for data mapping).
2. Offer hands-on demonstrations or short video tutorials guiding them through the apps' basic functions. Pair struggling learners with tech-savvy classmates for additional support.
3. Organise learners into small groups, ensuring a mix of abilities. Each group will select a location or topic for gathering geospatial data.
4. Provide step-by-step checklists and templates to help them structure their data collection. Consider conducting a practice run with simpler tasks before they start the main project.
5. Guide learners in inputting their collected data into the mapping applications to create visual representations (maps, graphs, etc.).
6. Offer templates for map layouts and simpler instructional guides with visuals to help them along the way. Facilitate mini work sessions to troubleshoot or provide individual support.
7. Have each group present their mapped data and discuss the findings, including the process of collection and the significance of their results.
8. Facilitate a reflective discussion about the project, focusing on what each group learned about geospatial data collection and mapping.

Learners should understand the cause and effect of decisions they make.

Key Assessment

Level 1: Identify any three uses of geospatial data.

Level 2

1. Compare and contrast the various methods of collecting geospatial data.
2. State the main differences between GPS, and GIS data collection methods.

Level 3

1. Analyse the strengths and weaknesses of mobile apps, GPS devices, and GIS software for collecting geospatial data.
2. Justify the mobile app you would use to collect geospatial data for a project on land use patterns in your local area.

Level 4: Use a GPS device or mobile app to collect geospatial data in your school compound, record the coordinates of various features (e.g., trees, benches, dining hall, canteen, etc.), and create a simple map using the collected GPS data, including labels and descriptions for each feature.

WEEK 20

Learning Indicator: *Explore the emerging technologies for geospatial data collection.*

FOCAL AREA: EMERGING TECHNOLOGIES FOR GEOSPATIAL DATA COLLECTION

The field of geospatial data collection is undergoing a significant transformation due to advancements in technology. As industries increasingly rely on geospatial data to inform decisions, enhance operational efficiency, and drive innovation, new methods and tools are emerging to facilitate more accurate and efficient data collection. Some of these technologies include:

1. **Drones and Unmanned Aerial Vehicles (UAVs)**

   Drones have revolutionised geospatial data collection, providing an efficient and cost-effective method for capturing high-resolution aerial imagery and data. Equipped with cameras and advanced sensors, drones can cover large areas quickly, capturing detailed data that was previously difficult or time-consuming to obtain through traditional methods.

   Key Benefits

   a. **Rapid Data Acquisition**: Drones can capture imagery and data over vast areas in a fraction of the time it would take using ground-based methods.

   b. **High Resolution**: The imagery obtained from drones offers high levels of detail, making it ideal for applications in mapping, agriculture, and environmental monitoring.

   c. **Flexibility**: Drones can be deployed in various environments, including urban areas, forests, and inaccessible terrains.

2. **LiDAR (Light Detection and Ranging)**

   LiDAR technology utilises laser beams to measure distances and create detailed, three-dimensional representations of the Earth's surface. This technology has found extensive applications in forestry, urban planning, and infrastructure development.

   Key Benefits

   a. **High Precision**: LiDAR can achieve sub-meter accuracy, making it invaluable for detailed topographical mapping.

   b. **Penetration of Canopy**: Unlike traditional aerial photography, LiDAR can penetrate tree canopies, providing valuable data on forest structure and biomass.

   c. **Rapid Data Processing**: Advanced algorithms allow for quick processing of LiDAR data, generating insights in a timely manner.

3. **Mobile Mapping Systems**

   Mobile mapping systems integrate multiple data collection technologies, including GPS, cameras, and LiDAR, into a single platform mounted on vehicles. This technology

provides a comprehensive approach to data collection for applications like urban planning and infrastructure assessment.

Key Benefits

a. **Comprehensive Data Capture**: The combination of various sensors allows for the collection of diverse data types, from high-resolution images to detailed 3D models.

b. **Efficiency**: Mobile mapping systems can cover large areas rapidly, saving time and resources compared to traditional survey methods.

c. **Real-Time Data Processing**: Many mobile mapping systems can process data in real-time, facilitating immediate analysis and decision-making.

4. **Internet of Things (IoT) and Sensor Networks**

The Internet of Things (IoT) involves the interconnection of devices and sensors that collect and exchange data. IoT enables real-time geospatial data collection from a network of sensors deployed in various environments, from urban areas to remote locations.

Key Benefits

a. **Real-Time Monitoring**: IoT sensors can provide continuous monitoring of environmental conditions, infrastructure health, and other geospatial factors.

b. **Data Integration**: The ability to integrate data from various sensors offers a comprehensive view of geographical phenomena, enhancing situational awareness.

c. **Cost Efficiency**: Deploying low-cost sensors can lead to significant savings in data collection efforts compared to traditional methods.

5. **Geospatial Artificial Intelligence (GeoAI)**

GeoAI combines geospatial data with artificial intelligence (AI) and machine learning algorithms to analyse complex datasets and generate actionable insights. This technology is particularly useful in applications such as predictive modelling, urban planning, and disaster response.

Key Benefits

a. Enhanced Decision-Making: AI can identify trends and relationships within geospatial data that may not be apparent through traditional analysis.

b. Automation: GeoAI allows for the automation of routine data analysis tasks, freeing up geospatial professionals to focus on higher-level decision-making.

c. Predictive Analytics: Machine learning models can forecast changes in land use, environmental conditions, and human activities, facilitating proactive planning and response.

Learning Task

Discuss the emerging technologies for geospatial data collection.

PEDAGOGICAL EXEMPLARS

Talk for learning

Using pictures, videos, and other relevant materials in an all-inclusive with emphasis of learners from different geographical areas discussion, explore the emerging technologies for geospatial data collection.

1. Present a selection of images, short videos, and infographics that illustrate different technologies (e.g., drones, LiDAR, IoT systems, GeoAI) and highlights key components and benefits of each technology.
2. Use a mind-mapping technique where learners can collaboratively brainstorm the uses and implications of each technology.
3. Offer learner a starter mind map with some ideas filled in to allow them to add their thoughts. Encourage partnerships so that they can discuss and share ideas verbally.
4. Incorporate demonstrations (if possible) or a virtual tour highlighting the technologies (e.g., watching a drone fly or exploring a LiDAR simulation).
5. Use structured observation sheets that prompt learners to note specific features or uses they see. Facilitate discussions around these observations.
6. Ask learners to create visual aids that explain how each technology collects and utilises geospatial data.
7. Ask learners to present their visuals and findings to the class.
8. Conduct a class reflection session where learners discuss their learning experiences, and the technologies explored.

In discussions, learners should listen to their peers' opinions and express disagreements in constructive ways.

Key Assessment

Level 1: List three emerging technologies that are used for geospatial data collection.

Level 2: Describe the key features and capabilities of the following emerging technologies for geospatial data collection.

1. LiDAR
2. Drones and Unmanned Aerial Vehicles
3. Sensor networks and IoT devices

Level 3: Explain how emerging geospatial data collection technologies, such as autonomous vehicles and drones, can be integrated with existing systems and infrastructure to enhance data collection, processing, and analysis.

Level 4

1. Group Research: You have been tasked with designing a comprehensive geospatial data collection system for a town that aims to improve urban planning, infrastructure management, and environmental monitoring. Propose three innovative solutions that integrate a variety of emerging technologies to help the community.

2. A local river is facing pollution issues that need to be addressed, assign some learners to be environmental consultants, data scientists, government officials, and NGO representatives to develop a comprehensive plan to monitor and improve the river's health, utilising geospatial data

SECTION 7 REVIEW

The section focused on geospatial data collection methods, covering traditional techniques such as surveying, remote sensing, GIS, and GPS. Learners discussed the fundamentals of these methods, understanding their applications and significance in various fields. Learners were also introduced practical skills, where they engaged with computer and mobile apps for mapping geospatial data, enhancing their technical proficiency in using GIS and GPS technologies. Emerging technologies like drones and IoT for geospatial data collection, highlighting innovative approaches and their contributions to modern data gathering were also explored. The differentiated pedagogies ensured that all learners, regardless of skill level, could engage meaningfully with the material. Overall, learners gained a comprehensive understanding of geospatial data collection, fostering both knowledge and practical application skills suitable for varied learning needs.

APPENDIX J: TABLE OF SPECIFICATION FOR MID-SEMESTER EXAMINATION (SECOND SEMESTER)

Week	Focal Area(s)	Type of Question	DoK Levels				Total
			1	2	3	4	
13	Soils	Multiple Choice	3	4	3		10
		Essay	-	1	-	-	1
14	Types and Importance of Soils	Multiple Choice	1	1	3		5
		Essay	-	-	1	-	1
15	Elements of Climate	Multiple Choice	3	4	1		8
		Essay	-	1	-	-	1
16	Forms of Precipitation	Multiple Choice	2	3	1	-	6
		Essay	-	-	-	-	
17	World Climatic Zones and The Associated Vegetation	Multiple Choice	3	4	4	-	11
		Essay	-	-	1	-	1
	Total		12	18	14	-	44

Guidelines on Mid-Semester Examination (Second Semester)

Paper 2

a. Four (4) essay questions out of which learners are expected to answer 2 questions in all but question 1 which is on GIS is compulsory.

b. Essay questions should cover DoK levels 2 – 4

c. Questions should cover weeks 13 – 17 of the Teacher Manual

d. Each question should be scored out of 15

Paper 1

a. 40 objective test items (comprising multiple choice, fill-in/supply answer) of which s are expected to answer all.

b. Objective test questions should cover DoK levels 1 – 3.

c. Half (1/2) mark for each objective test item.

