Physical Geography

Physical Geography

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Abstract & Introduction

Abstract

Physical geography (also known as physiography) is one of the three main branches of geography. Physical geography is the branch of natural science which deals with the processes and patterns in the natural environment such as the atmosphere, hydrosphere, biosphere, and geosphere. This focus is in contrast with the branch of human geography, which focuses on the built environment, and technical geography, which focuses on using, studying, and creating tools to obtain, analyze, interpret, and understand spatial information. The three branches have significant overlap, however.

Introduction

Mental geography and earth science journals communicate and document the results of research carried out in universities and various other research institutions. Most journals cover a specific publish the research within that field, however unlike human geographers, physical geographers tend to publish in inter-disciplinary journals rather than predominantly geography journal; the research is normally expressed in the form of a scientific paper. Additionally, textbooks, books, and communicate research to laypeople, although these tend to focus on environmental issues or cultural dilemmas. Examples of journals that publish articles from physical geographers are (but not limited):

- Bulletin of the American Meteorological Society
- Climatic Change
- Earth Interactions
- Earth Surface Processes and Landforms
- Geographia Technica

PART I
MAIN BODY

1. Content

Chapter 1 What is Physical Geography?

What is Physical Geography?

Learning Objectives

After completion this chapter, you will learn how to:

- Define the Physical Geography
- Describe all 'spheres' in Earth System

- Physical geography is the study of our planet and its systems (ecosystems, climate, atmosphere, hydrology).
- Understanding the climate and how it's changing (and the

potential results of those changes) affect people now and can help plan for the future.
- Because the study of Earth is vast, numerous sub-branches of physical geography specialize in different areas, from the upper limits of the sky to the bottom of the ocean.

Physical geography consists of many diverse elements. These include: the study of the earth's interaction with the sun, seasons, the composition of the atmosphere, atmospheric pressure and wind, storms and climatic disturbances, climate zones, microclimates, the hydrologic cycle, soils, rivers and streams, flora and fauna, weathering, erosion, natural hazards, deserts, glaciers and ice sheets, coastal terrain, ecosystems, geologic systems, and so much more.

The Four Spheres

It's a little deceiving (even overly simplistic) to say that physical geography studies the Earth as our home and looks at the four spheres because each possible area of research encompasses so much.

The ***atmosphere*** itself has several layers to study, but the atmosphere as a topic under the lens of physical geography also includes research areas such as the ozone layer, the greenhouse effect, wind, jet streams, and weather.

The ***hydrosphere*** encompasses everything having to do with water, from the water cycle to acid rain, groundwater, runoff, currents, tides, and oceans.

The ***biosphere*** concerns living things on the planet and why they live where they do, with topics from ecosystems and biomes to food webs and the carbon and nitrogen cycles.

The study of the ***lithosphere*** includes geological processes, such as the formation of rocks, plate tectonics, earthquakes, volcanoes, soil, glaciers, and erosion.

Chapter 2 The System of The Geography

Learning Objectives

After completion this chapter, you will learn how to:

- Describe the main 'spheres' and sub-branches of 'spheres' that occur on Earth.
- Analyze the system that occur on Earth.

The Four Spheres

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Sub-Branches of Physical Geography

Since the Earth and its systems are so complex, there are many sub-branches and even sub-sub-branches of physical geography as a research area, depending on how granularly the categories are divided. They also have overlap between them or with other disciplines, such as geology.

Geographical researchers will never be at a loss of something to study, as they often need to understand multiple areas to inform their own targeted research.

Geomorphology: the study of Earth's landforms and its surface's processes—and how these processes change and have changed Earth's surface—such as erosion, landslides, volcanic activity, earthquakes, and floods.

Hydrology: the study of the water cycle, including water distribution across the planet in lakes, rivers, aquifers, and groundwater; water quality; drought effects; and the probability of flooding in a region. Potamology is the study of rivers.

Glaciology: the study of glaciers and ice sheets, including their formation, cycles, and effect on Earth's climate.

Biogeography: the study of the distribution of life forms across the planet, relating to their environments; this field of study is related to ecology, but it also looks into the past distribution of life forms as well, as found in the fossil record.

Meteorology: the study of Earth's weather, such as fronts, precipitation, wind, storms, and the like, as well as forecasting short-term weather based on available data.

Climatology: the study of Earth's atmosphere and climate, how it has changed over time, and how humans have affected it.

Pedology: the study of soil, including types, formation, and regional distribution over Earth.

Paleogeography: the study of historical geographies, such as the location of the continents over time, through looking at geological evidence, such as the fossil record.

Coastal geography: the study of the coasts, specifically concerning what happens where land and water meet.

Oceanography: the study of the world's oceans and seas, including aspects such as floor depths, tides, coral reefs, underwater eruptions, and currents. Exploration and mapping is a part of oceanography, as is research into the effects of water pollution.

Quaternary science: the study of the previous 2.6 million years on Earth, such as the most recent ice age and Holocene period, including what it can tell us about the change in Earth's environment and climate.

