Chapter 1. Essentials of Geography

Learning Objectives

- ***Define*** geography in general and physical geography in particular.
- ***Discuss*** human activities and human population growth as they relate to geographic science, and summarize the scientific process.
- ***Describe*** systems analysis, open and closed systems, and feedback information, and relate these concepts to Earth systems.
- ***Explain*** Earth's reference grid: latitude and longitude and latitudinal geographic zones and time.
- ***Define*** cartography and mapping basics: map scale and map projections.
- ***Describe*** modern geoscience techniques—the Global Positioning System (GPS), remote sensing, and geographic information systems (GIS)—and explain how these tools are used in geographic analysis.

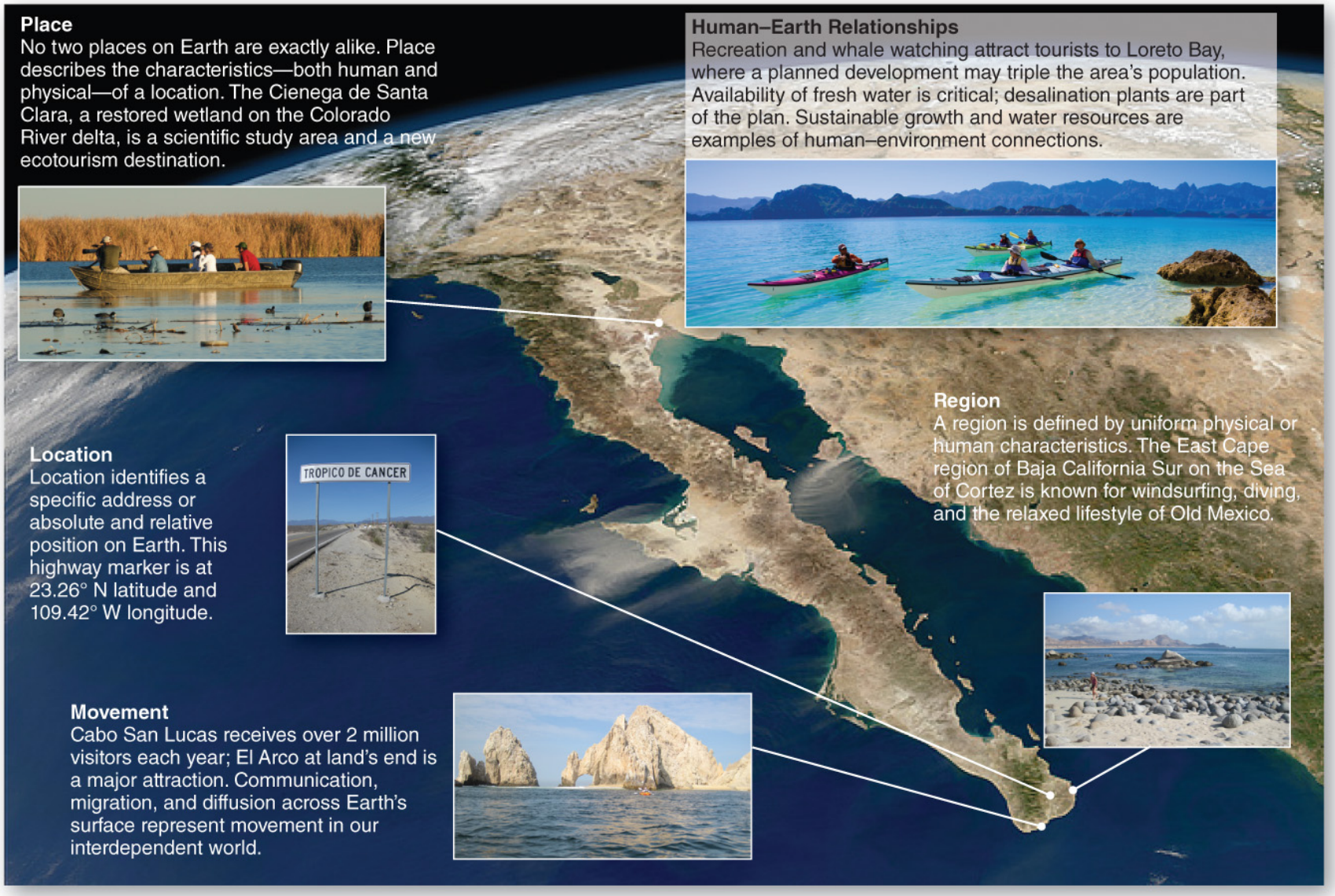
Geography

- *Geo* means “Earth,” *graphein* means “to write,” and *geography* means “to write something about Earth.”
- Geography is the science that studies the relationships among
  - geographic areas,
  - natural systems,
  - society,
  - cultural activities,
  - and the interdependence of all the above **through space (spatial)**.

What is Spatial?

- The term **spatial** refers to the nature and character of physical space, its measurement, and the distribution of things within it.
- We often divide geographic science into five themes: **location, place**, **region**, **movement**, and **human–Earth relationships.**

Five Themes of Geographic Science



Location

Location

Location identifies a specific address or absolute and relative position on Earth. These New Jersey road signs direct drivers on route 37 to locations.

Place

Place is an area with definite or indefinite boundaries or a portion of space which has a name.

Place

No two places on Earth are exactly alike. The Bay of Fundy, separating New Brunswick and Nova Scotia, has the highest average tides in the world—up to 17 m (55.7 ft) in height.