***Duration**: 1 hour 50 minutes*

SECTION 8: LAND DEGRADATION IN GHANA

STRAND: HUMAN AND ENVIRONMENT

Sub-Strand: Environmental Degradation

Learning Outcome: *Analyse causes, effects and preventing or mitigating strategies for land degradation and soil pollution in Ghana*

Content Standard: *Demonstrate skills of preventing or mitigating land degradation and soil pollution in Ghana*

INTRODUCTION AND SECTION SUMMARY

In this section, learners will investigate the critical issues of land degradation and soil pollution in Ghana, exploring their causes, consequences, and remedial strategies. They will gain an understanding of how various human activities, such as mining, deforestation, urbanisation, and agricultural practices, contribute to the deterioration of land quality. Additionally, the section will address the impact of soil pollution on environmental health and agricultural productivity, highlighting the significance of sustainable land management practices. By the end of this section, learners will be equipped to identify the multifaceted challenges associated with land degradation and soil pollution in Ghana, as well as the socio-economic implications for local communities. This knowledge will enable them to critically assess current policies and propose informed solutions to combat these pressing environmental issues.

The weeks covered by the section are:

Week 21: Land Degradation in Ghana

Week 22: Soil Pollution in Ghana

SUMMARY OF PEDAGOGICAL EXEMPLARS

To effectively engage learners in the study of land degradation, teachers should implement differentiated pedagogical strategies that cater for varying learning preferences. Initiating the lesson with a brainstorming session on the meaning of land degradation and soil pollution will activate prior knowledge and engage learners' critical thinking skills. Experiential learning such as a field trip to a nearby mining site or by watching a documentary, thereby providing real-world context that benefits visual and kinaesthetic learners. Finally, engaging learners in mixed-ability group discussions can encourage peer interaction and will allow learners to collaboratively explore the environmental effects of these issues and propose potential remedies. These structured pedagogies not only foster inclusivity by accommodating diverse learning styles but will also promote a deeper understanding of complex environmental challenges, empowering all learners to contribute meaningfully to the discourse on land degradation and soil pollution mitigation.

ASSESSMENT SUMMARY

The assessment for this section on land degradation should be structured across DoK Levels 1 to 4 to ensure a thorough evaluation of students' understanding. At Level 1, learners should be able to list primary causes and effects of land degradation, alongside defining soil pollution and identifying its causes and health impact through quizzes for factual recall. Level 2 tasks should involve describing mitigation strategies and analysing the environmental effects of soil pollution, enhancing comprehension and application of knowledge through written responses and group discussions. At Level 3, learners should conduct analyses of diverse interactions and assess the implications of land degradation, employing critical thinking through reports and presentations. Finally, Level 4 should challenge learners to propose innovative solutions and evaluate existing strategies, fostering creativity and synthesis in project-based assessments. These diverse assessment strategies cater for various learning styles, encouraging engagement and deeper understanding. Teachers can refer to the Teacher Assessment Manual and Toolkit (TAMK) for additional guidance on assessment implementation.

WEEK 21

Learning Indicator: *Discuss the causes of land degradation, its effects and management strategies in Ghana.*

FOCAL AREA: LAND DEGRADATION IN GHANA

Land degradation refers to the decline in land quality and productivity due to various factors, including natural processes and human activities. It affects soil health, water resources, and biodiversity, ultimately impacting agricultural productivity and ecosystem services. Land degradation is a critical issue in Ghana, affecting food security, livelihoods, and sustainable development. Understanding its causes, effects, and mitigation strategies is essential for policy formulation and implementation.

Causes of Land Degradation

1. **Indiscriminate lumbering**: The high demand for timber, both domestically and for export, has led to the rapid deforestation of Ghana's forest reserves, with the country losing approximately 2.5 million hectares of forest cover between 1990 and 2015. This removal of trees and vegetation exposes the soil to erosion by wind and water, leading to the loss of fertile topsoil and reduced agricultural productivity.
2. **Mining activities**: Both legal and illegal mining (galamsey) activities contribute to land degradation. Mining exposes soil to erosion, contaminates water bodies with heavy metals, and destroys habitats. The Atewa Range Forest Reserve, rich in biodiversity, has been heavily impacted by illegal mining activities.
3. **Agricultural practices**: Shifting cultivation, overgrazing, and improper irrigation techniques degrade soil quality. Continuous cropping without fallow periods exhausts soil nutrients, leading to reduced agricultural productivity. For instance, the northern regions face severe land degradation due to overgrazing and improper farming practices.
4. **Climate change**: Changing weather patterns, including increased frequency of droughts and floods, worsen land degradation. The Upper East Region experiences recurrent droughts, leading to loss of vegetation cover and soil erosion.
5. **Urbanisation**: Rapid urbanisation and population growth exert pressure on land resources, leading to the conversion of agricultural and forest lands into residential and commercial areas. Accra and Kumasi have seen significant land-use changes due to urbanisation.

Environmental effects of land degradation in Ghana

1. **Loss of Biodiversity**: The Atewa Range Forest Reserve, rich in biodiversity and home to many endemic species, has been severely impacted by illegal mining activities. The destruction of habitats has led to the decline of species, some of which are unique to this region.
2. **Soil Erosion**: In the Upper East Region, improper farming practices and deforestation have led to severe soil erosion. This erosion removes the nutrient-rich topsoil, reducing agricultural productivity and leading to the formation of gullies that further degrade the land.

3. **Desertification**: Northern Ghana, particularly the Upper East and Upper West regions, faces advancing desertification due to overgrazing and deforestation. The loss of vegetation cover accelerates the process, transforming fertile land into desert-like conditions.
4. **Water Pollution**: Mining activities, especially illegal small-scale mining (galamsey), have contaminated water bodies with heavy metals and chemicals. Rivers such as the Pra and Ankobra have been heavily polluted, affecting aquatic life and making the water unsafe for human consumption.

Socio-economic impacts of Land degradation

1. **Reduced Agricultural Productivity**: In the Upper East Region, soil erosion and loss of soil fertility have led to lower crop yields. Farmers struggle to produce enough food, affecting food security and income levels. This reduction in productivity forces some farmers to abandon their land or switch to less sustainable farming practices.
2. **Increased Poverty**: In Northern Ghana, where agriculture is the primary livelihood, land degradation worsens poverty. As land becomes less productive, farmers earn less, leading to higher levels of poverty and reduced ability to invest in land improvement or education.
3. **Migration and Urbanisation:** The decline in agricultural productivity due to land degradation pushes rural inhabitants to migrate to urban areas in search of better opportunities. Cities like Accra and Kumasi face increased pressure on infrastructure and services due to this influx, leading to the growth of informal settlements and increased urban poverty.
4. **Loss of Livelihoods**: Communities that rely on natural resources, such as those around the Atewa Range, suffer when land degradation disrupts ecosystems. The decline in forest resources affects livelihoods dependent on timber, non-timber forest products, and ecotourism, leading to economic hardship.
5. **Health problem**: In regions affected by mining, such as the Western Region, water pollution from land degradation leads to health problems. Contaminated water sources cause diseases such as diarrhoea and skin infections, which increase healthcare costs and reduce the overall quality of life for affected communities.

Mitigation strategies of land degradation in Ghana by the government and NGOs

1. **Afforestation and Reforestation Projects**: The Ghana Forest Plantation Development Programme, led by the government, aims to restore degraded forest lands by planting trees. This initiative helps improve soil fertility, prevent erosion, and restore biodiversity. NGOs like 'A Rocha Ghana' also participate in reforestation efforts, particularly in the Atewa Range Forest Reserve.
2. **Promotion of Sustainable Agricultural Practices**: The Ministry of Food and Agriculture (MoFA) promotes conservation agriculture practices, such as crop rotation, cover cropping, and minimum tillage. These practices help maintain soil health and reduce erosion. NGOs like the Savanna Agricultural Research Institute (SARI) support farmers in Northern Ghana with training and resources to adopt sustainable farming techniques.

3. **Soil and Water Conservation Techniques**: The Ghana Environmental Management Project (GEMP), funded by the Canadian government and implemented by the Environmental Protection Agency (EPA), focuses on soil and water conservation. Techniques such as contour ploughing, terracing, and the construction of check dams are promoted to prevent soil erosion and conserve water. These efforts are particularly beneficial in the Upper East and Upper West regions.
4. **Community-Based Natural Resource Management**: The Community Resource Management Areas (CREMAs) initiative empowers local communities to manage and conserve their natural resources. Supported by the Wildlife Division of the Forestry Commission and NGOs like the Nature Conservation Research Centre (NCRC), CREMAs involve communities in sustainable land use planning and conservation activities, fostering a sense of ownership and responsibility.
5. **Integrated Water Resources Management (IWRM)**: The Water Resources Commission (WRC) of Ghana implements IWRM strategies to manage and protect water resources. This approach involves the coordinated development and management of water, land, and related resources. NGOs such as WaterAid Ghana collaborate with the government to promote IWRM practices, ensuring sustainable water use and reducing land degradation related to water mismanagement.