Landscape ecology: the study of how ecosystems interact with and affect each other in an area, especially looking at the effects of the uneven distribution of landforms and species in these ecosystems (spatial heterogeneity).

Geomatics: the field that gathers and analyzes geographic data, including the gravitational force of Earth, the motion of the poles and Earth's crust, and ocean tides (geodesy). In geomatics, researchers use the Geographic Information System (GIS), which is a computerized system for working with map-based data.

Environmental geography: the study of the interactions between people and their environment and the resulting effects, both on the environment and on the people; this field bridges physical geography and human geography.

Astronomical geography or ***astronography***: the study of how the sun and moon affect the Earth as well as our planet's relationship to other celestial bodies.

Chapter 3 Atmosphere, Lithosphere, Hydrosphere, Biosphere

Learning Objectives

After completion this chapter, you will learn how to:

- Explain the Atmosphere, Hydrosphere, Biosphere and Lithosphere.
- Determine the interaction between Earth system.

The Atmosphere

An atmosphere (from Ancient Greek ἀτμός (atmós) 'vapour, steam', and σφαῖρα (sphaîra) 'sphere') is a layer of gas or layers of gases that envelop a planet, and is held in place by the gravity of the planetary body. A planet retains an atmosphere when the gravity is great and the temperature of the atmosphere is low. A stellar atmosphere is the outer region of a star, which includes the layers above the opaque photosphere; stars of low temperature might have outer atmospheres containing compound molecules.

The atmosphere of Earth is composed of nitrogen (78 %), oxygen (21 %), argon (0.9 %), carbon dioxide (0.04 %) and trace gases. Most organisms use oxygen for respiration; lightning and bacteria perform nitrogen fixation to produce ammonia that is used to make nucleotides and amino acids; plants, algae, and cyanobacteria use carbon dioxide for photosynthesis. The layered composition of the atmosphere minimises the harmful effects of sunlight, ultraviolet radiation, solar wind, and cosmic rays to protect organisms from genetic damage. The current composition of the atmosphere of the Earth is the product of billions of years of biochemical modification of the paleoatmosphere by living organisms.

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https://openbook.ums.edu.my/physicalgeography/?p=31#h5p-1

Structure of Earth

Earth

The atmosphere of Earth is composed of layers with different properties, such as specific gaseous composition, temperature, and pressure.

The troposphere is the lowest layer of the atmosphere. This extends from the planetary surface to the bottom of the stratosphere. The troposphere contains 75–80 % of the mass of the atmosphere, and is the atmospheric layer wherein the weather occurs; the height of the troposphere varies between 17 km at the equator and 7.0 km at the poles.

The stratosphere extends from the top of the troposphere to the bottom of the mesosphere, and contains the ozone layer, at an altitude between 15 km and 35 km. It is the atmospheric layer that absorbs most of the ultraviolet radiation that Earth receives from the Sun.

The mesosphere ranges from 50 km to 85 km, and is the layer wherein most meteors are incinerated before reaching the surface.

The thermosphere extends from an altitude of 85 km to the base of the exosphere at 690 km and contains the ionosphere, where solar radiation ionizes the atmosphere. The density of the ionosphere is greater at short distances from the planetary surface in the daytime and decreases as the ionosphere rises at night-time, thereby allowing a greater range of radio frequencies to travel greater distances.

The exosphere begins at 690 to 1,000 km from the surface, and extends to roughly 10,000 km, where it interacts with the magnetosphere of Earth.

Pressure

Atmospheric pressure is the force (per unit-area) perpendicular to a unit-area of planetary surface, as determined by the weight of the vertical column of atmospheric gases. In said atmospheric model, the atmospheric pressure, the weight of the mass of the gas, decreases at high altitude because of the diminishing mass of the gas above the point of barometric measurement. The units of air

pressure are based upon the standard atmosphere (atm), which is 101,325 Pa (equivalent to 760 Torr or 14.696 psi). The height at which the atmospheric pressure declines by a factor of e (an irrational number equal to 2.71828) is called the scale height (H). For an atmosphere of uniform temperature, the scale height is proportional to the atmospheric temperature, and is inversely proportional to the product of the mean molecular mass of dry air, and the local acceleration of gravity at the point of barometric measurement.

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The Hydrosphere

A hydrosphere is the total amount of water on a planet. The hydrosphere includes water that is on the surface of the planet, underground, and in the air. A planet's hydrosphere can be liquid, vapor, or ice. On Earth, liquid water exists on the surface in the form of oceans, lakes, and rivers. It also exists below ground—as groundwater, in wells and aquifers. Water vapor is most visible as clouds and fog. The frozen part of Earth's hydrosphere is made of ice: glaciers, ice caps and icebergs. The frozen part of the hydrosphere has its own name, the cryosphere. Water moves through the hydrosphere in a cycle. Water collects in clouds, then falls to Earth in the form of rain or snow. This water collects in rivers, lakes and oceans. Then it evaporates into the atmosphere to start the cycle all over again. This is called the water cycle.