Region

Region

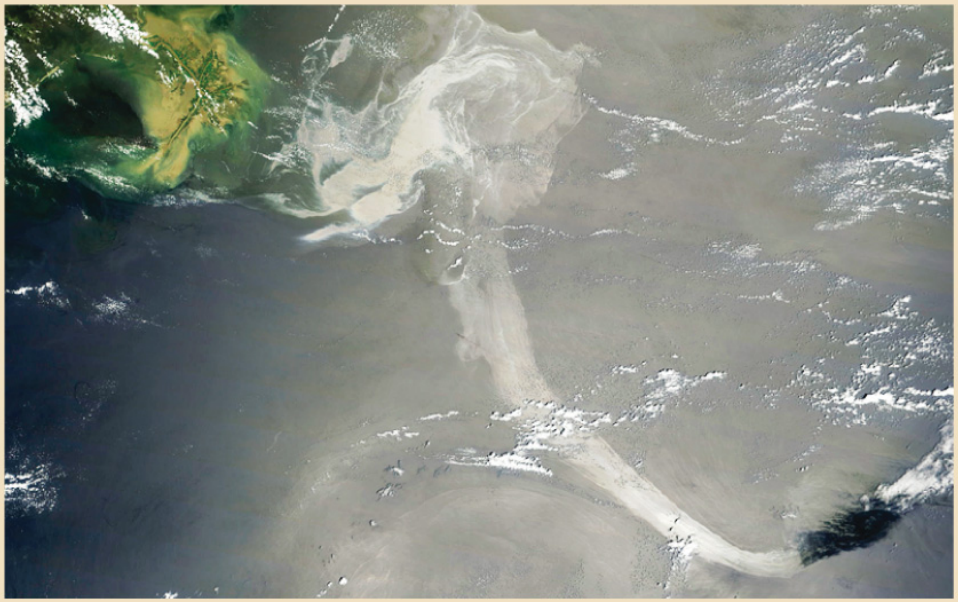
A region is an area defined by uniform characteristics. South-central Texas is a distinct region of grasslands, large cattle ranches, irrigated feed crops and feedlots.

Movement

Movement

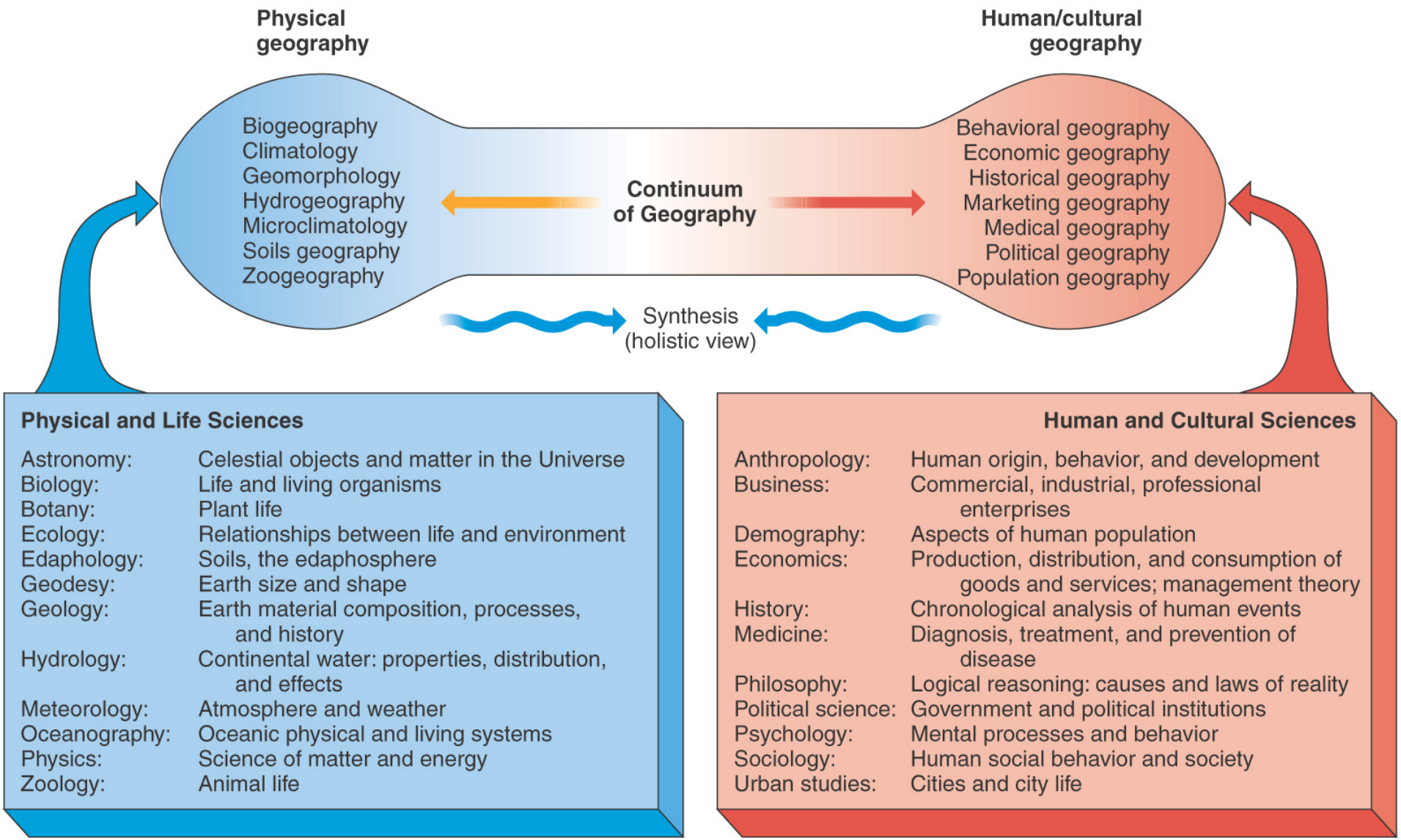
Communication, circulation, migration, and diffusion across Earth's surface represent movement in our interdependent world. Animals migrate with seasonal change; Snow Geese feed and rest along their journey.

Human-Earth Relationships



Human–Earth Relationships
Human–environment connections include resource exploitation, hazard perception, and environmental pollution and modification. *Terra* satellite image of the *Deepwater Horizon* oil spill in the Gulf of Mexico, highlighted by a sunglint on the gulf's surface, this human-caused spill is the largest in history.