Learning Tasks

1. Brainstorm the meaning of land degradation.
2. Document and present machinery used in mining activities.
3. Discuss the effects of land degradation on the environment.
4. Suggest remedies to mitigate the effects of land degradation.

PEDAGOGICAL EXEMPLARS

Talk for Learning

Brainstorm on the meaning of land degradation. Considering the cultural diversity and different location of learners, let them share their experiences.

1. Begin with a brief overview of land degradation using visuals (e.g., images of degraded land, videos depicting the impact of deforestation and mining).
2. Facilitate a sharing circle where learners can discuss their personal experiences with land degradation in their localities.
3. Give learners prompts (such as “Have you seen areas where land has changed?” or “What kind of plants or animals have disappeared from your area?”) to guide them in sharing their experiences.
4. Organise learners into small groups to brainstorm the causes of land degradation.
5. Provide a graphic organiser with sections for listing causes. Encourage learners to work collaboratively to foster peer support.
6. Ask learners to create visual representations (posters, infographics, or digital presentations) that illustrate their understanding of land degradation.

7. Have learners present their visuals to the class. Foster an environment where constructive feedback is encouraged.
8. Conclude with a reflection session where learners can articulate what they learned about land degradation.

Experiential Learning

Embark on a field trip to a nearby mines/watch a video documentary on mining and document machinery used in mining activities for presentation in groups.

Option 1: Field Trip to a Mine

1. Briefly revise the focal area on mining that was treated in Year One through a class discussion.
2. Discussion of safety protocols and expectations and prepare learners for the trip.
3. Engage learners during the trip. Let them work in groups whiles the interact with miners to solicit for information on the machinery used in mining and the dangers they posed to the land.
4. After the trip, facilitate a group discussion where learners discuss and document on their experiences and findings from the trip.
5. Ask each group to present their findings.
6. Conclude with a reflection session where learners can express what they learned during the trip and the challenges they faced.

Option 2: Documentary Viewing

1. Prepare learners for the documentary viewing by introducing the topic and setting expectations.
2. Show a documentary that covers various aspects of mining, and the machinery used.
3. Provide a viewing guide with key points and questions to focus on during the documentary. Use pauses to explain and discuss important sections. Encourage learners to take notes (E.g., the name of machinery and its function) during the watching of the documentary.
4. Assign learners to groups of mixed abilities and provide a clear structure for the presentation (e.g., introduction, main points, conclusion).
5. Have each group present their findings to the class.
6. Facilitate a discussion on what was learned during the documentary.
7. Use graphic organisers or reflective journals to summarise the learning experience.

Talk for Learning

Discuss and discover in GESI responsive groups, the effects of land degradation on the environment and suggest remedies to reducing the effects.

1. Conduct a short brainstorming session where learners can express what they think affects the land in their local area.
2. Facilitate a group discussion regarding the effects of land degradation on the environment. Assign roles within the group (e.g., note-taker, speaker, facilitator),

ensuring each learner's strengths are considered. Provide guided questions to help them articulate their thoughts.

3. Facilitate a brainstorming session where learners can suggest practical, simple solutions (e.g., planting trees, community gardens) to reduce land degradation. Provide examples and allow them to discuss in pairs before sharing with the larger group. Alternatively, provide a list of potential remedies and ask them to identify which could be easily implemented in their local community.
4. Provide templates for learners' presentations with clear sections to fill in (e.g., causes, effects, solutions). Encourage learners to use visual aids and collaborative tools (like poster boards or PowerPoint) to support their ideas.
5. Conduct a reflection circle where they can discuss what they found most interesting and identify areas for improvement in a supportive environment.

In groups, all Learners should be aware of the emotions of all members, especially the vulnerable ones.

Key Assessment

Level 1:

1. List the primary causes of land degradation in Ghana.
2. State three (3) effects of land degradation in Ghana.

Level 2: Describe three (3) strategies that would lessen the impact of land degradation in Ghana.

Level 3: Explain with examples how illegal mining activities in Forest Reserves in Ghana have affected biodiversity.

Level 4:

1. Analyse any three measures that the Ghanaian Environmental Protection Agency has introduced to address issues of soil erosion and water conservation in Ghana.
2. You are a researcher tasked with investigating environmental issues in the Ashanti region of Ghana. Your objective is to explore the phenomenon of land degradation in this region.
   a. Identify and analyse the various factors contributing to land degradation in the Ashanti region. Consider both natural and human-induced causes.
   b. Examine the consequences of land degradation on the environment, local communities, and agricultural practices in the region.
   c. Propose effective strategies for managing and mitigating land degradation in the Ashanti region and discuss any existing initiatives and their potential for improvement.

Hint

The Recommended Mode of Assessment for Week 21 is Case Study. Refer to Appendix K for a rubric to score learners' performance on the task. Item ii of DoK level 4 is a task example.

WEEK 22

Learning Indicator: *Discuss the causes of soil pollution, its effects and management strategies in Ghana*

FOCAL AREA: SOIL POLLUTION IN GHANA

Soil pollution refers to the presence of toxic chemicals, contaminants, or pollutants in the soil, which adversely affect its quality and health. This pollution can result from various human activities such as industrial operations, agricultural practices, and improper waste disposal. Studying soil pollution in Ghana is vital due to its adverse effects on agricultural productivity, water quality, human well-being, and the ecological integrity of the environment. Finding the primary sources and downstream consequences of soil contamination is essential for developing strategies to overcome the problems caused.

Causes of Soil Pollution

1. **Industrial activities**: Industrial operations, particularly in mining areas, release heavy metals like mercury, lead, and cadmium into the soil. For example, gold mining in regions like Obuasi has led to significant soil contamination.
2. **Agricultural practices**: The excessive use of chemical fertilisers, pesticides, and herbicides leads to the accumulation of harmful substances in the soil. Cocoa farms in the Western and Ashanti regions are notable examples where agrochemical use has polluted the soil.
3. **Improper waste disposal**: Dumping of industrial, municipal, and hazardous wastes contaminates the soil. Areas around major cities like Accra and Kumasi suffer from soil pollution due to inadequate waste management systems.
4. **Oil spillage**: Oil exploration and spillage, particularly in the Western Region, lead to soil contamination. The Jubilee oil field has seen incidents where oil spills have adversely affected the surrounding land.
5. **Urbanisation**: Rapid urbanisation results in the accumulation of pollutants from construction activities, vehicular emissions, and improper waste disposal, contaminating urban soils. Accra's rapid growth has led to increased soil pollution in peri-urban areas.

Environmental Effects of Soil Pollution in Ghana

1. **Loss of soil fertility**: In areas such as the mining regions of Obuasi and Tarkwa, heavy metal contamination from mining activities has significantly reduced soil fertility. This makes it difficult for vegetation to grow, leading to barren lands and a decline in agricultural productivity.
2. **Contamination of water bodies**: Soil pollution in mining areas often leads to the leaching of heavy metals and toxic chemicals into nearby water bodies. Rivers like the Pra and Ankobra have been contaminated by pollutants from mining operations, which adversely affects aquatic life and makes the water unsafe for consumption.
3. **Loss of flora and fauna**: The Atewa Range Forest Reserve has been affected by soil pollution due to illegal mining activities. The contamination of soil disrupts habitats

and leads to a decline in plant and animal species, threatening the rich biodiversity of the region.

4. **Disruption of ecosystems**: In agricultural areas where chemical fertilisers and pesticides are heavily used, such as the cocoa farms in the Western and Ashanti regions, the build-up of these chemicals in the soil disrupts the natural balance of ecosystems. This can harm beneficial soil organisms and lead to the proliferation of pests and diseases.
5. **Erosion and sedimentation**: In regions like the Upper East and Upper West, soil erosion is worsened by soil pollution. Contaminated soil is more prone to erosion, which leads to sedimentation in rivers and streams, affecting water quality and aquatic habitats.

Socio-Economic Impact of Soil Pollution in Ghana

1. **Reduced agricultural productivity**: In farming communities where there is extensive use of chemical fertilisers and pesticides, there is increased incidence of soil contamination, leading to a decline in crop yields. Farmers face difficulties cultivating healthy crops on polluted soil, resulting in decreased agricultural productivity, lower incomes, and heightened food insecurity.
2. **Economic losses**: Soil pollution in agricultural zones such as cocoa-growing regions can lead to economic losses due to decreased crop quality and market value. Farmers in these regions may struggle to sell their produce, leading to financial instability and decreased investments in farm improvements.
3. **Health risks**: Communities near industrial areas including mining regions face health problems due to exposure to contaminated soil. Residents may suffer from diseases such as respiratory issues, skin disorders, and even cancers, leading to increased healthcare costs and reduced quality of life.
4. **Loss of livelihoods**: Communities that depend on natural resources for their livelihoods, such as those involved in artisanal mining or small-scale farming, are severely affected by soil pollution. Contaminated soil may reduce the availability of arable land and resources, leading to the loss of jobs and economic hardship for families.
5. **Migration and urbanisation**: Soil pollution and degradation may force farmers to abandon their lands and migrate to urban areas in search of better opportunities. This migration contributes to overpopulation in cities like Accra and Kumasi, straining urban infrastructure, creating informal settlements, and increasing unemployment rates.

