**Chapter 1**

**Physical Geography: Earth Environments and Systems**

**Chapter Objectives**

This chapter should enable your students to…

* 1.1 Explain why physical geography examines both the natural world and human interaction with the natural world.
* 1.2 Discuss important ways in which geographic information and techniques are useful in different careers.
* 1.3 Describe the three major perspectives of physical geography: spatial science, physical science, and environmental science.
* 1.4 Think of the Earth as a system of interacting parts that respond to both natural processes and human actions.
* 1.5 Illustrate with examples how some interactions between people and their environment are advantageous, whereas others are detrimental or hazardous.
* 1.6 Summarize how knowledge of physical geography contributes to a better understanding of the environment.
* 1.7 Recognize that every physical environment offers an array of advantages and challenges to human life and living conditions.
* 1.8 Explain how physical geography is relevant to your everyday life.

**Chapter Outline**

**I. Chapter Preview**

**II. The Study of Geography**

**III. Physical Geography**

**IV. Geographic Tools and Technology**

**V. Major Perspectives in Physical Geography**

A. Spatial Science Perspective

1. Location

2. Characteristics of Places

3. Spatial Distribution and Pattern

4. Spatial Interaction

5. Change over Space and Time

B. Physical Science Perspective

1. Earth as a System

2. Earth’s Four Major Subsystems

3. Earth System Dynamics

C. Environmental Science Perspective

1. Ecosystems

2. Human-Environment Interactions

3. Environmental Sustainability

**VI. Using Models and Systems**

A. Systems Analysis

B. Open and Closed Systems

C. Equilibrium in Earth Systems

**VII. Physical Geography and You**

**Chapter Summary**

* Physical geography is a major part of the field of geography, which is the study of all aspects of Earth in its role as the home of people. Geography as a whole includes the examination, description, and explanation of culture as well as natural physical variables on Earth.
* Geographers take a holistic approach to problem solving, meaning that they are open to all factors that might be involved in the solution, including human ones. Being concerned with nearly all aspects of Earth, physical geographers are trained to view a natural environment and consider how it functions in its entirety.
* Maps are essential components of geography. Maps function as source of geographic data, tools to aid in the analysis and interpretation of geographic data, and means for displaying results of geographic studies. Geographers use satellite-based GPS (Global Positioning System) technology to determine the precise location of points on Earth’s surface, and digital technologies for mapmaking (cartography) and for conducting many aspects of map analysis.
* Physical geographers use the scientific method to guide their learning about the processes and features on Earth. The scientific method entails developing valid explanations about the issue being studied by objectively testing hypotheses and analyzing all pertinent evidence and facts. Since physical geography uses the scientific method to study variations over space, it is a spatial science.
* Physical geographers study Earth’s principle subsystems – the atmosphere, lithosphere, biosphere, and hydrosphere - and many specialize in identifying and reducing environmental degradation and pollution. Geographers often employ models to give them information about a particular system. Many types of model exist – including pictorial and graphic models, mathematical and statistical models, computer-generated models, and conceptual models.

**Lecture Suggestions**

* Use a Google Earth map of the area where your academic institution is located. Discuss the physical geography characteristics that may have led to the location of towns and industry in your area.
* Compare similarities between two areas of the same type in the world. For example, compare deserts in the southwestern United States to those in Asia or Africa. Ask students for suggestions regarding how to plan a scientific experiment that is capable of capturing the similarities and differences between these two areas.
* Using Figure 1.7, discuss how changes in the night-time environment may impact the biosphere for nocturnal animals.
* Using Figure 1.10, postulate how pollution and population changes may impact each of the cycles shown in the Figure on a local, regional, and global scale.
* Ask students for suggestions regarding how to sustain the environment in your area.
* Look at NASA’s Climate in a Box <https://modelingguru.nasa.gov/community/middleware/climateinabox> as an example of how models can be used for examining changes in Earth’s climate system.
* Visit <http://www.udel.edu/FREC/spatlab/anim/animate.html> to show students examples of how models are used in geography.