Content of Geography



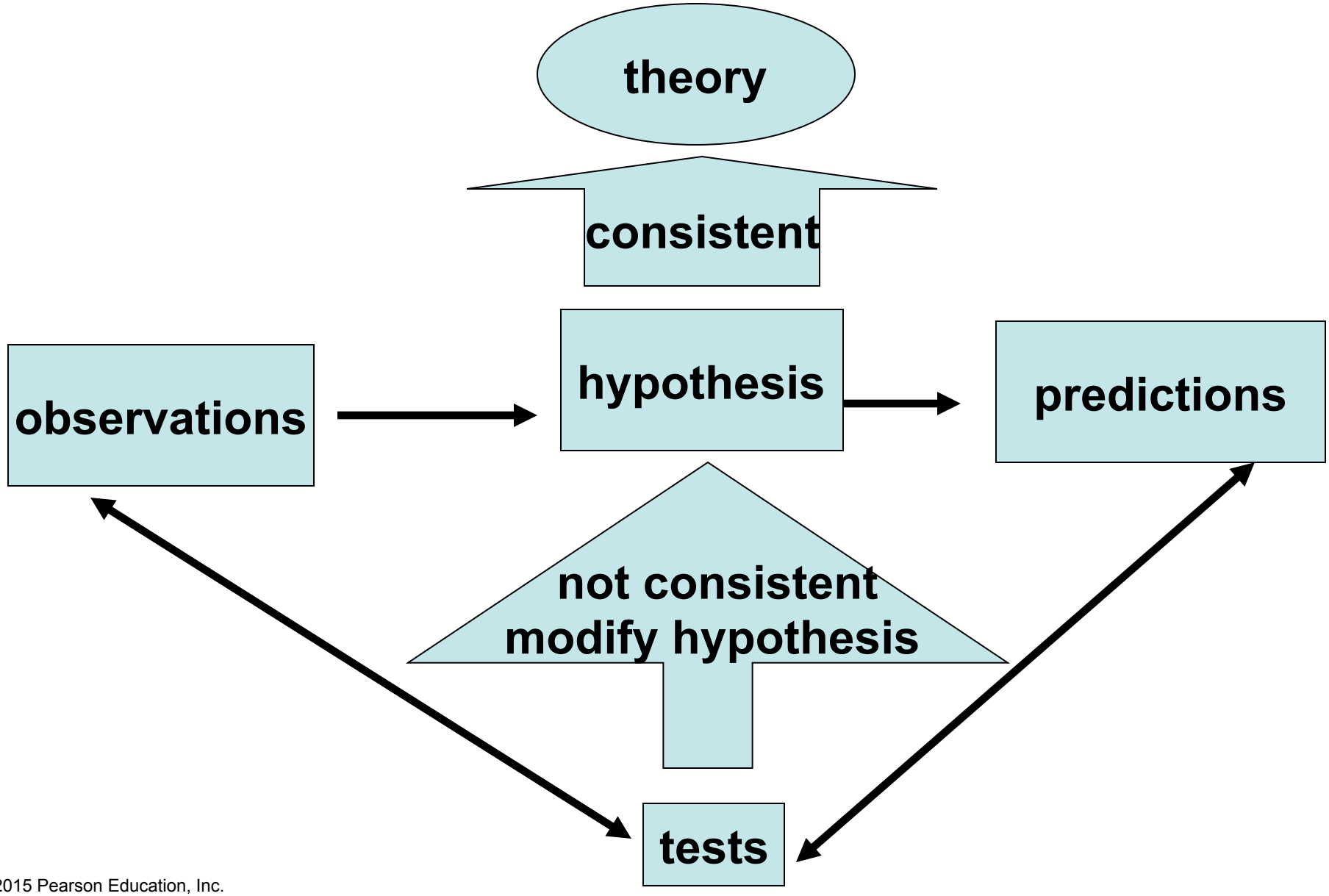
Earth Science

- What is the “Science” in Earth Science?

  The sciences are a group of disciplines that have a common approach to finding out how aspects of the universe work.
- This approach is called the “scientific method.”

The Scientific Method

Scientific Method



How Do We Test a Hypothesis?

- Conduct experiments.
- Collect further observations and measurements.

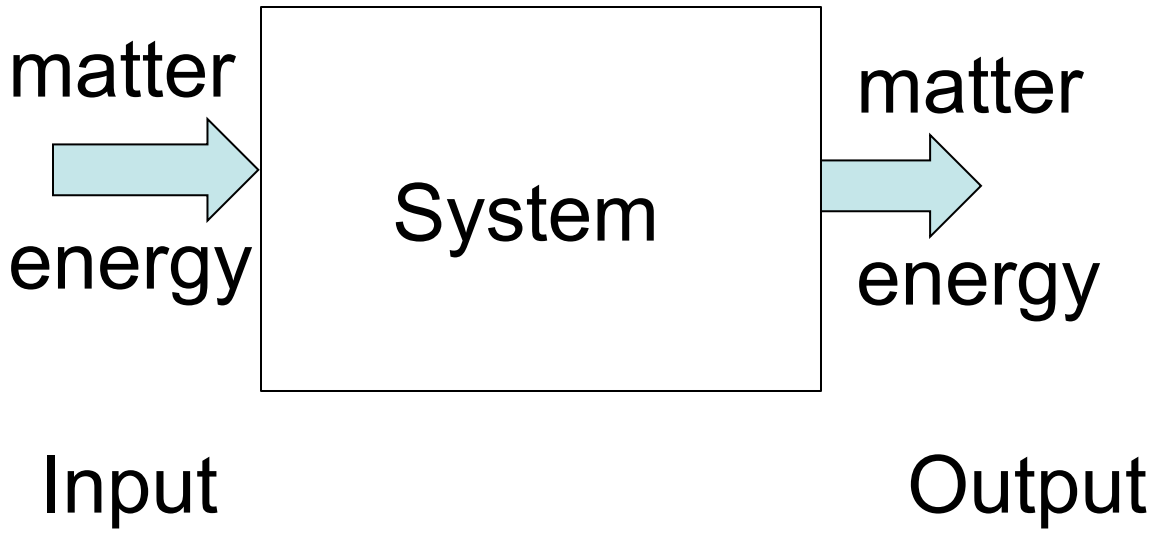
Scientific Theory

- A scientific theory must be “falsifiable”, i.e., there must be some experiments or possible observations that could invalidate the theory.
- No matter how good a theory is, it can not be "absolute truth”.
- When a theory is said to be "true" it means that it agrees with all known experimental and/or observational evidence. When a theory cannot explain new observations it will have to be replaced by a new theory.