The Biosphere

The biosphere has existed for about 3.5 billion years. The biosphere's earliest life-forms, called prokaryotes, survived without oxygen. Ancient prokaryotes included single-celled organisms such as bacteria and archaea. Some prokaryotes developed a unique chemical process. They were able to use sunlight to make simple sugars and oxygen out of water and carbon dioxide, a process called photosynthesis. These photosynthetic organisms were so plentiful that they changed the biosphere. Over a long period of time, the atmosphere developed a mix of oxygen and other gases that could sustain new forms of life. The addition of oxygen to the biosphere allowed more complex life-forms to evolve. Millions of different plants and other photosynthetic species developed. Animals, which consume plants (and other animals) evolved. Bacteria and other organisms evolved to decompose, or break down, dead animals and plants. The biosphere benefits from this food web. The remains of dead plants and animals release nutrients into the soil and ocean. These nutrients are reabsorbed by growing plants. This exchange of food and energy makes the biosphere a self-supporting and self-regulating system. The biosphere is sometimes thought of as one large ecosystem—a complex community of living and nonliving things functioning as a single unit. More often, however, the biosphere is described as having many ecosystems.

The Lithosphere

The lithosphere is the solid, outer part of Earth. The lithosphere includes the brittle upper portion of the mantle and the crust, the outermost layers of Earth's structure. It is bounded by the atmosphere above and the asthenosphere (another part of the upper mantle) below. Although the rocks of the lithosphere are still considered elastic, they are not viscous. The asthenosphere is viscous, and the lithosphere-asthenosphere boundary (LAB) is the point where geologists and rheologists—scientists who study the flow of matter—mark the difference in ductility between the two layers of the upper mantle. Ductility measures a solid material's ability to deform or stretch under stress. The lithosphere is far less

ductile than the asthenosphere. There are two types of lithosphere: oceanic lithosphere and continental lithosphere. Oceanic lithosphere is associated with oceanic crust, and is slightly denser than continental lithosphere.

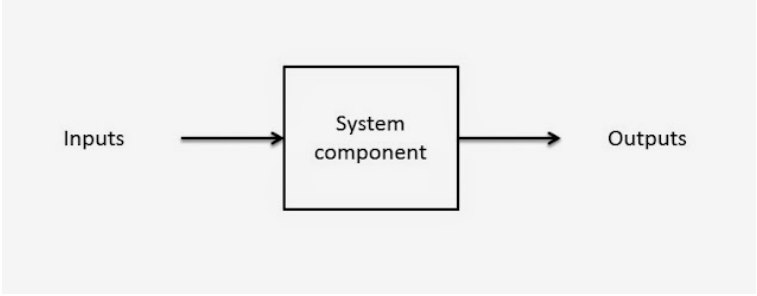
Plate Tectonics

The most well-known feature associated with Earth's lithosphere is tectonic activity. Tectonic activity describes the interaction of the huge slabs of lithosphere called tectonic plates. The lithosphere is divided into tectonic plates including the North American, Caribbean, South American, Scotia, Antarctic, Eurasian, Arabian, African, Indian, Philippine, Australian, Pacific, Juan de Fuca, Cocos, and Nazca. Most tectonic activity takes place at the boundaries of these plates, where they may collide, tear apart, or slide against each other. The movement of tectonic plates is made possible by thermal energy (heat) from the mantle part of the lithosphere. Thermal energy makes the rocks of the lithosphere more elastic. Tectonic activity is responsible for some of Earth's most dramatic geologic events: earthquakes, volcanoes, orogeny (mountain-building), and deep ocean trenches can all be formed by tectonic activity in the lithosphere. Tectonic activity can shape the lithosphere itself: Both oceanic and continental lithospheres are thinnest at rift valleys and ocean ridges, where tectonic plates are shifting apart from one another.

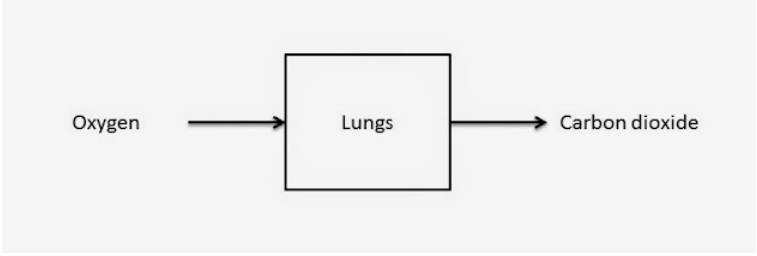
Chapter 4 The Human and The System Geography

Nearly anything you can think of is part of a system. Thinking about things as parts of systems (systems thinking) gives us a number of advantages over considering everything in isolation. First, it provides insight into the unit's function as part of the system. For example, insects may not seem important, or might even seem to be a nuisance, until their roles in feeding many other animals, decomposing dead organic matter, and pollination are considered. The same is true for the contribution of a small stream to a larger river and eventually the water cycle.