**Key Terms**

physical geography

geography

spatial discipline

human geography

region

cartography

scientific method

absolute location

relative location

spatial distribution

spatial pattern

spatial interaction

system

Earth system

subsystem

atmosphere

lithosphere

biosphere

hydrosphere

environment

ecology

ecosystem

natural hazard

environmental degradation

pollution

natural resource

environmental overshoot

environmental sustainability

model

pictorial/graphic model

physical model

mathematical/statistical model

computer-generated model

visualization

conceptual model

mental map

systems analysis

input

output

open system

closed system

equilibrium

dynamic equilibrium

feedback

negative feedback

positive feedback

threshold

feedback loop

**Answers to Questions for Review**

1. Some of the subfields of physical geography include meteorology, climatology, geomorphology, biogeography, oceanography, hydrology, glaciology, and pedology. Meteorologists study the daily weather and in forecasting weather. Climatologists study regional climates, the averages and extremes of weather data, climate change, and climate hazards. Geomorphologists are interested in understanding and explaining variations in landforms and landscapes, as well as the processes involved, and the nature of Earth’s surface features. Biogeographers examine the geographic ranges and patterns of vegetation and animal species. Pedologists study soils. Oceanographers, hydrologists, and glaciologists study the oceans, water, and glaciers, respectively.
2. Geography’s focus is spatial—understanding where things are, their spatial distributions, and their patterns. For example, geographers may ask: Why are deserts located where they are? Where do tornadoes occur most frequently in the U.S.? Why do cold ocean currents flow along west coasts in the middle latitudes? Why do active volcanoes and earthquakes tend to occur in certain regions, but not in others? Why is the vegetation on a south-facing hillside different from the vegetation on a north-facing hillside? The three major perspectives of geography – spatial science, physical science, and environmental science – allow geographers to gain a holistic view of systems.
3. Holistic means giving consideration to all relevant aspects (natural- and human-influenced) that affect an environmental concern (e.g., weather, climate, soils, landforms, water bodies, biota, human activities).
4. The four major divisions of the Earth system are the Atmosphere, the Biosphere, the Hydrosphere, and the Lithosphere. Many examples of overlap exist among Earth’s systems. M.A. For example: The content of water in the atmosphere often depends on evapotranspiration (the release of water to the atmosphere by plants). The soils of the lithosphere can be favorable for the growth of certain plants while not favorable for others. Humans, which are part of the biosphere, build structures that change the flow of water and the habitat of animals.
5. Understanding physical attributes and processes and how they interact to impact environmental systems supports the scientific method, and helps develop answers to questions (hypotheses) in the physical sciences.
6. Geographers have long been interested in how humans affect their environments and how they adapt to their environments. Environmental science involves studying and understanding these interactions.
7. Open systems allow inputs and outputs across their boundaries, whereas closed systems do not. Most of Earth’s subsystems (atmosphere, lithosphere, etc.) are open to both energy and matter, but Earth as a whole can be viewed as a closed system because the amount of matter entering and leaving Earth is so small that it has little impact on Earth’s systems.
8. A threshold is a condition that causes systems to change dramatically. For example, earthquakes will not occur until the built-up stress reaches a threshold level that overcomes the strength of the rocks to resist breaking. Fertilizing a plant will help it grow larger and faster, but if too much is added a threshold is reached and may poison the plant.
9. A negative feedback tends to regulate, offset, or minimize changes in a system in order to maintain equilibrium. An example of a negative feedback is when an increase in a deer population depletes the deer food supply, which leads to a decrease in population back toward the original number of deer.

**Answers to Consider and Respond Questions**

**M.A. = Many answers possible**

1. M.A., depends on the geography of the local area.
2. M.A., depends on the geography of the local area.
3. M.A., depends on the geography of the local area.
4. Advantages and disadvantages for geographers are the same as for other scientists. Chief advantages include: 1) the ability to focus on a specific problem or subsystem and 2) to quantify the behavior, processes, and impacts of each system variable on other variables and on the system as a whole. Chief disadvantages include: 1) difficulty in constructing an accurate model for the area studied, and 2) obtaining results that may skew or distort interpretations for actual patterns and processes.
5. M.A., depends on the interests of the person. Faculty at the student’s school can help with suggestions about geography-related employment and the courses that will help to prepare the student for a career in geography. Having a spatial outlook, skill at spatial analysis, and knowledge of mapping are advantageous skills in many career fields. Many jobs, even those not directly related to geography, require some skills in geospatial techniques, such as geographical information systems (GIS). Direct students to the Association of American Geographers website [www.AAG.org](http://www.AAG.org). On that site there is a section on careers and jobs in geography.