Earth Systems Concepts

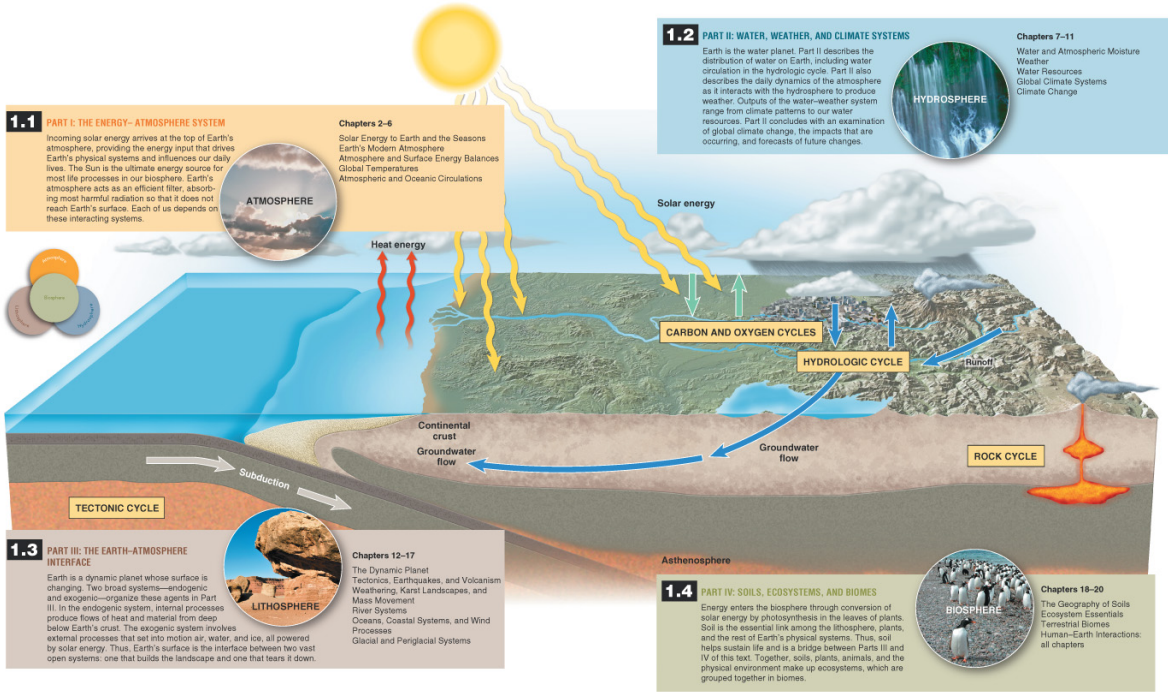
- What is a system?

  A system is any ordered, interrelated set of things and their attributes, linked by flows of energy and matter.



Earth's Four Spheres

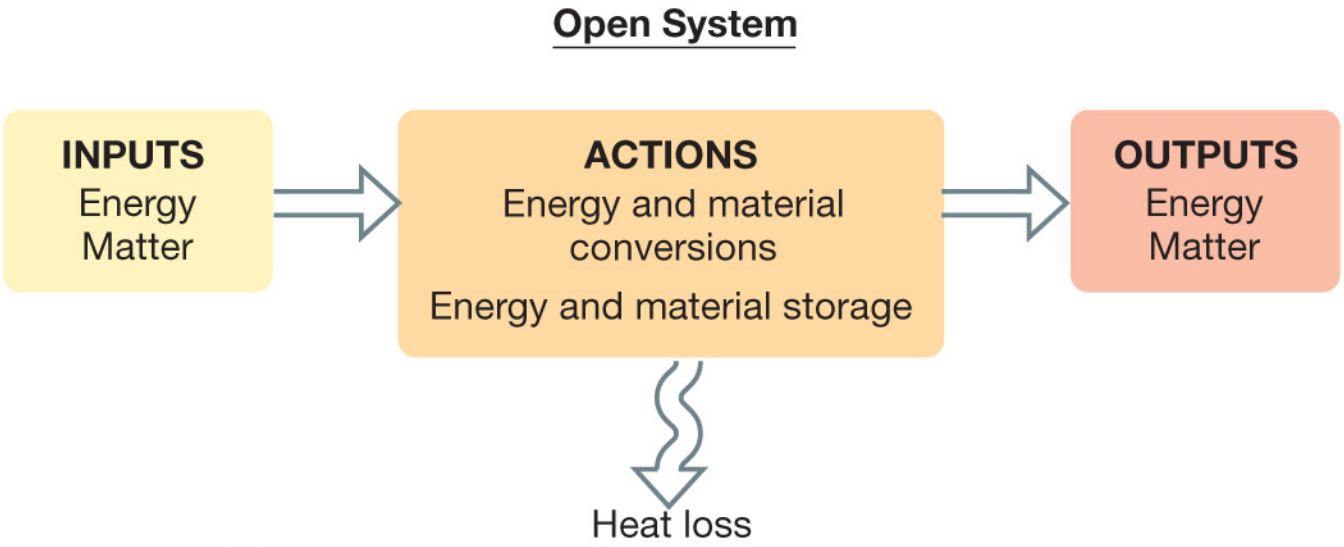
- We divide Earth into abiotic (non-living) and biotic (living) spheres.
- Three abiotic spheres: atmosphere, hydrosphere, lithosphere (geosphere)
- Biotic sphere: biosphere



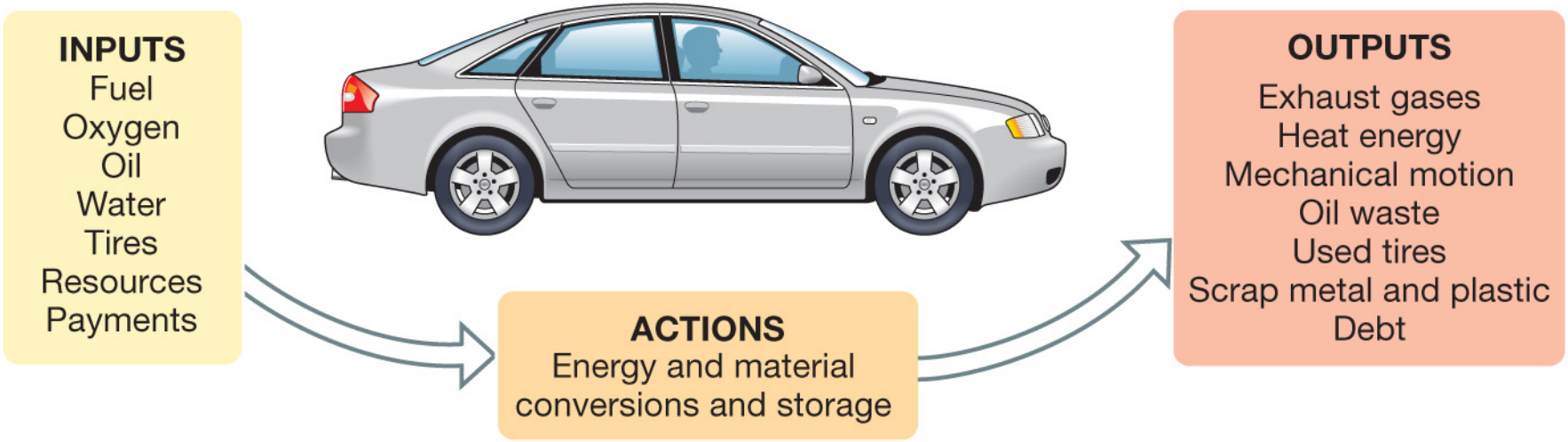
Conservation Laws of Mass and Energy

- Mass is neither destroyed nor created.
- Energy is the capacity to change the motion of, or to do work on, matter.
- Energy is neither destroyed nor created.
- Input − Output = Storage Change