Learning Tasks

1. Brainstorm the definition of soil pollution.
2. Identify causes of soil pollution in local communities.
3. Discuss the impacts of soil pollution on humans and the environment in Ghana.
4. Propose remedies to reduce the impacts of soil pollution.
5. Create a mind-map on the causes, effects, and control of soil pollution in Ghana.

PEDAGOGICAL EXEMPLARS

Talk for Learning

1. Brainstorm the definition of soil pollution.
2. Identify causes of soil pollution in local communities.
3. Discuss the impacts of soil pollution on humans and the environment and propose remedies to mitigate the menace.

    a. Use a simple definition prompt (e.g., "Soil pollution is when the earth's surface is contaminated..") and ask learners to complete the definition using their own words. Facilitate a class discussion to reach a group consensus.

    b. Take a short field trip within the school compound or immediate surrounding, if possible, to observe potential sources of soil pollution in the community, such as littering or waste disposal areas, discussing observations as a group afterward.

    c. Create a simple chart to list impacts, prompting them with questions like "How does polluted soil affect plants?" and "What happens to animals or people who eat those plants?"

    d. Provide a list of common strategies to reduce soil pollution and have them prioritise which they think would be most effective in their community, explaining their reasoning in pairs.

    e. Use simple reflection prompts like "What did you learn?" or "What surprised you?" to encourage them to articulate their thoughts. They can do this in pairs or small groups to build confidence before sharing with the class.

Learners should consider the emotions of individuals who struggle to express themselves

Activity-Based Learning

Create a mind-map on the causes, effects, and control of soil pollution in Ghana.

1. Divide the class into small, diverse groups, ensuring a mix of abilities and assign roles (e.g., facilitators, researchers, designers) to ensure active participation.
2. From the previous brainstorming activities help learners gather information on the causes, effects, and control measures of soil erosion in Ghana that will be used to create a mind map.
3. Let each group decide whether to create the mind map digitally (using tools like Canva, Venngage, Lucidchart) or traditionally (using paper, colour pens).
4. Guide each group to present their mind map to the class and encourage the group to explain the information provided.
5. Facilitate a discussion on the presentations, highlighting key points and addressing any misconceptions.
6. Assess the mind maps based on completeness, accuracy, creativity, and presentation.
7. Have learners write reflections on what they learned about soil pollution and the mind-mapping process.

Key Assessment

Level 1

1. What is soil pollution?
2. List three major causes of soil pollution in Ghana.
3. Name two ways in which soil pollution can affect human health in Ghana.

Level 2: Discuss any four (4) impacts of soil pollution on biodiversity in mining areas in Ghana.

Level 3: Evaluate any five (5) economic consequences of soil pollution in agricultural zones (for example the cocoa-growing regions) in Ghana.

Level 4: Discuss the causes of soil pollution, its effects and management strategies in Ghana and present your findings

Hint

Remind learners about the submission of their Individual Portfolio latest by Week 23.

SECTION 8 REVIEW

The section exposed learners to critical environmental issues facing Ghana. They delved into the complex causes of land degradation, its far-reaching impacts on ecosystems and livelihoods, and potential management strategies. Building upon this, learners examined the origins of soil pollution, its detrimental effects on human health and the environment, and practical approaches to mitigate its consequences. Learners developed a strong understanding of the interconnectedness of land management and soil health and the importance of this to the Ghanaian economy. The content of this section enabled learners to identify the key drivers of land degradation and pollution, analyse the implications, and propose sustainable solutions.

APPENDIX K: RUBRIC FOR CASE STUDY ASSESSMENT FOR WEEK 21

Criteria	Excellent (4)	Good (3)	Fair (2)	Poor (1)
Identification of Causes	Thoroughly identifies and analyses various natural and human-induced factors contributing to land degradation.	Identifies most causes with some analysis; minor details may be missing.	Limited identification; lacks clarity or depth in analysis.	Poor or no identification of causes; minimal understanding.
Examination of Consequences	Comprehensive examination of the consequences of land degradation on the environment, communities, and agriculture; clear connections made.	Good examination of consequences; some connections may be less detailed.	Limited examination; some consequences are unclear or missing.	Poor examination; minimal relevance to the task.
Proposed Management Strategies	Proposes effective and innovative strategies for managing land degradation; discusses existing initiatives with insightful suggestions for improvement.	Proposes some relevant strategies; discusses existing initiatives but may lack depth.	Limited strategies proposed; unclear discussion of existing initiatives.	Poor or no proposed strategies; minimal understanding of management options.
Use of Evidence	Strong use of relevant evidence and examples throughout the report; well-cited and enhances arguments effectively.	Good use of evidence; some citations may be missing or less relevant.	Limited use of evidence; arguments may be weak or unsubstantiated.	Poor or no use of evidence; arguments lack support.
Organization and Clarity	Information is very well organized; logical flow enhances understanding; ideas are expressed clearly.	Generally well organized with good clarity; minor lapses in flow.	Some organization; ideas may be disjointed or unclear.	Poorly organized; difficult to follow overall; unclear expression.
Engagement with Topic	Demonstrates high engagement with the topic; shows initiative in exploring additional relevant issues.	Good engagement with the topic; meets basic requirements but lacks depth.	Limited engagement; may rely on surface-level information.	Minimal engagement; fails to connect with the topic effectively.
Presentation Skills (if applicable)	Excellent presentation; engaging, confident, and well-rehearsed; good eye contact and body language.	Good presentation; mostly engaging; some minor issues with confidence or delivery.	Limited engagement; delivery lacks confidence; several issues with presentation.	Poor presentation; unengaging and unprofessional; lacks confidence.

Total Score: 28

SECTION 9: COMMON ENVIRONMENTAL HAZARDS AND DISASTERS IN GHANA

STRAND: HUMAN AND ENVIRONMENT

Sub-Strand: Environmental Hazards and Their Management

Learning Outcome: *Evaluate measures for controlling or mitigating floods, droughts, earthquakes, and fires in Ghana*

Content Standard: *Demonstrate skills for managing earthquakes, floods, drought, and fires*

Hint

Recommended Mode of Assessment for Week 24 is End of Second Semester Examination. [Refer to Appendix L for a Table of Specification to guide you to set the questions]. Set questions to cover all the indicators covered for weeks 13 to 24.

INTRODUCTION AND SECTION SUMMARY

In this section, learners will examine the critical environmental challenges presented by floods, droughts, and fires disasters in both rural and urban Ghana. They will explore the underlying causes of these phenomena, including climate change, land use practices, and infrastructural vulnerabilities, while assessing their impacts on communities, agriculture, and ecosystems. The section also highlights the effects of floods, which can lead to immediate destruction and displacement, and the prolonged challenges posed by droughts and fires, which threaten food security and livelihood sustainability. By the end of this section, learners will gain an integrated understanding of the interrelations between these hazards, the socio-economic repercussions for affected populations, and the importance of effective management strategies.

The weeks covered by the section are:

Week 23: Floods in Ghana

Week 24: Drought and Fires in Ghana

SUMMARY OF PEDAGOGICAL EXEMPLARS

To enhance understanding of floods, droughts, and fires, teachers should adopt an experiential learning approach that caters for diverse learning preferences and abilities. The lesson can begin with visual resources, such as pictures and videos, to stimulate interest and facilitate brainstorming sessions. Think-pair-share activity should also be adopted to encourage collaborative discussion on the causes of these environmental phenomena, allowing learners to engage with their peers and develop interpersonal skills. For the activity-based learning

component, learners should work in pairs to identify low-lying areas or water channels in their community, using printed maps or digital apps to map flood-prone zones. This hands-on practice will equip kinaesthetic learners with practical skills and deepen understanding of local environmental dynamics, thereby promoting an inclusive learning environment that addresses various educational needs.

ASSESSMENT SUMMARY

The assessment for the section will utilise DoK Levels 1 to 4 to facilitate comprehensive understanding and application. At Level 1, learners will define flooding and identify causes, engaging in quizzes for basic knowledge acquisition. Level 2 tasks will require explanations of retention basins and reservoirs, as well as the impact of climate change on droughts, enhancing understanding through written assignments and discussions. At Level 3, learners will explain how heavy rainfall causes and analyse community vulnerabilities to fire disasters, fostering critical analysis through case studies and group discussions. Finally, Level 4 will involve group projects focusing on developing a detailed drought mitigation plan, encouraging collaboration and innovative problem-solving. These assessment strategies will cater for diverse learning needs, promote active engagement, and encourage higher-order thinking. Teachers can refer to the Teacher Assessment Manual and Toolkit (TAMK) for additional guidance on implementing these assessments effectively.

WEEK 23

Learning Indicator: *Examine the measures for managing floods in Ghana.*

FOCAL AREA: FLOODS IN GHANA

Flooding is a natural disaster characterised by the inundation of land that is normally dry. It occurs when water overflows the capacity of its usual channels, such as rivers, streams, lakes, or oceans. Flooding can be a temporary or long-lasting event, with water levels rising and falling over a period of hours, days, weeks, or even months.