**Answers to Practical Applications Questions**

**M.A. = Many answers possible**

1. Students’ mental maps of their home environments will vary greatly. This is an exercise in their ability to spatially visualize and diagram/map their home environment.
2. M. A. Students should follow the example in Fig. 1.23 on page 22 and substitute some other process (deer numbers and food supply, for example).

**Answers to Figure-Legend Questions**

**M.A. = Many answers possible**

Figure 1.1 M.A. The geographer is at the center of problems that develop at any location and her/his knowledge of, and relationship to, other sciences makes him/her a good choice for coordinating cross disciplinary work and engaging scientists in a variety of disciplines.

Figure 1.2 M.A. Examples: cold and snow in the higher elevations, steep mountains, vegetation changes, rock structures, landforms, soils, climate, cloud patterns, and potential human impacts.

Figure 1.6 M. A. Examples: Natural and human patterns can be seen on the landscape. Human settlement is largely found at lower elevations.

Figure 1.7 Distributions: More lights (population near the coasts). Higher populations in the east as compared to the west. Patterns: Regular, block-like arrangement of lights in the Midwest in large cities, and outlines of coastal areas can be seen.

Figure 1.9 M.A. Examples: changes in sea level, changes in the glacier size, changes in vegetation in response to climate change and global warming, and changes in permafrost depth or average temperature.

Figure 1.10 Various aspects of an ecosystem are linked with each, providing the necessary components for life to other members of the ecosystem. For example, rain falls, plants grow, animals eat the plants (primary consumer), a secondary consumer (e.g., fox) eats the primary consumer, and soils develop through decomposition.

Figure 1.11 Weathering by rain and wind will begin to erode the rock. Soils will form. Birds and insects may begin to visit the island, bringing seeds for plants and fungi. Plants will begin to grow. Soil will continue changing, now due to biology and weathering.

Figure 1.12 Animals derive nutrients for growth from the plant portion of the biosphere. Primary and secondary consumers consume primary producers through the food chain. The ultimate source of energy is derived from the Sun, when plants interact with soils and water in the lithosphere and hydrosphere, respectively, and carbon dioxide in the atmosphere to gain energy for photosynthesis.

Figure 1.13 Suitable living space is a limited resource. Currently, to sustain a large population, significant amounts of land are being devoted to agricultural production. Potential areas for settlement include areas that are currently forested, grassy areas, deserts, and tundra regions. In some future scenarios, underwater settlements have also been proposed.

Figure 1.16 Water supplies, the return of wildlife, the restoration of ecosystems, and the expansion of recreational opportunities should be considered. All of these options should be balanced against the cost of the project, the economic loss of farmland and pasture, and the threat of renewed flooding.

Figure 1.19 The human body has individual systems that all have a specific function (e.g. heart, lungs, kidneys), yet all work together to make us function as a person. Just like the human body, the systems on Earth – for example, the oceans, the atmosphere, the biosphere – have specific functions that allow the system to function as a whole.

Figure 1.20 M.A. Examples could be sunlight that comes into Earth’s atmosphere and that either gets reflected by clouds or absorbed by Earth’s surface, generating plant growth and changes in weather systems. A forest that gains energy from the Sun, grows, and then decays. Soils that break down from parent rock, etc.

Figure 1.21 M.A. Examples could include a pond that receives water from rain and streams and that loses water due to evaporation and stream outflow; a forest that receives rainwater and that loses water through hydrological flow and soil from erosion; or a desert that loses sand due to wind erosion and a loss of plant matter.

Figure 1.23 M.A. A potential alternative from not curtailing the release of CFCs in the atmosphere could have been total destruction of the stratospheric ozone layer. Such a scenario would have led to additional UV at Earth’s surface, more skin cancer, and devastating consequences for plant and animal life.

Figure 1.24 M.A. A background in spatial concepts can be beneficial for both science and business. Scientists and government planners need spatial information to outline potential future impacts of decisions on landscapes, water systems, and human and animal populations. Businesses need spatial information to determine routes for supplies and employees, the best way to cut costs during production, etc.

Figure of Geography’s Environmental Perspective: Human Environmental Interactions

M.A. Answers will depend on location.

**Answers to Global Geoscience Watch Activity**

1. a
2. hurricanes
3. Gliderpalooza