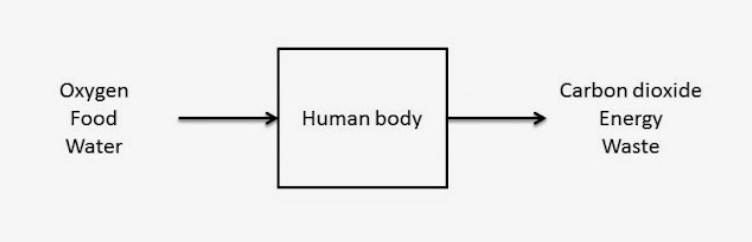
Let's look at a generic diagram for a very basic system:



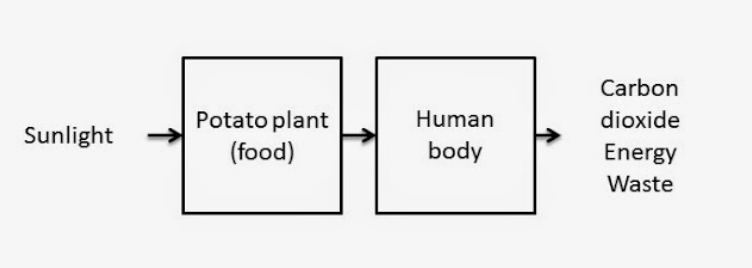
This is a little abstract but we can see that there are things that go into systems and things that come out of them. Here are some more concrete examples:



Clearly, lungs are part of a larger system (the human body)–but their basic function is to take in oxygen and exchange it with our blood, then exhale carbon dioxide. What would happen if the input of oxygen was stopped? First, carbon dioxide would no longer be output. But there are more serious ramifications for the function of other system components! We can diagram this larger system like so:



Earth systems can be diagrammed in the same way. Let's add a simple connection to the human system to understand how we fit into larger life systems:



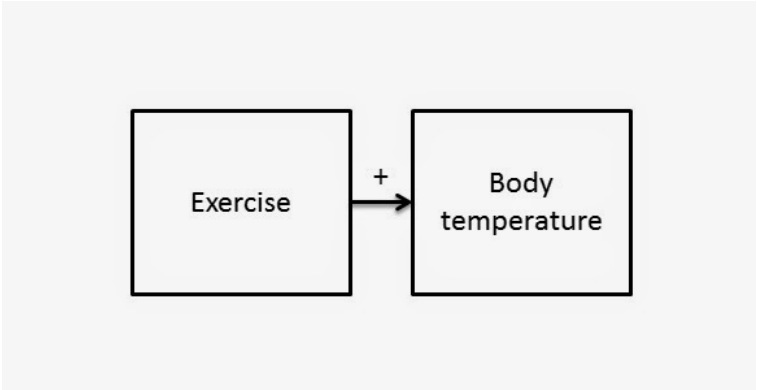
Now we can see that sunlight is an essential input (among others) to creating food, which is essential to providing our bodies with energy. Waste products are also created as we metabolize our food.

Causation and System Feedback

Feedback is an essential part of systems–without it, systems would not function at all. Feedback describes the "signal" that a unit of a system receives from other parts of the system, and can be positive or negative.

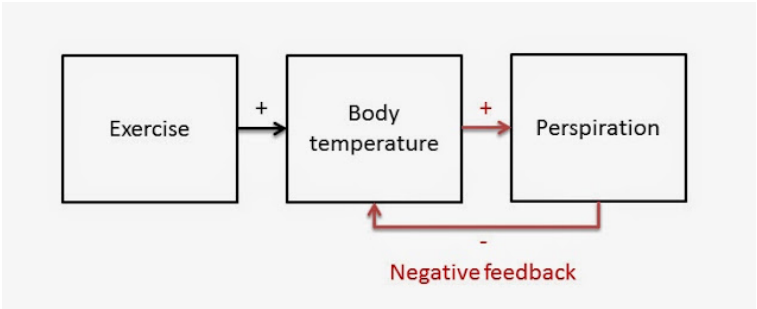
Let's take a look at some simple diagrams to understand relationships in systems. First, the arrows in the diagrams above

have been showing the flow of inputs and outputs, short for "goes into" and "comes out of." We're going to ad a + or – sign to these arrows, which is a short hand way of saying "increases" or "decreases." For example, to return to the system of our human body,



The plus sign indicates a **positive relationship** that we have all experienced. We can read this two ways: "increased exercise leads to increased body temperature," or also "decreased exercise leads to decreased body temperature." Either way the relationship is positive, as **more** of one thing leads to **more** of the other and vice-versa.

Fortunately our bodies have a way of responding to increased temperatures, diagrammed below:



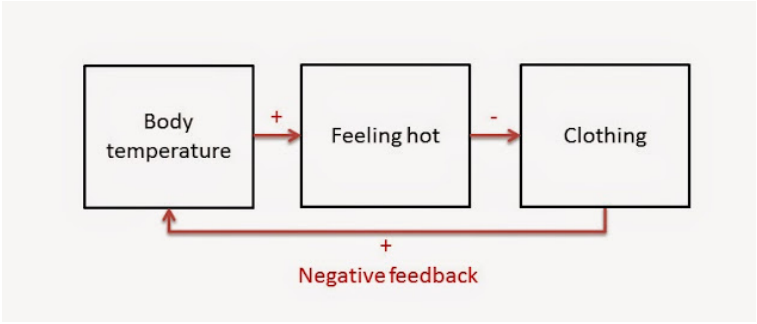
When our body temperature rises, we perspire (sweat) in response. The plus sign between body temperature and perspiration indicates

that normally when body temperature increases, perspiration increases, and when body temperature decreases, so does perspiration. This is another positive relationship. Following the entire chain, we can see that more exercise leads to more perspiration.

