

SECTION

1 Biophysical interactions



Geography is the study of earth's surface features and related human activity. Studying geography helps us make sense of our place in a rapidly changing world and engage with issues such as climate change, the management of scarce water resources, the challenges facing our great cities, global inequalities and political instability. It gives us the knowledge and understanding—as well as the language, skills and techniques—to grapple with the major issues as humans place ever-greater demands on the earth and its systems.

Geography studies real people in real places, and in doing so it shows how daily lives are shaped by local circumstances—not only the physical characteristics of place, but also the social, cultural, economic and political opportunities and constraints that exist. Geography seeks to understand each local place in a regional, national, international and global context.

Geography is a practical subject. It teaches skills needed in school, at home and in the workplace. Through geography, students learn about map use, data analysis and problem solving. They find out how to work alone and in a team. By undertaking fieldwork, they gain experience working directly in the real world. Students of geography also develop an appreciation of social and environmental responsibility.

Outcomes

Students:

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|----------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------|
| P1 differentiate between spatial and ecological dimensions in the study of geography | P8 select, organise and analyse relevant geographical information from a variety of sources |
| P2 describe the interactions between the four components which define the biophysical environment | P9 use maps, graphs and statistics, photographs and fieldwork to conduct geographical inquiries |
| P3 explain how a specific environment functions in terms of biophysical factors | P10 apply mathematical ideas and techniques to analyse geographical data |
| P6 identify the vocational relevance of a geographical perspective | P12 communicate geographical information, ideas and issues using appropriate written and/or oral, cartographic and graphic forms |
| P7 formulate a plan for active geographical inquiry | |

Overview

This section focuses on a geographical investigation of biophysical processes and how an understanding of these processes contributes to sustainable management.

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|------------------|-------------------------------------------|
| Chapter 1 | Biophysical interactions: an introduction |
| Chapter 2 | The atmosphere |
| Chapter 3 | The hydrosphere |
| Chapter 4 | The lithosphere |
| Chapter 5 | The biosphere |
| Chapter 6 | Coastal environments and management |
| Chapter 7 | Catchments and river regulation |



Biophysical interactions: an introduction

Throughout the relatively short period of time that humans have occupied the planet, they have admired, and tried to understand, the natural wonders that surround them. However, the more knowledge we gain of the planet, the more we realise how much more remains to be learnt. Thirty years ago it was thought that there were only about 3 million species of living things on earth; recent sampling has pushed this estimate up to 30 million, a figure that may yet prove to be conservative. This uncertainty demonstrates just how poorly we understand the complexity of the earth's biophysical systems.

Geographers have a special role to play in investigations of the planet. They study all the phenomena that make up the biophysical environment, not as poets or artists but as scientists. Yet, where science fundamentally specialises, geography analyses the earth as a whole and seeks to understand the connections and interrelationships that exist.

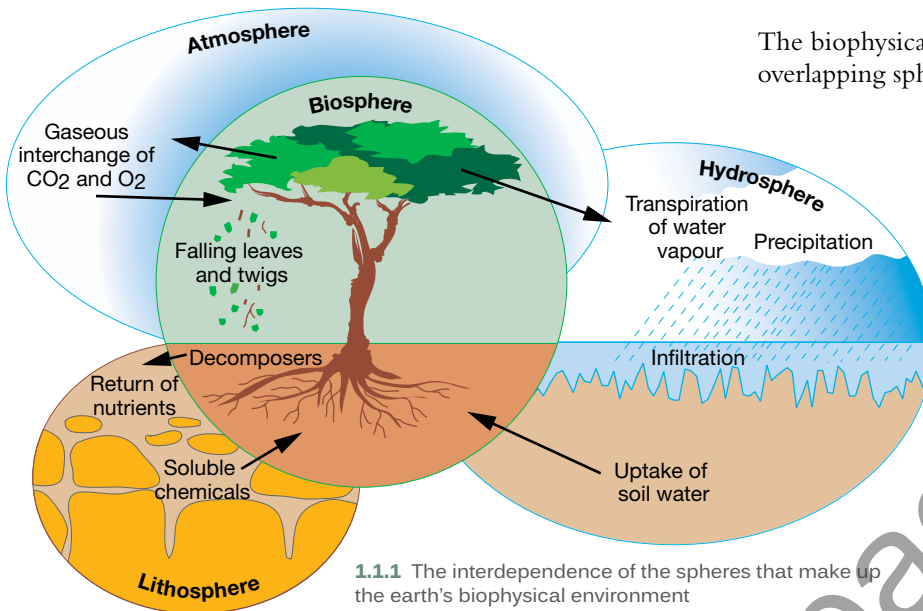
**Economic advance
is not the same as
human progress.**

John Clapman, English economist



UNIT 1.1

The components of the biophysical environment



1.1.1 The interdependence of the spheres that make up the earth's biophysical environment

The biophysical environment of the earth consists of four overlapping spheres, as shown in Figure 1.1.1:

- the atmosphere—the combination of gases and particles enveloping the globe
- the lithosphere—the earth's solid outer shell
- the hydrosphere—the interconnecting system of water in the atmosphere and lithosphere
- the biosphere—the earth's surface zone and its adjacent atmosphere in which all organic life exists.