An Open System



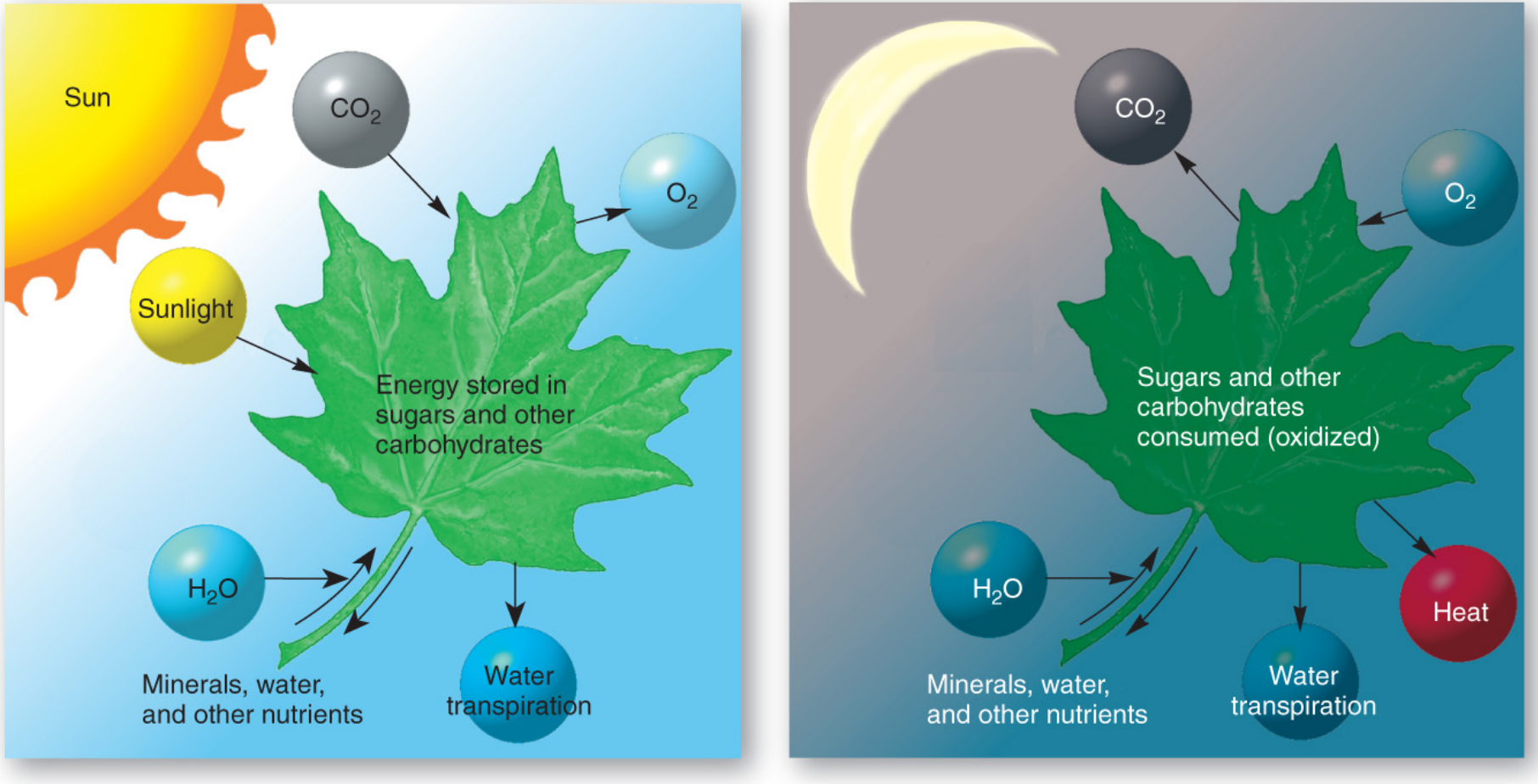
Example: an automobile



Open System and Closed System

- An open system is a system with inputs of energy or matter and outputs of energy or matter.
- A closed system is shut off from the surrounding environment so that it is self-contained. Closed systems are rare in nature.
- Earth system is an open system in terms of energy.
- Earth system is a closed system in terms of physical matter and resources.