Perspiration cools our bodies through evaporation. That's shown with the – sign, which can be interpreted as "increased perspiration decreases body temperature." The negative sign indicates a **negative relationship–more** of one thing is associated with **less** of another.

The lower arrow returning from perspiration to body temperature is an example of a **feedback loop** because it returns to an earlier part of the system chain. Feedback is essential to the functioning of systems and it's hard for us to understand how systems work without understanding their feedback loops. Body temperature being regulated by perspiration is an example of a **negative feedback** loop. Negative feedback tends to maintain **equilibrium** in a system. In the case of our examples, normal body temperature is maintained by negative feedback.

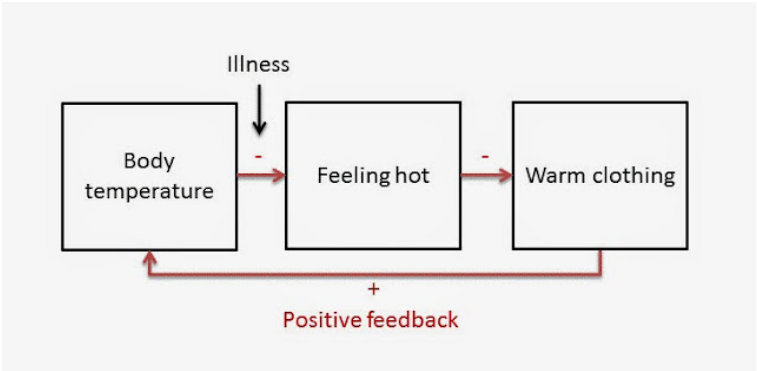
Positive feedback, on the other hand, is one in which feedback serves to accelerate change in a system, moving it further from its original operations. To expand on the previous example, let's take a look at a closely related negative feedback loop for temperature regulation:



The signs get confusing here so remember how we've defined these relationships. Starting with body temperature, we see a positive relationship, meaning "increases in body temperature lead to an

increase in feeling hot," and conversely, "decreases in body temperature lead to decreases in feeling hot." The next relationship in the chain shows us that "increases in body temperature lead to decreases in clothing," or that "decreases in body temperature lead to increases in clothing." If we feel hot, we take off some clothes. If we feel "not hot" (cold), we put clothes on. See how increases are met with decreases and vice-versa? That's a negative relationship. Finally, to complete the feedback loop, "increases in clothing lead to increases in body temperature," and "decreases in clothing lead to decreases in body temperature."

Let's modify the same example to show **positive feedback**:



Here we see that increases in body temperature are no longer met with increases in feeling hot. This is sometimes seen when we are sick. Instead, even as we become warm, we continue to feel cold and we bundle up, increasing our temperature further. We may even shiver, which also serves to increase our temperature. We call this abnormally high body temperature a "fever," a good example of **positive feedback**. You can see how the feedback loop moves the body away from its normal temperature.

Super important to note here is that there are two negative relationships in this diagram, yet it's still an example of positive feedback. Let's take a moment to explore why that is. It's easier to understand if we remember the way we interpret the plus and minus signs. Following the boxes and arrows left-to-right, we can

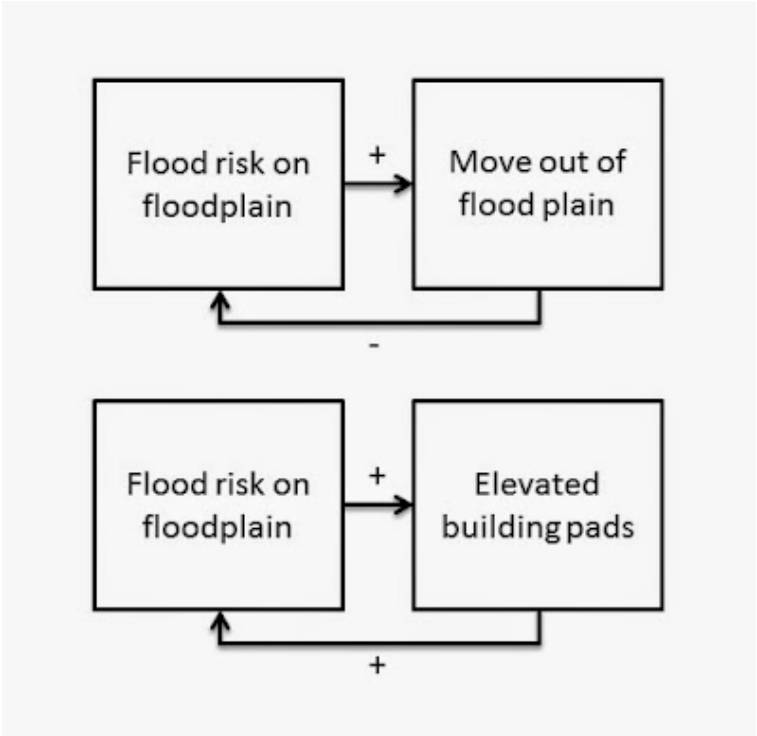
read, “increases in body temperature lead to a decrease in feeling hot, and decreases in feeling hot lead to an increase in putting on clothes.” Thus, when we have a fever we feel cold and put on more clothes even though our bodies temperature is higher than normal! The key insight is to treat the negatives and positives like multiplying numbers. A negative number times a positive number is negative. But two negative numbers multiplied is positive, which we see in the fever example.