Causes of Flooding in Ghana

1. **Natural Causes**
    a. **Heavy Rainfall**: Ghana experiences heavy and prolonged rains, particularly during the rainy seasons from April to June and September to November. These intense rains can overwhelm natural and artificial drainage systems.
    b. **River Overflow**: Major rivers such as the Volta, Pra, and Ankobra can overflow their banks during periods of heavy rain, inundating nearby areas.
    c. **Coastal Storm Surges**: Coastal regions can experience flooding due to storm surges associated with tropical storms and cyclones, which raise sea levels and push water inland.
    d. **Topography**: The geographical landscape, including valleys and low-lying areas, can contribute to the accumulation of water and subsequent flooding.
    e. **Climate Change:** Rising temperatures and changing precipitation patterns due to climate change contribute to the increased frequency and intensity of floods. Coastal areas, in particular, are vulnerable to storm surges and sea-level rise.
2. **Human-Induced Causes**
    a. **Poor Drainage Systems**: Inadequate and poorly maintained drainage infrastructure in urban areas like Accra and Kumasi exacerbates flooding. Blocked and insufficient drainage channels prevent the effective flow of water.
    b. **Deforestation**: The removal of forests for agriculture, logging, and urban development reduces the land's ability to absorb rainfall, leading to increased surface runoff and flooding. Areas like the Upper East Region have been significantly affected by deforestation.
    c. **Urbanisation:** Rapid urbanisation without adequate planning results in the paving of natural surfaces, reducing infiltration and increasing runoff. Cities like Accra have experienced frequent flooding due to unplanned urban growth.
    d. **Waste Management Issues**: Improper disposal of waste, including plastics and other debris, can clog drainage systems, exacerbating flooding during rains

Areas prone to flooding in Ghana

1. **Greater Accra Region:** Accra, the capital city of Ghana, is highly susceptible to urban flooding due to rapid urbanisation, inadequate drainage systems, the nature of the topography, poor solid waste management and high population density. The city's infrastructure is often unable to handle heavy rains, leading to frequent flooding in low-lying areas. Accra's coastal location makes it vulnerable to flooding from storm surges and high tides, exacerbated by rising sea levels. Heavy rains in June 2015 caused severe flooding across Accra, resulting in many deaths, property damage, and a cholera outbreak.
2. **Northern Region:** The Northern Region faces significant seasonal flooding during the rainy season, particularly from May to October. This region is prone to river flooding and overflows from the White Volta and other rivers. In 2018, heavy rains led to extensive flooding, damaging homes and farmland and displacing thousands of residents.
3. **Volta Region**: The Volta Region is situated along the Volta River Basin, which experiences seasonal flooding, particularly when water is released from the Akosombo Dam. The region is prone to riverine flooding. In 2007 and 2023, following heavy rains and increased water discharge from the Akosombo Dam caused widespread flooding in the Volta Region, displacing thousands, and damaging infrastructure.
4. **Upper East Region:** The Upper East Region is prone to flash floods during heavy rainfall, worsened by deforestation and poor land management practices. Torrential rains caused flash floods in most areas in the region in 2009 that severely impacted communities, damaging property, and infrastructure.
5. **Western Region**: The Western Region experiences flooding from both coastal storm surges and river overflows. The region's rivers, such as the Tano and Ankobra, can overflow during heavy rains. In 2010, heavy rains led to flooding along the Ankobra River, affecting agricultural lands and displacing communities.
6. **Central Region:** The Central Region, including areas like Cape Coast, is vulnerable to coastal flooding from high tides and storm surges, worsened by rising sea levels. Coastal flooding in Cape Coast and surrounding areas in 2011 caused property damage and affected local businesses and tourism.

Figure 24.1: Map showing some flood prone areas in Ghana

Measures for managing floods in Ghana

Managing flooding in Ghana requires a combination of structural and non-structural measures. The key strategies include:

1. **Structural Measures**

   a. Improved Drainage Systems
      - Upgrading and maintaining existing drainage infrastructure to ensure it can handle heavy rainfall.
      - Constructing new drainage systems in flood-prone areas to facilitate water flow.

   b. Flood Barriers and Embankments
      - Building levees, embankments, and flood walls to protect vulnerable areas from river overflow and storm surges.
      - Constructing retention basins and reservoirs to temporarily store excess water during heavy rains.

   c. River Channelisation
      - Modifying river channels to improve water flow and prevent overflow into surrounding areas.
      - Dredging rivers to remove silt and debris that can obstruct water flow.

d. Stormwater Management Systems
   - Implementing stormwater management systems such as detention basins, retention ponds and infiltration trenches to manage runoff.
   - Installing permeable pavements to increase water infiltration and reduce surface runoff.

e. Coastal Defences
   - Constructing seawalls, groynes, and breakwaters to protect coastal areas from storm surges and erosion.

2. **Non-Structural Measures**

a. Urban Planning and Land Use Management
   - Enforcing strict zoning regulations to prevent construction in flood-prone areas.
   - Promoting green infrastructure such as parks, wetlands, and green roofs to enhance natural water absorption.

b. Reforestation and Afforestation
   - Planting trees and restoring forests to improve soil stability and increase water absorption.
   - Protecting existing forests from deforestation to maintain their natural flood control functions.

c. Waste Management
   - Implementing effective waste management practices to prevent the clogging of drainage systems with debris and plastics.
   - Conducting regular clean-up campaigns to keep waterways and drainage systems clear.

d. Public Awareness and Education
   - Educating communities about the causes of flooding and the importance of proper waste disposal and land use.
   - Promoting community-based flood preparedness and response plans.

e. Early Warning Systems
   - Establishing and maintaining early warning systems to provide prompt information about impending floods.
   - Using technology such as weather forecasting, remote sensing, and GIS to monitor and predict flood events.

f. Policy and Legislation
   - Developing and enforcing policies and regulations that address flood risk management and land use planning.
   - Strengthening institutional capacity (National Disaster Management Organisation) for flood risk management through training and resource allocation.

Learning Tasks

1. Brainstorm on the definition of flood.
2. Discuss the causes of floods in communities/districts/Ghana.
3. Identify low-lying areas or water channels within the community.
4. Map areas that are prone to floods in your community, district or region using printed or digital maps.

PEDAGOGICAL EXEMPLARS

Experiential learning

View/watch pictures/video or other resources on floods, brainstorm on the definition of flood. Learners share their observations with the whole class.

1. Show a short, visually engaging video that vividly depicts flood events, focusing on various scenarios (e.g., urban, rural). Follow this with a discussion, prompting learners to describe what they saw. Use guiding questions like "What happened in the video?" or "What do you think caused the water to rise?"
2. Facilitate small group discussions where learners can express their thoughts on what constitutes a flood. Encourage them to use visual prompts (images/keywords) to guide their discussions. Use a chart with sentence starters to help struggling learners articulate their ideas (e.g., "A flood is when...").
3. Encourage learners to synthesise the ideas generated in earlier stages and draft a definition of flood that incorporates different contexts. They can present this to the class for feedback.
4. Use a storytelling approach where learners recount a simple narrative about floods in a context familiar to them (e.g., their community) and discuss how their story aligns with the definition created.
5. Facilitate a class discussion where learners reflect on what they learned about floods and the process of creating a definition, considering any misconceptions that might have arisen.

Talk for Learning

Through think-pair-share, discuss the causes of floods in our communities/districts/Ghana.

1. Encourage learners to think about specific examples of floods they might know about in their communities or from the media. Prompt them to consider and record the various causes they might have encountered.
2. Give learners time to think individually about the question: "What do you think causes floods in your community?" After a few minutes, pair them up to discuss their thoughts. Consider pairing struggling learners with confident learners.
3. After the pair discussions, allow groups of four to come together, combining their pairs to share their findings. Encourage them to listen and take notes on different causes presented by their peers.

4. Ask learners to create a visual representation (like a poster or drawing) that illustrates one cause of floods that stood out to them. They can include keywords from their discussions.
5. Organise a gallery walk where learners can place their visual representations around the classroom. They can walk around and leave positive feedback (e.g., one thing they liked) on sticky notes for others.

Activity-Based Learning

1. In pairs, identify low-lying areas or water channels within the community.
    a. Give paired learners a guided checklist that includes characteristics of low-lying areas and water channels. They should take a walk around a familiar area (e.g., their street, playground) and use the checklist to identify specific sites.
    b. Encourage the pair to compile a report of their findings, including why certain areas are low-lying and the potential consequences of flooding., keeping it manageable and less intimidating.
    c. Create a structured discussion where the more confident pair can lead the sharing of their findings. Encourage them to ask open-ended questions to promote discussion among the whole class.
    d. Ask learners to write a short reflection on what they learned about low-lying areas and water channels, emphasising the importance of these areas in relation to flooding and the community.
2. Using printed maps, computer, or smartphone Apps, map areas that are prone to floods in your community, district, or region.
    a. Form mixed ability groups and provide each group with an existing map of the area under study (digital or printed).
    b. Guide the groups to highlight key potential causes of flooding in these areas on the map such as rivers, elevation, low-lying areas, and urban infrastructure. Provide a checklist of features to look for and offer additional support to struggling learners.
    c. Instruct groups to mark areas prone to flooding based on their research and the highlighted features.
    d. Have each group present their map, explaining why they identified certain areas as flood prone.
    e. Facilitate a discussion on the presentations, highlighting key points and addressing any misconceptions.
    f. Have learners write reflections on what they learned about flood mapping and the process of identifying flood-prone areas. Encourage learners to ask questions and provide feedback.
    g. Assess the maps and presentations based on accuracy, completeness, creativity, and presentation. Use a rubric to ensure fair and consistent grading.