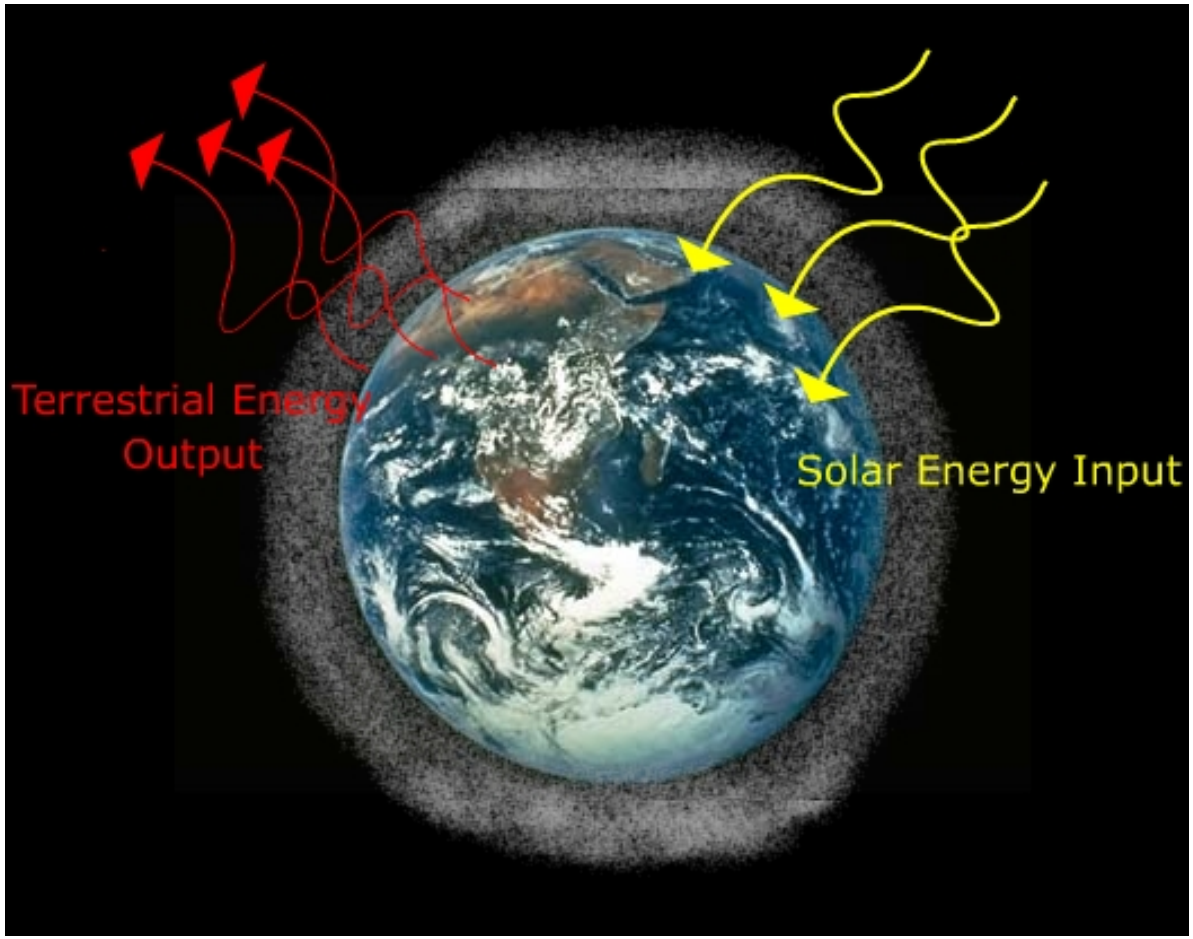
A leaf is a natural open system



(a) Plant photosynthesis

(b) Plant respiration

Earth System



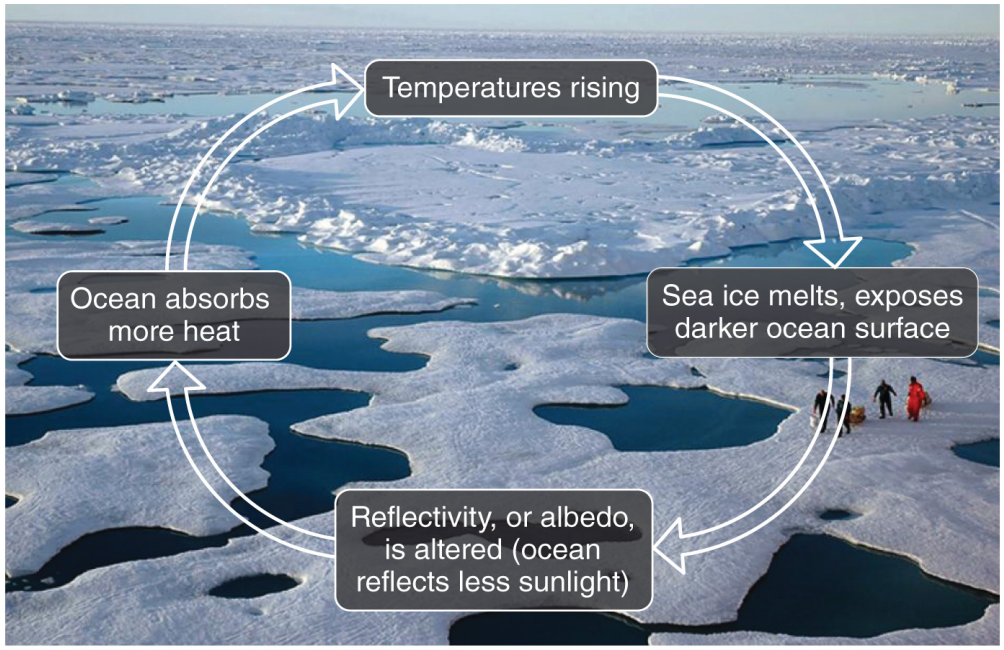
Earth system is an open system in terms of energy.
Earth system is a closed system in terms of physical matter and resources.

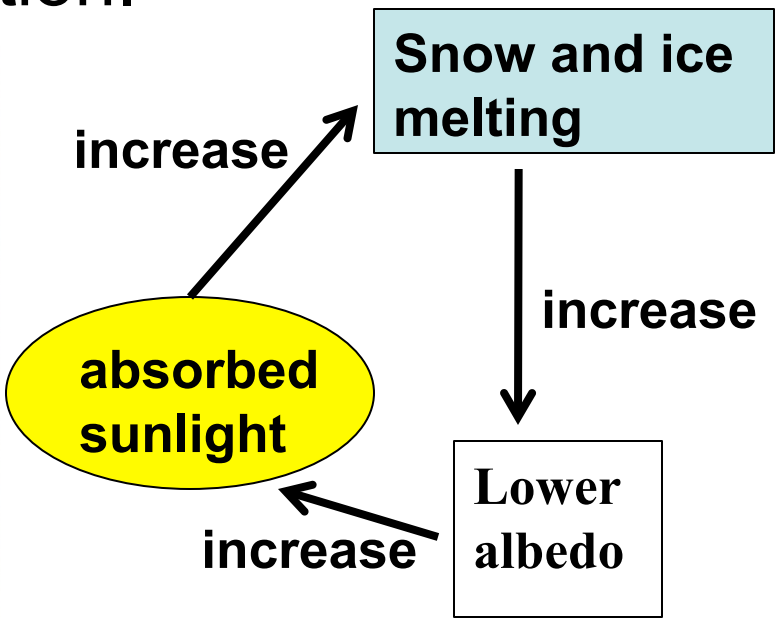
System Feedback

- Feedback loop: Outputs of a system influence the system's operation through a pathway.
- Negative feedback: The feedback information discourages response in the system. — a self regulation, stable condition
- Positive feedback: The feedback information increased response in the system. — a runaway condition (snowballing)