While sick our bodies usually regulate temperatures away from dangerously high levels, which is signalled by profuse perspiration as a fever “breaks.” What is really breaking is the positive feedback loop as the body returns to a normal temperature by using its typical negative feedback loop.

What’s all this about body temperature?

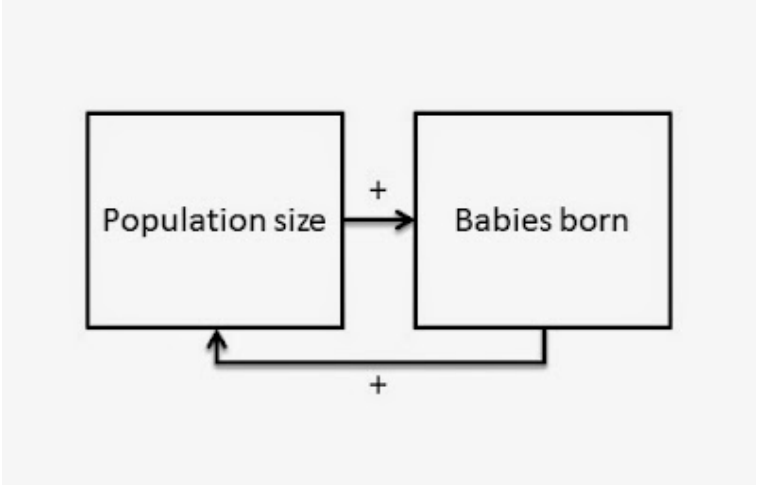
OK, OK, these examples were deliberately selected to be super familiar so you can hopefully understand the concepts more easily. Let’s look at some interesting and important examples of system feedback on Earth.

Our first example looks at two different feedback loops possible when humans deal with the physical risk of flooding on a floodplain:



The top feedback is negative. High risk of floods leads people to move out of the flood plain, which in turn puts everyone at lower risk of floods. (Floods will still occur, but people won't be at risk.) However, the lower feedback is positive. In this example, a high risk of floods leads people to create elevated building pads on the floodplain. That saves the building from a flood, but makes flooding **more** likely on the rest of the flood plain. The more building pads are built, the higher the floodwaters become until eventually it's nearly the same risk on top the building pads!
Our final example for this section looks at an issue that was quite concerning to many during the second part of the last century. We'll discuss this feedback more fully in our chapter on population, as it turns out this diagram and feedback loop are overly simplified

(though they are essentially true if all other factors are held constant):



Here we see that the larger a population, the more babies are born (again, holding all other factors constant); in turn, the more babies are born, the larger the population becomes.

Chapter 5 The Physical Geography in Education

Geography is the study of places and the relationships between people and their environments. Geographers explore both the physical properties of Earth's surface and the human societies spread across it. They also examine how human culture interacts with the natural environment, and the way that locations and places can have an impact on people. Geography seeks to understand where things are found, why they are there, and how they develop and change over time.

Emergence of Geography Modern

Some people have trouble understanding the complete scope of the discipline of geography because geography is interdisciplinary, meaning that it is not defined by one particular topic. Instead, geography is concerned with many different topics—people, culture, politics, settlements, plants, landforms, and much more. Geography asks spatial questions—how and why things are distributed or arranged in particular ways on Earth's surface. It looks at these different distributions and arrangements at many different scales. It also asks questions about how the interaction of different human and natural activities on Earth's surface shape the characteristics of the world in which we live. Geography seeks to understand where things are found and why they are present in those places; how things that are located in the same or distant places influence one another over time; and why places and the people who live in them develop and change in particular ways. Raising these questions is at the heart of the "geographic perspective." Exploration has long been an important part of geography, and it's an important part of developing a geographic perspective. Exploration isn't limited to visiting unfamiliar places;