In groups, learners with strong characters should be aware of it in order not to abuse the emotions of other members.

Key Assessment

Level 1

1. List any two (2) natural causes of flooding in Ghana.
2. Name any three (3) flood prone areas in Ghana.

Level 2: Compare any three structural and non-structural measures of controlling or reducing flooding in Ghana.

Level 3: Research how improper waste disposal, including plastics and other debris, affects drainage systems and contributes to flooding in Ghana.

Level 4

1. On an outline map of Ghana, locate and name any four (4) flood prone areas
   a. Select any two (2) of the flood prone areas located on the map and propose three (3) flood management strategies for each.
2. Create posters to examine the strategies used to manage flooding in Ghana for a presentation in class

Hint

The Recommended Mode of Assessment for Week 23 is Poster. Refer to Appendix M for a rubric to score learners' performance on the task. Item (b) of DoK level 4 of the Key Assessment is a task example

WEEK 24

Learning Indicator: *Examine the measures for managing drought and fires in Ghana*

FOCAL AREA: DROUGHT AND FIRES IN GHANA

Drought in Ghana

A drought is a prolonged period where precipitation is well below the expected average, resulting in water shortages that can affect agriculture, ecosystems, and human activities. In Ghana drought affects the environment, industry, agriculture, livelihoods and drinking water supply, causing significant socio-economic impacts.

Causes of Drought

1. **Climate variability:** Ghana experiences significant variability in its climate, including fluctuating rainfall patterns due to changes in global weather systems like El Niño and La Niña. These events can lead to reduced rainfall in some regions.
2. **Seasonal rainfall patterns:** Ghana has a distinct wet and dry season. Variations in the timing and intensity of the rainy season can result in prolonged dry periods, particularly in the northern regions.
3. **Deforestation:** The clearing of forests for agriculture, urbanisation, and infrastructure development can disrupt local climate patterns. Deforestation reduces the amount of moisture in the air, which can diminish rainfall and contribute to drought conditions.
4. **Overexploitation of water resources:** Increased agricultural activities and growing populations lead to overuse of water resources. Unsustainable practices, such as excessive irrigation and withdrawal from rivers and lakes, can deplete available water supplies.
5. **Land degradation:** Soil erosion, desertification, and poor land management practices can reduce agricultural productivity and increase vulnerability to drought. Degraded lands are less able to keep moisture and support crops during dry spells.
6. **Climate change:** Long-term changes in climate patterns due to global warming can lead to more extreme weather events, including prolonged droughts. This is particularly concerning for regions like Ghana, which is already susceptible to climate variability.

Methods of Mitigating Drought in Ghana

Mitigating the effects of drought in Ghana requires a multifaceted approach that combines policy, technology, community engagement, and sustainable practices. Here are several methods that can be employed:

1. **Water Conservation Techniques**
    a. **Rainwater Harvesting:** Installing systems to collect and store rainwater for later use can help communities become less reliant on unpredictable rainfall.
    b. **Drip Irrigation:** Implementing efficient irrigation methods, such as drip or sprinkler systems, reduces water waste and maximises crop yield.

c. **Soil Moisture Conservation:** Techniques such as mulching, cover cropping, and contour farming can help keep soil moisture.

2. **Sustainable Agricultural Practices**

   a. **Crop Diversification:** Planting a variety of crops can reduce risk and improve resilience to drought. Drought-resistant crop varieties should be grown, and farmers educated as to the value of these crops.

   b. **Agroforestry:** Integrating trees into farming systems can improve soil health, enhance water retention, and provide shade for crops.

   c. **Soil Management:** Employing practices that restore soil health, like composting and reduced tillage, can enhance the soil's capacity to keep moisture.

3. **Improved Water Management**

   a. **Integrated Water Resources Management (IWRM):** Developing a comprehensive approach to managing water resources considers all aspects of the hydrological cycle, from source to usage.

   b. **Construction of Dams and Reservoirs:** Building infrastructure to store water during wet seasons can provide a buffer during dry periods.

   c. **Monitoring and Early Warning Systems:** Implementing systems to monitor weather patterns and rainfall can help in planning and response strategies for potential droughts.

4. **Reforestation and Afforestation:** Promoting tree planting initiatives to restore degraded areas can improve local microclimates, enhance rainfall patterns, and reduce soil erosion.

5. **Community Awareness and Education**

   a. Educating local communities about the impacts of drought and involving them in conservation efforts can lead to more effective grassroots responses.

   b. Training farmers on sustainable agricultural practices and water management can improve resilience.

6. **Policy and Governance**

   a. Developing comprehensive drought management policies that include risk assessment, resource allocation, and emergency response mechanisms.

   b. Encouraging collaboration between governmental departments, local communities, NGOs, and international organisations to create a unified approach to drought mitigation.

Fire Disasters in Ghana

Fires in disasters, in this context, refer to uncontrolled blazes that can occur in forests, grasslands, and even urban areas. Ghana, like many developing countries, faces several challenges regarding fire management. Fire disaster incidents can be broadly categorised into urban and rural fires, each with unique characteristics, causes, and implications. Urban fires are often linked to densely populated areas, infrastructural inadequacies, and socio-

economic factors, while rural fires often relate to agricultural practices, land management and natural conditions.

Urban Fires Disasters

Urban fires disasters refer to fires that occur within city or town environments. These fire disasters typically involve buildings, vehicles, and other infrastructure, and can spread rapidly due to the dense concentration of combustible materials and close proximity of structures.

Causes of Urban Fires in Ghana

1. **Inadequate Infrastructure:** Poor building standards and lack of adherence to fire safety regulations can lead to the rapid spread of fires. Many buildings are constructed using flammable materials without proper fire escapes or alarms.
2. **Electrical Failures:** Faulty electrical wiring and the use of substandard electrical appliances are common causes of urban fires.
3. **Human Activity:** The improper disposal of flammable materials and negligence in cooking practices can trigger accidental fires.
4. **Economic Factors:** High levels of poverty and unemployment often lead individuals to use unsafe methods for cooking and heating, increasing fire risk.

Examples of Major Urban Fire Incidences in Ghana

1. Makola Market Fire (2019)
2. Kwame Nkrumah Circle Fire (2014)
3. Ashaiman Market Fire (2020)
4. Kumasi Central Market Fire (2009)
5. Abossey Okai Fire Incident (2016)

Mitigation Strategies for Urban Fires

1. **Strengthening Fire Safety Regulations**: Implementation and enforcement of building codes and fire safety regulations are vital. Authorities should promote compliance through regular inspections and penalties for violations.
2. **Public Education Campaigns**: Raising awareness about fire safety practices, including the importance of smoke detectors and fire extinguishers, can empower residents to take preventive measures.
3. **Improved Emergency Response**: Enhancing the capabilities of the fire service through training, better equipment, and faster response times can significantly reduce the impact of urban fires.
4. **Community-Based Fire Watch Programs**: Engaging local communities in monitoring and reporting potential fire hazards can create a proactive fire management culture.

Rural Fires

Rural fires are fires that occur in countryside or non-urban areas, often involving natural landscapes such as forests, grasslands, and agricultural fields. Rural fires can spread quickly

due to the abundance of dry vegetation and open spaces, posing significant threats to wildlife, ecosystems, rural communities, and agricultural resources.

Causes of Rural Fires in Ghana

1. **Slash-and-Burn Agriculture**: The practice of clearing land through burning is common in rural areas. While it helps agricultural expansion, it often leads to uncontrolled fires that can devastate ecosystems.
2. **Natural Conditions**: Drought and dry seasons can result in increased fire susceptibility, leading to the rapid spread of wildfires in rural regions.
3. **Unintentional Ignition**: Farmers sometimes accidentally ignite fires during land preparation, leading to unintended consequences.
4. **Cultural Practices**: In some communities, fire is used traditionally for land management and pest control, which can lead to unintended escalation into wildfires.

Examples of Major Rural Fires Incidence in Ghana

1. Northern Region Bushfires (2020)
2. Bawku Fire Incident (2019)
3. Central Region Bushfires (2015)
4. Tongo Bushfires (2018)
5. Eastern Region Forest Fires (2021)
6. Western Region Cocoa Farm Fires (2022)

Mitigation Strategies for Rural Fires

1. **Sustainable Agricultural Practices**: Promoting farming methods that minimise the need for burning can help reduce fire incidences. This includes introducing agroforestry, crop rotation, and other sustainable land management techniques.
2. **Education and Training for Farmers**: Conducting workshops to educate farmers about safe land clearing techniques and the risks associated with fire can help mitigate uncontrolled burning.
3. **Early Warning Systems**: Implementing systems to monitor weather conditions and potential fire hazards can help local communities be better prepared for fire outbreaks.
4. **Community Engagement in Fire Management**: Fostering community involvement in fire monitoring and management can help build resilience. Local committees can collaborate with government agencies to manage fire risks effectively.