Each sphere plays a vital role in sustaining life on earth. Most of the life on this planet exists in a thin film of air, water and rocks in a zone extending from about 61 metres below the earth's surface to about 61 000 metres above sea level.

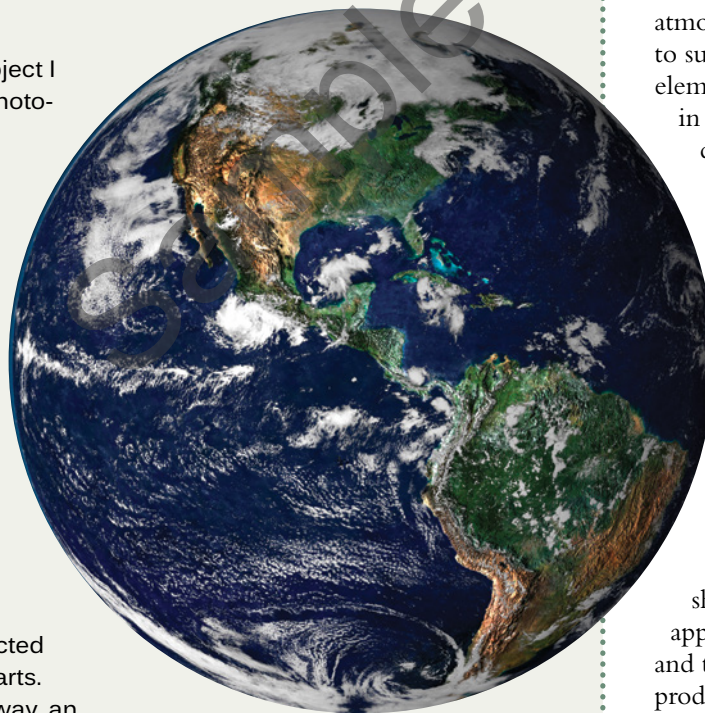
No other planets in the solar system have these four constituent parts. Some have no atmosphere, or are too hot or too cold to support life. Planet earth has all the elements necessary to support life, as seen in Figure 1.1.2. This life is amazingly diverse. Any geographical investigation of life reinforces the importance of the interaction between the spheres that constitute the biophysical environment. Such interactions are apparent at both a local and a global level.

A living organism

By Robert Lewis

The most beautiful object I have ever seen in a photograph, in all my life, is the planet earth seen from the distance of the moon, hanging there in space, obviously alive. Although it seems at first glance to be made up of innumerable separate species of living things, on closer examination every one of its working parts, including us, is independently connected to all other working parts. It is, to put it another way, an organism. It came alive, I shall guess, 3.8 million years ago today, and I wish it a happy birthday and a long life ahead, for our children and their grandchildren and theirs and theirs.

Robert Lewis, quoted in Norman Myers, *The Gaia Atlas of Planet Management*, Doubleday



1.1.2 The earth viewed from space

Interactions between the spheres

A study of the different aspects of the biophysical environment, as shown in Figure 1.1.3, leads to an appreciation of how the spheres interact and the many factors involved that produce recognisable patterns and features. Understanding the interactions between the spheres is necessary when attempting to improve our coexistence with nature, which is so important to our continued occupation of this planet.

Geographers are keen observers. When confronted with problems concerning the biophysical environment, they find it valuable to assess the relative importance of the processes involved. This inevitably leads to the interaction between the spheres.

The human element is only one part of the biosphere, but it is clearly apparent that the impact of humans on the biophysical environment must be recognised. Our studies will extend to the loss of flora and fauna on a global scale. The magnitude of this impact is increasing in proportion to technological development and population size.

Interactions on a local scale

Figure 1.1.4 illustrates the place of the tree within the biosphere and its interdependence with the other spheres. The imminent death of the tree in the image can be attributed to the loss of soil from around its root area. Soil contains the nutrients that are basic to the tree's survival. Further investigation at this site reveals that soil loss is due to the overexploitation of the land.