it also means documenting and connecting relationships between spatial, sociological, and ecological elements. The age-old practice of mapping still plays an important role in this type of exploration, but exploration can also be done by using images from satellites or gathering information from interviews. Discoveries can come by using computers to map and analyze the relationship among things in geographic space, or from piecing together the multiple forces, near and far, that shape the way individual places develop. Applying a geographic perspective demonstrates geography's concern not just with where things are, but with "the why of where"—a short but useful definition of geography's central focus. The insights that have come from geographic research show the importance of asking "the why of where" questions. Geographic studies comparing physical characteristics of continents on either side of the Atlantic Ocean, for instance, gave rise to the idea that Earth's surface is comprised of large, slowly moving plates—plate tectonics. Studies of the geographic distribution of human settlements have shown how economic forces and modes of transport influence the location of towns and cities. For example, geographic analysis has pointed to the role of the United States Interstate Highway System and the rapid growth of car ownership in creating a boom in U.S. suburban growth after World War II. The geographic perspective helped show where Americans were moving, why they were moving there, and how their new living places affected their lives, their relationships with others, and their interactions with the environment.

Geographic analyses of the spread of diseases have pointed to the conditions that allow particular diseases to develop and spread. Dr. John Snow's cholera map stands out as a classic example. When cholera broke out in London, England, in 1854, Snow represented the deaths per household on a street map. Using the map, he was able to trace the source of the outbreak to a water pump on the corner of Broad Street and Cambridge Street. The geographic perspective helped identify the source of the problem (the water from a specific pump) and allowed people to avoid the disease (avoiding water from that pump).

Investigations of the geographic impact of human activities have advanced understanding of the role of humans in transforming the surface of Earth, exposing the spatial extent of threats such as water pollution by artificial waste. For example, geographic study has shown that a large mass of tiny pieces of plastic currently floating in the Pacific Ocean is approximately the size of Texas. Satellite images and other geographic technology identified the so-called "Great Pacific Garbage Patch."

These examples of different uses of the geographic perspective help explain why geographic study and research is important as we confront many 21st century challenges, including environmental pollution, poverty, hunger, and ethnic or political conflict.

Because the study of geography is so broad, the discipline is typically divided into specialties. At the broadest level, geography is divided into physical geography, human geography, geographic techniques, and regional geography.

Physical Geography

The natural environment is the primary concern of physical geographers, although many physical geographers also look at how humans have altered natural systems. Physical geographers study Earth's seasons, climate, atmosphere, soil, streams, landforms, and oceans. Some disciplines within physical geography include geomorphology, glaciology, pedology, hydrology, climatology, biogeography, and oceanography.

Geomorphology is the study of landforms and the processes that shape them. Geomorphologists investigate the nature and impact of wind, ice, rivers, erosion, earthquakes, volcanoes, living things, and other forces that shape and change the surface of Earth.

Glaciologists focus on Earth's ice fields and their impact on the planet's climate. Glaciologists document the properties and distribution of glaciers and icebergs. Data collected by glaciologists has demonstrated the retreat of Arctic and Antarctic ice in the past century.

Pedologists study soil and how it is created, changed, and classified. Soil studies are used by a variety of professions, from

farmers analyzing field fertility to engineers investigating the suitability of different areas for building heavy structures.

Hydrology is the study of Earth's water: its properties, distribution, and effects. Hydrologists are especially concerned with the movement of water as it cycles from the ocean to the atmosphere, then back to Earth's surface. Hydrologists study the water cycle through rainfall into streams, lakes, the soil, and underground aquifers. Hydrologists provide insights that are critical to building or removing dams, designing irrigation systems, monitoring water quality, tracking drought conditions, and predicting flood risk.

Climatologists study Earth's climate system and its impact on Earth's surface. For example, climatologists make predictions about El Niño, a cyclical weather phenomenon of warm surface temperatures in the Pacific Ocean. They analyze the dramatic worldwide climate changes caused by El Niño, such as flooding in Peru, drought in Australia, and, in the United States, the oddities of heavy Texas rains or an unseasonably warm Minnesota winter.

Biogeographers study the impact of the environment on the distribution of plants and animals. For example, a biogeographer might document all the places in the world inhabited by a certain spider species, and what those places have in common.

Oceanography, a related discipline of physical geography, focuses on the creatures and environments of the world's oceans. Observation of ocean tides and currents constituted some of the first oceanographic investigations. For example, 18th-century mariners figured out the geography of the Gulf Stream, a massive current flowing like a river through the Atlantic Ocean. The discovery and tracking of the Gulf Stream helped communications and travel between Europe and the Americas.

Today, oceanographers conduct research on the impacts of water pollution, track tsunamis, design offshore oil rigs, investigate underwater eruptions of lava, and study all types of marine organisms from toxic algae to friendly dolphins.

Human Geography

Human geography is concerned with the distribution and networks of people and cultures on Earth's surface. A human geographer might investigate the local, regional, and global impact of rising economic powers China and India, which represent 37 percent of the world's people. They also might look at how consumers in China and India adjust to new technology and markets, and how markets respond to such a huge consumer base.

Human geographers also study how people use and alter their environments. When, for example, people allow their animals to overgraze a region, the soil erodes and grassland is transformed into desert. The impact of overgrazing on the landscape as well as agricultural production is an area of study for human geographers.