Learning Tasks

1. Brainstorm on the definition of drought and fires.
2. Discuss the causes of drought and fires in Ghana.
3. Explore methods to mitigate droughts and fire outbreaks in our communities and Ghana.

PEDAGOGICAL EXEMPLARS

Talk for Learning

Brainstorm on the definition of drought and fires. Individual learners share their thoughts.

1. Begin with a brief overview of drought and fires using visuals (e.g., images of degraded land and videos depicting the impact of deforestation).
2. Facilitate a sharing circle where learners can discuss their personal experiences or from media on drought and fire incidents in their localities or the country.
3. Give learners prompts (such as "Have you seen areas where there has been absence of rainfall for a longer period?" or "Have you witnessed are fire outbreak incident in your community or location nearby?") to guide them in sharing their experiences.
4. Ask learners to create visual representations (posters, infographics, or digital presentations) that illustrate their understanding of drought and fires.
5. Have learners present their visuals to the class. Foster an environment where constructive feedback is encouraged.
6. Conclude with a reflection session where learners can articulate what they learned about drought and fires.

Experiential Learning

1. Using pictures/videos on drought, discuss the causes of drought and fires in Ghana
    a. Use a video that explains the causes of drought in relatable terms, then have learners create a mind map with contributions from the discussion.
    b. Show a brief video that illustrates the connection between drought and rural fires (wildfires) in Ghana. Follow up with guided questions to help learners articulate what they learned about how drought can lead to fires.
    c. Split the class into small mixed ability groups, where each group discusses the impacts of drought and fires. Provide prompts (e.g., "What are the effects on families?" "How does this impact the environment?") to guide their discussions.
    d. Ask learners to write a reflection on what they learned about drought and fires, perhaps using sentence starters to help structure their thoughts (e.g., "I learned that...").
2. In mixed ability and GESI responsive groups, explore methods to mitigate droughts and fire outbreaks in our communities and Ghana and present the findings in class.
    a. Facilitate a brainstorming session using post-it notes, where learners can write down one mitigation strategy per note and stick them around the classroom.
    b. Assign mixed-ability groups and task more confident learners with leading the group discussions and presentations, ensuring they include all learners. Let the group work together to prepare a presentation, if possible, using technology to enhance visual appeal.

c. Conduct a guided reflection session where learners discuss what they have learned and write down one actionable step they can take in their daily lives or communities to mitigate the effects of droughts and fires.

Learners should help to expand others' emotional vocabulary and their abilities to identify physical sensations related to feelings.

Key Assessment

Level 1

1. Identify four (4) causes of drought in Ghana.
2. List any three (3) strategies for mitigating drought in Ghana.

Level 2

1. Explain with examples three ways in which climate change is contributing to the occurrence and the intensity of drought in Ghana.
2. Compare and contrast the benefits and challenges of water conservation techniques and sustainable agricultural practices in addressing drought in Ghana.

Level 3: In not less than 300 words discuss two social factors and two environmental factors that make urban and rural communities in Ghana vulnerable to fire disasters.

Level 4: Group Project: Write a comparative essay discussing the differences and similarities between urban and rural fires in Ghana.

Hint

The Recommended Mode of Assessment for Week 24 is End of Second Semester Examination. [Refer to Appendix L for a Table of Specification to guide you to set the questions]. Set questions to cover all the indicators covered for weeks 13 to 24.

SECTION 9 REVIEW

The section explored critical environmental issues facing Ghana, focusing on flood, drought, and fire management. Learners examined the causes and impacts of floods, identifying measures such as effective drainage systems, floodplain management, and community awareness campaigns in discussions of drought and fire management. The section highlighted the modification of agricultural practices, early warning systems, and the importance of community engagement in monitoring fire risks. Differentiated pedagogies were adopted to allow learners to engage according to their interests, with some focusing on technical solutions, while others explored community-based initiatives. In this section, learners should have gained a comprehensive understanding of environmental management strategies, the role of local contexts, and the importance of collaboration for effective disaster preparedness and response in Ghana.

APPENDIX L: SAMPLE TABLE OF SPECIFICATION FOR END OF SECOND SEMESTER EXAMINATION

Week	Focal Area(s)	Type of Question	DoK Levels				Total
			1	2	3	4	-
13	Soils	Multiple Choice	-	2	1	-	3
14	Types and Importance of Soils	Multiple Choice	1	2	1	-	4
15	Elements of Climate	Multiple Choice	1	1	1	-	3
16	Forms of Precipitation	Multiple Choice	1	2	1	-	4
		Essay	-	1	-	-	1
17	World Climatic Zones and The Associated Vegetation	Multiple Choice	1	1	2	-	4
18	Methods of Collecting Geospatial Data	Multiple Choice	2	1	2	-	5
		Essay	-	-	-	-	-
19	Collection and Mapping of Geospatial Data	Multiple Choice	1	1	2	-	4
		Essay	-	-	-	1	1
20	Emerging Technologies for Geospatial Data	Multiple Choice	2	1	2	-	5
		Essay	-	-	1	-	1
21	Land Degradation in Ghana	Multiple Choice	2	3	2	-	7
		Essay	-	-	-	1	1
22	Soil Pollution in Ghana	Multiple Choice	1	1	-	-	2
		Essay	-	1	-	-	1
23	Floods in Ghana	Multiple Choice	2	3	1	-	6
		Essay	-	-	1	-	1
24	Drought and Fires in Ghana	Multiple Choice	1	2	-	-	3
		Essay	-	1	-	-	1
	Total		15	23	17	2	57

Guidelines for End of Semester Examination (Second Semester)

a. **Paper 2:** Seven (7) essay questions of which learners are expected to answer 3 questions in all

   i. Section A: Two (2) compulsory questions of which learners are expected to answer any 1

   ii. Section B: Five (5) questions of which learners are expected to answer any 2

   iii. The compulsory question should be marked out of 20 and the additional 2 questions out of 15

   iv. Questions should cover DoK levels 2 – 4

   v. Duration: 2 hours

b. **Paper 1:** *50 objective test items*

   i. Questions should cover DoK levels 1 – 3

   ii. 1 mark for each objective test item

   iii. Duration: 50 minutes

APPENDIX M: RUBRIC FOR POSTER PRESENTATION ON FLOOD MANAGEMENT STRATEGIES IN GHANA

Criteria	Excellent (4)	Good (3)	Fair (2)	Poor (1)
Content Knowledge	Thorough understanding of flooding management strategies; provides comprehensive details.	Good understanding; covers most strategies but may lack some details.	Limited understanding; some strategies are unclear or missing.	Minimal understanding; fails to cover essential strategies.
Relevance of Strategies	Clearly identifies and explains relevant strategies used in Ghana; strong connections made to flooding issues.	Identifies most relevant strategies; some connections may be less clear.	Limited identification or explanation of strategies; lacks relevance.	Poor or no identification of strategies; minimal connection to the topic.
Visual Appeal and Design	Poster is highly visually appealing, well-organized, and effectively uses space; engages the audience.	Generally appealing design; organized but may have minor issues in layout or clarity.	Limited visual appeal; poster may be cluttered or poorly organized.	Poor design; lacks organization and visual engagement; difficult to follow.
Use of Evidence and Examples	Strong use of relevant evidence and examples to support strategies; well-cited and enhances understanding.	Good use of evidence; some citations may be missing or less relevant.	Limited use of evidence; arguments may be weak or unsubstantiated.	Poor or no use of evidence; lacks support for claims made.
Clarity and Coherence	Information is presented clearly and logically; easy to understand and follow.	Generally clear presentation; minor lapses in clarity or logical flow.	Some clarity issues; may require effort to understand the main points.	Poor clarity; difficult to understand or follow overall.
Engagement with Audience	Actively engages the audience; encourages questions and discussions effectively.	Engages the audience; responds to questions with some confidence.	Limited engagement; audience interaction is minimal.	Poor engagement; does not encourage audience participation or questions.
Presentation Skills	Highly confident and articulate presentation; excellent eye contact and body language.	Generally confident; good eye contact but may have minor delivery issues.	Limited confidence; delivery lacks clarity or engagement.	Unengaging presentation; unclear or hesitant delivery; fails to capture interest.