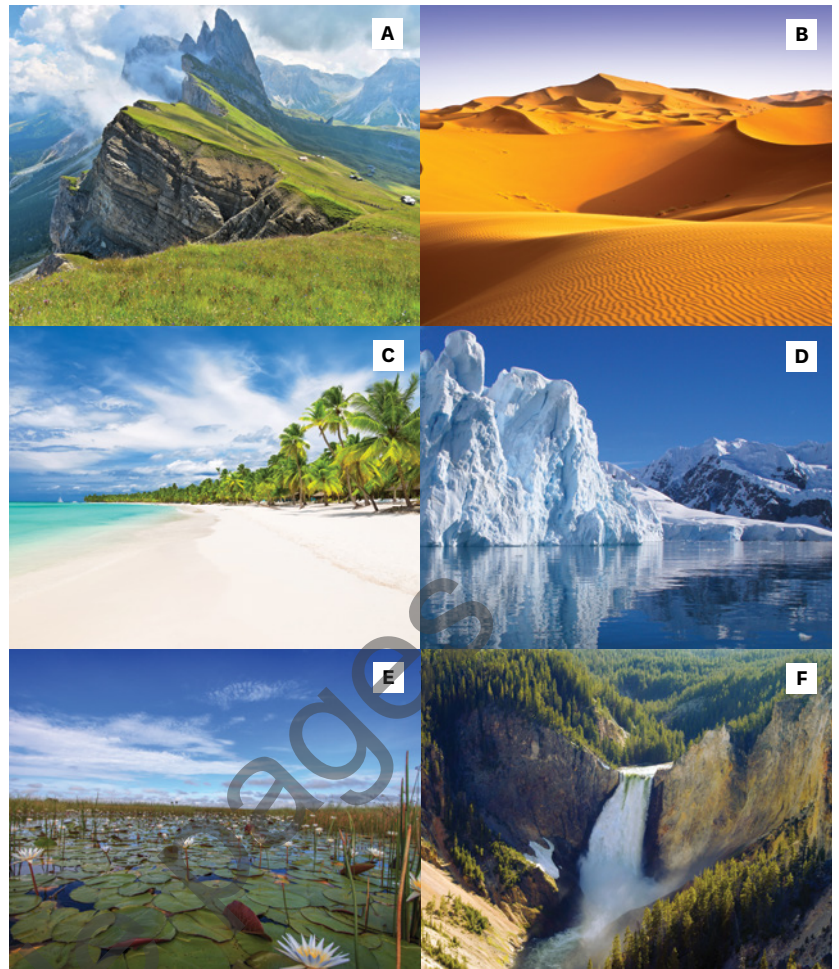
Ongoing decline in the health of trees at the site will result in associated changes in all the spheres, including the following:

- lithosphere—lower organic content within the soil; exposed soil that is subject to removal by wind and water erosion
- hydrosphere—reduced infiltration of water into the soil; increased surface run-off
- atmosphere—less water vapour gained from transpiration; altered microclimate, including less shade, higher temperatures and higher rates of evaporation
- biosphere—loss of habitat for native animals.

Problems such as those at the site do not occur in isolation. Change over time can have far-reaching consequences on many aspects of the biophysical environment.

Land degradation arises because some humans perceive that the resources of the biophysical environment can be readily exploited. They give little consideration to the environmental impact of such activities. The original inhabitants of Australia perceived their environment very differently. They managed the land carefully for tens of thousands of years in ways that meant it could continue to sustain life for them. Indigenous Australians would have appreciated the richness of life on offer in the area.

The dying tree is symbolic of how modern Australians have misused the resources available to them. We are now confronted with the task of trying, in some human-modified environments, to recreate nature, because what we have created in its place is unsustainable.



1.1.3 The varied landscapes of the earth: **A** the Italian Alps, **B** Moroccan Desert, **C** Soan Island in the Caribbean, **D** Antarctica, **E** the Okavango Delta, **F** Yellowstone National Park



1.1.4 The tree in the foreground will soon die because of the soil erosion around its roots.

Human impacts, global dimensions

In the relentless human colonisation of every corner of this planet, from the Arctic to the Antarctic, we are witnessing the end, indeed the death, of natural environments. The water we drink, the air we breathe, the food we eat, are all modified by human activity. Our activities, and the seemingly inevitable degradations of the earth, have meant, in effect, the death of the natural world. We are seeing a trans-formation from a naturally 'managed' world to a managed 'natural' world.

B.W. Boer, 'Living sustainably', The Architecture Show

The earth should no longer be seen in terms of isolated environments. Each environment is part of an interacting global environment, on which humans are having an increasing impact.

Human impacts on the biophysical environment have not only occurred relatively recently; for tens of thousands of years groups of indigenous people behaved in ways that often transformed ecosystems and led to the extinction of species. Such impacts were usually followed by long periods of environmental and ecological stability. During these times the elements of the biophysical environment adjusted to the human impacts. Many societies ultimately managed to live in harmony with nature. They utilised the land, marine environments and plants and animals in ways that did not greatly disturb the fragile ecological balance.