Finally, human geographers study how political, social, and economic systems are organized across geographical space. These include governments, religious organizations, and trade partnerships. The boundaries of these groups constantly change.

The main divisions within human geography reflect a concern with different types of human activities or ways of living. Some examples of human geography include urban geography, economic geography, cultural geography, political geography, social geography, and population geography. Human geographers who study geographic patterns and processes in past times are part of the subdiscipline of historical geography. Those who study how people understand maps and geographic space belong to a subdiscipline known as behavioral geography.

Many human geographers interested in the relationship between humans and the environment work in the subdisciplines of cultural geography and political geography.

Cultural geographers study how the natural environment influences the development of human culture, such as how the climate affects the agricultural practices of a region. Political geographers study the impact of political circumstances on interactions between people and their environment, as well as environmental conflicts, such as disputes over water rights.

Some human geographers focus on the connection between

human health and geography. For example, health geographers create maps that track the location and spread of specific diseases. They analyze the geographic disparities of health-care access. They are very interested in the impact of the environment on human health, especially the effects of environmental hazards such as radiation, lead poisoning, or water pollution.

Geographic Techniques

Specialists in geographic techniques study the ways in which geographic processes can be analyzed and represented using different methods and technologies. Mapmaking, or cartography, is perhaps the most basic of these. Cartography has been instrumental to geography throughout the ages.

Today, almost the entire surface of Earth has been mapped with remarkable accuracy, and much of this information is available instantly on the internet. One of the most remarkable of these websites is Google Earth, which "lets you fly anywhere on Earth to view satellite imagery, maps, terrain, 3D buildings, from galaxies in outer space to the canyons of the ocean." In essence, anyone can be a virtual explorer from the comfort of home.

Technological developments during the past 100 years have given rise to a number of other specialties for scientists studying geographic techniques. The airplane made it possible to photograph land from above. Now, there are many satellites and other above-Earth vehicles that help geographers figure out what the surface of the planet looks like and how it is changing.

Geographers looking at what above-Earth cameras and sensors reveal are specialists in remote sensing. Pictures taken from space can be used to make maps, monitor ice melt, assess flood damage, track oil spills, predict weather, or perform endless other functions. For example, by comparing satellite photos taken from 1955 to 2007, scientists from the U.S. Geological Survey (USGS) discovered that the rate of coastal erosion along Alaska's Beaufort Sea had doubled. Every year from 2002 to 2007, about 13.7 meters (45 feet) per year of coast, mostly icy permafrost, vanished into the sea.

Computerized systems that allow for precise calculations of how

things are distributed and relate to one another have made the study of geographic information systems (GIS) an increasingly important specialty within geography. Geographic information systems are powerful databases that collect all types of information (maps, reports, statistics, satellite images, surveys, demographic data, and more) and link each piece of data to a geographic reference point, such as geographic coordinates. This data, called geospatial information, can be stored, analyzed, modeled, and manipulated in ways not possible before GIS computer technology existed.

The popularity and importance of GIS has given rise to a new science known as geographic information science (GISci). Geographic information scientists study patterns in nature as well as human development. They might study natural hazards, such as a fire that struck Los Angeles, California, United States, in 2008. A map posted on the internet showed the real-time spread of the fire, along with information to help people make decisions about how to evacuate quickly. GIS can also illustrate human struggles from a geographic perspective, such as the interactive online map published by the New York Times in May 2009 that showed building foreclosure rates in various regions around the New York City area.

The enormous possibilities for producing computerized maps and diagrams that can help us understand environmental and social problems have made geographic visualization an increasingly important specialty within geography. This geospatial information is in high demand by just about every institution, from government agencies monitoring water quality to entrepreneurs deciding where to locate new businesses.

Regional Geography

Regional geographers take a somewhat different approach to specialization, directing their attention to the general geographic characteristics of a region. A regional geographer might specialize in African studies, observing and documenting the people, nations, rivers, mountains, deserts, weather, trade, and other attributes of the continent. There are different ways you can define a region.

You can look at climate zones, cultural regions, or political regions. Often regional geographers have a physical or human geography specialty as well as a regional specialty.

Regional geographers may also study smaller regions, such as urban areas. A regional geographer may be interested in the way a city like Shanghai, China, is growing. They would study transportation, migration, housing, and language use, as well as the human impact on elements of the natural environment, such as the Huangpu River.

Whether geography is thought of as a discipline or as a basic feature of our world, developing an understanding of the subject is important. Some grasp of geography is essential as people seek to make sense of the world and understand their place in it. Thinking geographically helps people to be aware of the connections among and between places and to see how important events are shaped by where they take place. Finally, knowing something about geography enriches people's lives—promoting curiosity about other people and places and an appreciation of the patterns, environments, and peoples that make up the endlessly fascinating, varied planet on which we live.

Glossary

atmosphere

the envelope of gases surrounding any celestial body

condensation

process of changing from a gas to a liquid or solid state

flood

the rising of a body of water and its overflowing onto land

flood plain

a low plain adjacent to a river that is formed chiefly of river sediment and is subject to flooding

precipitation

the falling to earth of any form of water