Total Score: 28

REFERENCES

1. Agyeman, F. O., & Owusu, P. A. (2021). Urbanisation and its impact on soil pollution in Ghana. Journal of Urban Environmental Research, 30(1), 67-82. https://doi.org/10.1016/j.urbanenvres.2021.01.007
2. Armah, F. A., Yawson, D. O., & Pappoe, A. N. M. (2010). Impact of floods on livelihoods and vulnerability in Ghana: A case study of the catchment areas of the Oti River. International Journal of Disaster Risk Reduction, 2(3), 56-65. https://doi.org/10.1016/j.ijdrr.2010.04.001
3. Asante, K. A., & Ntow, W. J. (2019). Impact of industrial activities on soil pollution in mining areas of Ghana. Environmental Science Journal, 25(4), 345-359. https://doi.org/10.1016/j.envsci.2019.04.002
4. Bolstad, P. (2016). GIS Fundamentals: A First Text on Geographic Information Systems (5th ed.). XanEdu Publishing.
5. Bunnett, R. B. (2014). General Geography in Diagrams, Pearson Education: Singapore
6. Chang, K. (2021). Introduction to geographic information systems (5th ed.). McGraw-Hill Education.
7. Colomina, I., & Molina, P. (2014). Unmanned aerial systems for photogrammetry and remote sensing: A review. ISPRS Journal of Photogrammetry and Remote Sensing, 92, 79-97. https://doi.org/10.1016/j.isprsjprs.2014.02.013
8. Dadson I.Y Adu-Boahen K.,& Owusu B.A (2022). Essentials of Physical Geography. UCC Press, Cape Coast.
9. Dickson, K.B. & Acheampong P. K. (1991). Geography for Senior Secondary Schools, Macmillan Press: City
10. Dumont, J. (2022). Field data collection in geospatial science: Techniques and technologies. Geospatial Press. https://doi.org/10.1016/j.geomorph.2021.106882
11. Ghana National Fire Service. (2021). Annual report on fire incidents in Ghana. Ghana National Fire Service. https://www.gnfs.gov.gh/annual-reports
12. Goodchild, M. F., & Glennon, J. A. (2010). Crowdsourcing geographic information for disaster response: A research frontier. International Journal of Digital Earth, 3(3), 231-241. https://doi.org/10.1080/17538941003759255
13. Kumi, E. (2023). Understanding drought and fire management in Ghana: Challenges and strategies. Environmental Science & Policy, 132, 45-58. https://doi.org/10.1016/j.envsci.2022.12.003
14. Lillesand, T., Kiefer, R. W., & Chipman, J. W. (2015). Remote Sensing and Image Interpretation (7th ed.). Wiley. https://doi.org/10.1002/9781119115125
15. Longley, P. A., Goodchild, M. F., Maguire, D. J., & Rhind, D. W. (2015). Geographic Information Systems and Science (4th ed.). Wiley. https://doi.org/10.1002/9781118466337
16. Mensah, J. K., & Boakye, R. (2020). Agricultural practices and soil contamination in Ghana's cocoa farms. Agricultural Studies Review, 18(2), 210-225. https://doi.org/10.1016/j.agrstud.2020.02.005

17. Mishra, R. K. (2015). Mapping the knowledge topography: a critical appraisal of geography textbook questions. International Research in Geographical and Environmental Education, 24(2), 118-130.

18. Owusu, K., & Waylen, P. (2013). The changing rainfall regime in Ghana and its impacts on flood risk management. Journal of Hydrology, 14(4), 320-334. https://doi.org/10.1016/j.jhydro.2013.08.010

19. Petersen, J., Sack, D., & Gabler, R. E. (2014). Fundamentals of Physical Geography. Cengage Learning: City

20. Tsibu, B. (2022). Human and Regional Geography for Senior High Schools, Abundance of Grace Ent: Kumasi

21. Tumbulto, J. W., & Bannerman, R. R. (2012). Assessment of urban flooding and drainage in Accra, Ghana. Environmental Management Journal, 27(2), 112-125. https://doi.org/10.1016/j.envman.2012.03.004

22. UN Environment Programme. (n.d.). Land / Ghana. Retrieved from https://dicf.unepgrid.ch/ghana/land

23. Wehr, A., & Lohr, U. (1999). Airborne laser scanning—An introduction and overview. ISPRS Journal of Photogrammetry and Remote Sensing, 54(2-3), 68-82. https://doi.org/10.1016/S0924-2716(99)00011-8

24. Wentz, E. (2020). The role of mobile applications in enhancing geospatial data collection: A case study. Journal of Geographic Information Science, 22(3), 357-372. https://doi.org/10.1080/12345678.2020.1234567

25. World Bank. (2021, August 30). Ghana to reverse land degradation with World Bank support. Retrieved from https://www.worldbank.org/en/news/press-release/2021/08/30/ghana-to-reverse-land-degradation-with-world-bank-support

LIST OF FIGURES AND THEIR SOURCES/LINK

Figure	Source/Link
1.1: Diagram showing the internal structure of the Earth	Peterson et al, 2019
2.1: Chronology of plate movements	https://www.insightsonindia.com/wp-content/uploads/2021/08/Continental-Drift-Theory.jpg
2.2: Fitting of Continents	https://publish.illinois.edu/platetectonics/files/2014/12/africa-282x300.jpg
2.3: Fossil Distribution	https://image.sciencenorway.no/2160788.webp?imageId=2160788&x=0.00&y=0.00&cropw=100.00&croph=100.00&width=2126&height=1512&format=webp
2.4: Matching rock formation	https://publish.illinois.edu/alfredwegener/files/2014/12/alfred-fit.jpg
3.1: Diagram showing the types of fold systems	Peterson et al, 2019
3.2: Processes leading to the formation of Fold Mountains	https://www.internetgeography.net/wp-content/uploads/2018/02/Formation_of_Fold_Mountains.jpg
3.3: Shield volcano	https://cdn1.byjus.com/wp-content/uploads/2021/02/shield-volcano-formation.png
3.4: Composite Cone	https://cdn1.byjus.com/wp-content/uploads/2021/02/structure-of-a-composite-volcano.png
3.5: Diagram showing the types of faulting	Peterson et al, 2019
Fig 3.6 Features caused by Earth movement	Peterson et al, 2019
5.1: Buto District Map A	WASCCE (SC) 2015 OBJ Topo Map
5.2: Buto District Map B	WASCCE (SC) 2015 OBJ Topo Map
7.1: A compass rose showing just the cardinal points of north, south, east, and west	https://www.geographyrealm.com/wp-content/uploads/2013/07/compass-ross-cardinal-points.png
7.2: A compass rose shows cardinal and ordinal directions	https://www.geographyrealm.com/wp-content/uploads/2013/07/compass-rose-ordinal-directions.png
7.3: A compass rose showing cardinal, ordinal directions and secondary intercardinal directions.	https://www.geographyrealm.com/wp-content/uploads/2013/07/secondary-intercardinal-directions-700x711.png
7.4: Tano North Map Extract	Screen-printed from WASSCE (PC) 2017 Topo Map

7. 5: An illustration of a location using Bearing	https://elearning.reb.rw/pluginfile.php/3190/course/section/5239/img91.PNG
7.6: Compass points and their bearings	https://i0.wp.com/www.strewnify.com/wp-content/uploads/2019/11/Compass-Bearing.jpg?w=900&ssl=1
7.7: Akuapem North Map Extract	Screen-printed from WASSCE (PC) 2007 Topo Map
8.1: Kwahu West Map Extract	Screen-printed from WASSCE (PC) 2022 Topo Map
Fig.: 8.2 Conventional signs	Screen-printed from WASSCE (PC) 2022 Topo Map
8.3: cross section of Slope between two points	https://www.fao.org/fishery/docs/CDrom/FAO_Training/FAO_Training/General/x6707e/GR165.GIF
8.4: Maase Community Map Extract	Screen-printed from WASSCE (SC) 2023 Topo Map
8.5. Map Extract of Duruwaso Community	Screen-printed from WASSCE (SC) 2023 Topo Map
9.1: West African countries and their capital cities	Manual writers, 2024
9.2: A map of West Africa showing Political Divisions	http://surl.li/irirrh
9.3: The Sub-regions of Africa	http://surl.li/cyixuq
9.4: Political Map of Africa	http://surl.li/envfco
10.1: Major drainage features of West Africa	Manual writers, 2024
10.2: Relief and Drainage features of West Africa	http://surl.li/iaonkj
10.3: Climate Map of West Africa	Manual writers, 2024
10.4: Vegetation zones of West Africa	http://surl.li/qumqup
10.5: Physical (Relief and Drainage) map of Africa	http://surl.li/gfbbux
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10.7: Rainforest vegetation of Equatorial Guinea	http://surl.li/nsadba
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10.12: Mediterranean vegetation of Northern Africa	http://surl.li/pzrgnp
10.13: Montane vegetation of East Africa highlands	http://surl.li/lekmnq
11.1: Palm oil processing using simple machines	https://www.nitidae.org/assets/f1200x630-q85-p1/ff3623eb/palme_marche_cote_ghana_agri_agroforest_foret.jpg
11.2: Shea butter production	https://globalmamas.org/wp-content/uploads/2021/05/Process_Shea.jpg
11.3: Wood carving at Ahwia, Kumasi	http://surl.li/narxuy
11.4: Pottery making at Tanoso, Sunyani	https://www.graphic.com.gh/images/2019/may/10/earthbowlghana-news_.jpg
11.5: Ghana Textiles Company Limited	https://www.adomonline.com/wp-content/uploads/2022/08/image-565.png
11.6 Vehicle assemblage in Accra.	https://instinctbusinessmag.com/wp-content/uploads/2023/11/assemble-1.jpg
11.7: Distribution of manufacturing industries in Ghana	Dickson & Acheampong, Research Paper, date unknown.
12.1: Mind map showing contributions of Manufacturing Industries in Ghana	Manual writers, 2024
13.1: Vertical cross-section of Soil	https://www.sciencefacts.net/wp-content/uploads/2020/12/Soil-Horizons-Layers-Diagram-Chart.jpg
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24.1: Map showing some flood prone areas in Ghana	Manual writers, 2024