The Arctic Sea Ice–Albedo Positive Feedback

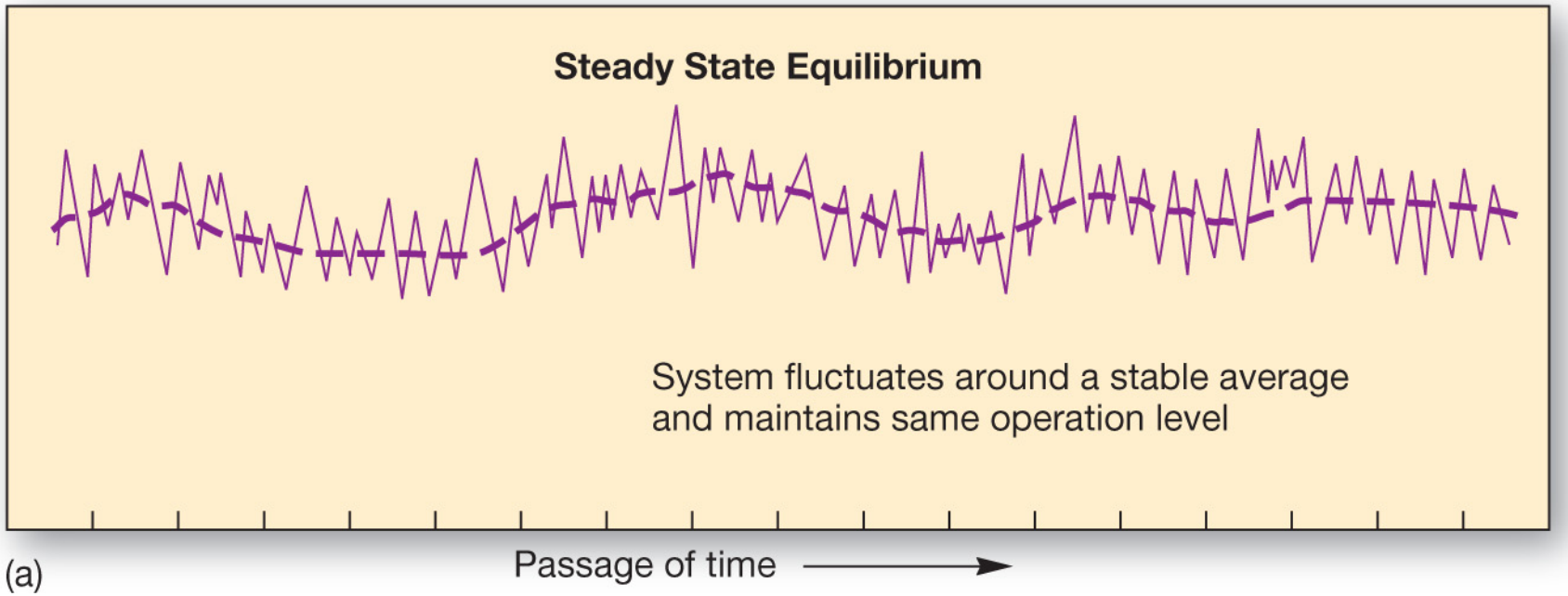
- Albedo is the ratio of reflected solar radiation to the total incoming solar radiation.





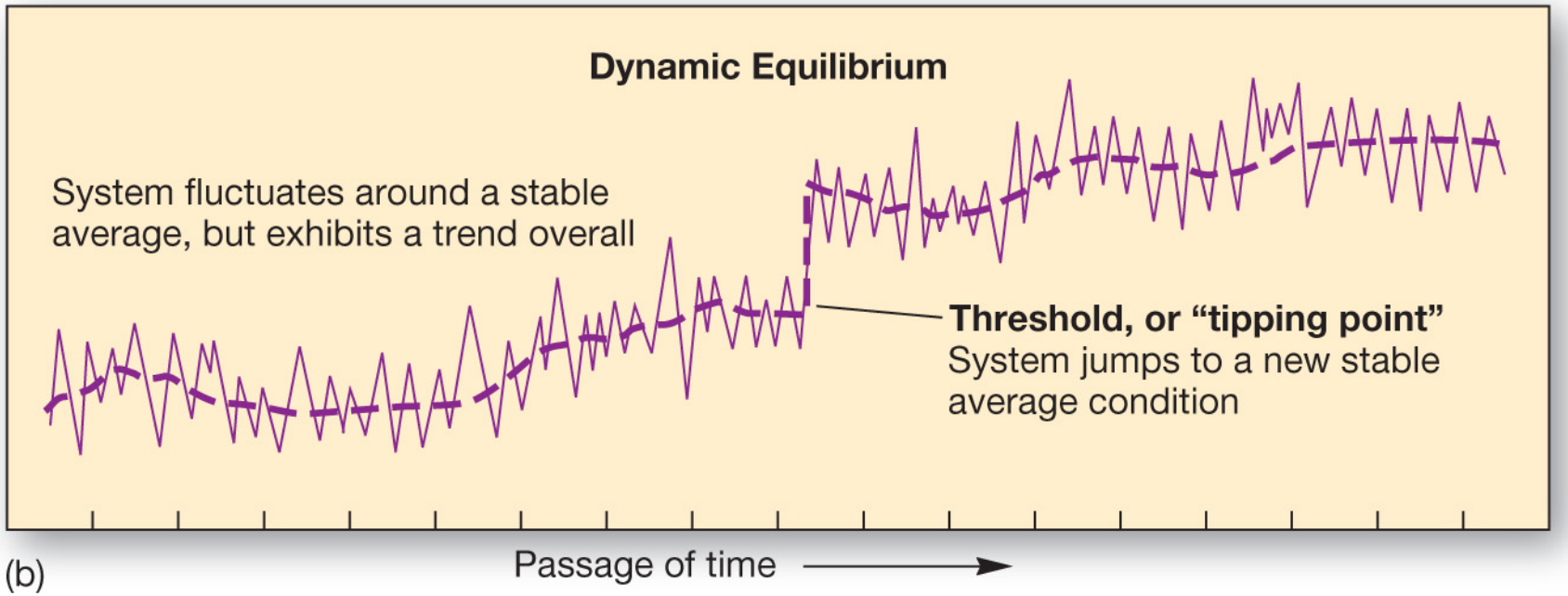
Steady-State Equilibrium

- Steady-state equilibrium: when the rates of inputs and outputs in the system are equal and the amounts of energy and matter in storage within the system are constant (or fluctuate around a stable average).