More recently, the Industrial Revolution and related technological advances have greatly intensified human impacts on the environment. Contemporary industrial societies have exploited the biophysical environment with little regard for its ecological limits. They have done so motivated by the pursuit of material wealth, consumption and economic development.

Humans have the ability to overcome the problems caused by the exploitation of the environment. We have the capacity to better manage and protect the global ecosystem and bring about a more prosperous future for all. This can be achieved not as individual countries working on their own but together, in a global partnership for sustainable development.



1.1.5 Despite their bad reputation for living off carcasses, vultures are a very hygienic species. Their head and neck are featherless to prevent any bacteria from the carrion they eat ruining their feathers. The sun then sterilises the exposed skin.

Vultures: ecosystem guardians

Vultures are scavengers. They swarm over dying animal carcasses (see Figure 1.1.5) and are a vital part of an ecosystem. Vultures are intelligent birds with a keen sense of smell that enables them to locate food. The acid in their stomach is extremely corrosive and this enables them to feed on carcasses infected with diseases such as anthrax, cholera, botulinum toxin and rabies that would be deadly to other animals.

SPOTLIGHT

A strong-beaked bird named after Barack Obama

The World Wide Fund for Nature's Living Amazon Initiative has discovered nearly 381 new species in the Amazon.

The new species include: a fire-tailed titi monkey, a pink river dolphin and the little puffbird seen in Figure 1.1.6.

The puffbird or the western striolated-puffbird (*Nystalus obamai*) has been named in tribute of the former US President Barack Obama. The bird has a strong beak and well-defined eyes. Its habitat includes the upland forests and the protected areas in Peru, Brazil and Ecuador. When hunting for food it can sit patiently for over an hour before launching a sudden strike to catch its prey.



1.1.6 The western striolated-puffbird, *Nystalus obamai*, was discovered in the Amazon in 2017.

Vultures have an important role in disposing of rotting carcasses that can spread diseases, which is not often recognised. As a result of intentional and unintentional human activity, vultures are being pushed to extinction around the world. The use of the painkiller Diclofenac in India and Nepal by humans and in the livestock industry has caused thousands of vulture deaths. Meanwhile in Namibia and Kenya, farmers use Carbofuran, an extremely toxic pesticide, to target lions with the aim of protecting people and livestock. The pesticide causes animals to die painfully, and animals that ingest the pesticide then pass it on to the vultures.

Sustainable development

Sustainable development is achieved by enabling people's economic and social wellbeing (their quality of life) while also maintaining and protecting the quality of the biophysical environment.

The principles that guide sustainable development include a recognition that:

- improvements in healthcare, education and social wellbeing are necessary to reduce birth rates in developing countries and stabilise world population
- the earth's renewable resources should only be used in a way that does not reduce their usefulness for future generations
- decisions made today should not damage the prospects for maintaining or improving future living standards
- people should be involved in decisions that affect their lives
- priority should be given to the development of new technologies that are cleaner, more energy-efficient and use fewer natural resources
- steps should be taken to prevent further degradation of the land and biophysical resources
- the benefits of economic growth should be more evenly distributed
- sustainable development and good environmental management go hand in hand.

Activities

Understanding the text

- 1 Explain how the role of geographers differs from that of scientists.
- 2 Identify the four components of the biophysical environment. Give a brief description of each.
- 3 Explain where most life on earth occurs.
- 4 State two factors that have increased the magnitude of human impact on the biophysical environment.
- 5 Outline, in brief, the nature of the relationship that many indigenous people have with the biophysical environment.
- 6 Explain what has motivated contemporary industrial societies to exploit the biophysical environment.
- 7 Define the term sustainable development. What are its guiding principles?

Working geographically

- 8 Divide into four groups. Each group is to select one of the four components of the biophysical environment and then brainstorm the following:
 - a the ways in which the selected component affects the activities of people
 - b the ways in which the activities of people have affected the selected component.
 Record the main points raised in your group's discussion on a large sheet of paper. Share your group's findings with the rest of the class.
- 9 Investigate the discovery of a new species. Prepare a media release detailing the attributes of the new species, its habitat, threats to its survival or actions undertaken to protect it.

Glossary

atmosphere the blanket of air surrounding earth

biosphere the living part of the planet that consists of a thin layer extending from just above the earth's surface to just below it; the combined ecosystems of the earth

hydrosphere the part of the earth that is composed of water, including clouds, oceans, seas, ice caps, glaciers, lakes, rivers, underground water supplies and atmospheric water vapour

lithosphere the upper zone of the earth's mantle and its inorganic mixture of rocks and mineral matter (including soil) in the earth's crust

sustainable development development that meets the needs and aspirations of the present generation without compromising the capacity of future generations to satisfy their needs and aspirations