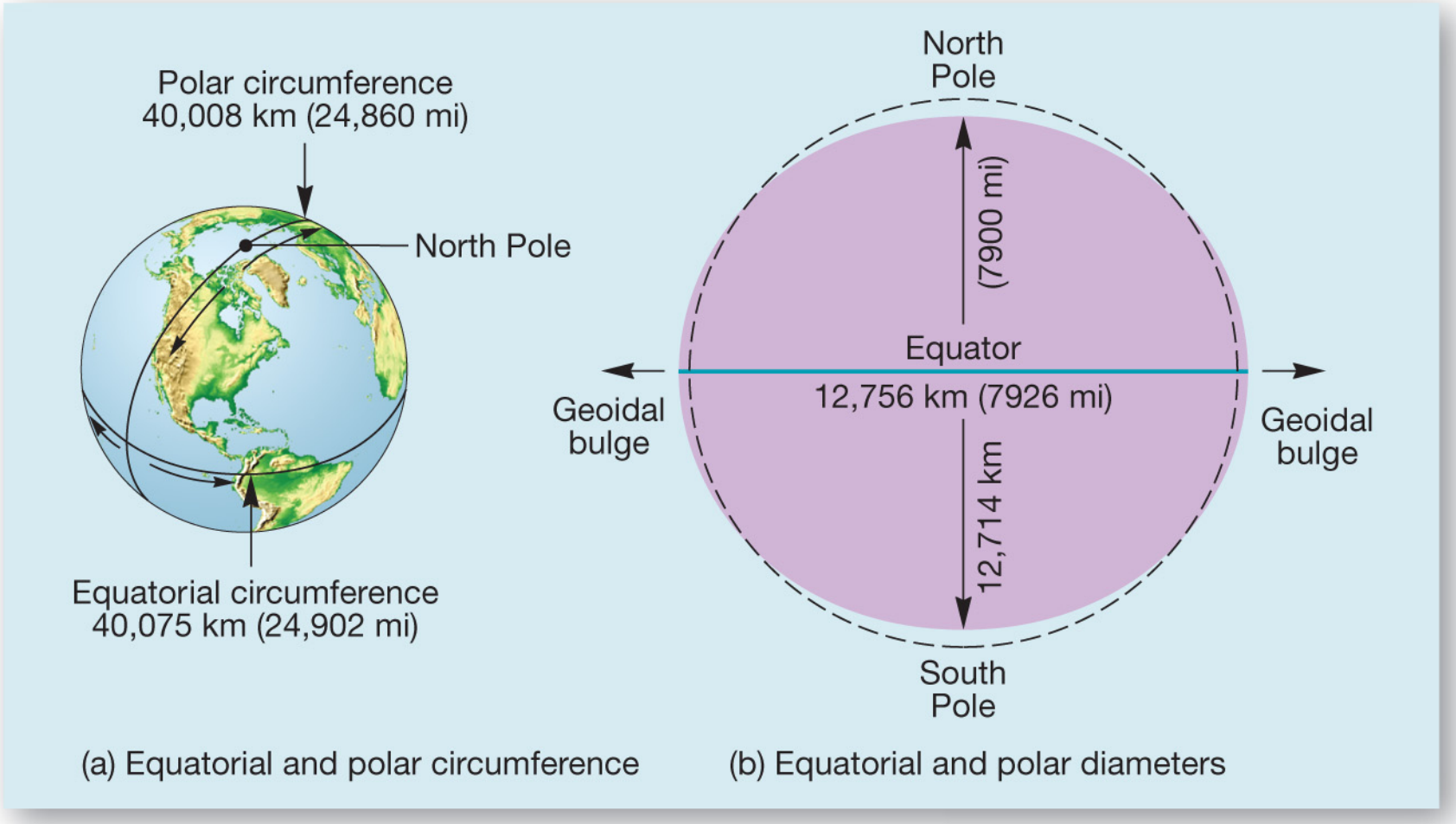


Dynamic Equilibrium

- Some systems are in a condition of dynamic equilibrium with an increasing or decreasing trend. A dynamic equilibrium system may change to a new operation level as it reaches a threshold called *tipping point*.

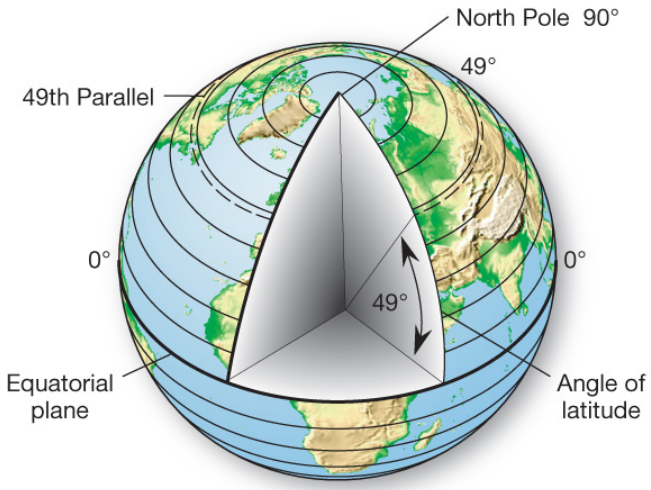


Earth's Dimensions

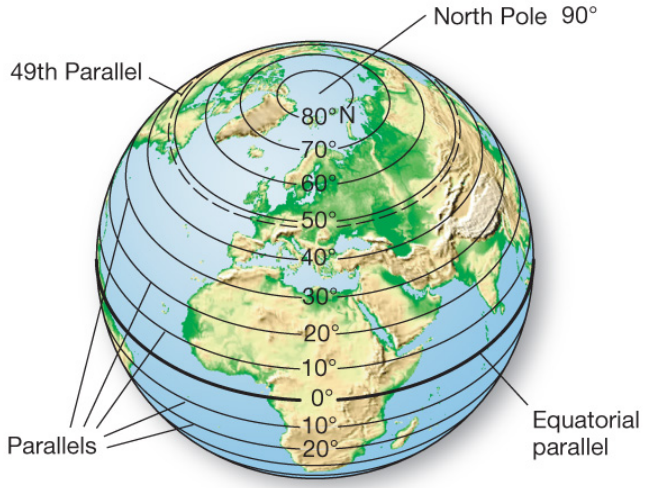


Latitude

- Latitude is an angular distance north or south of the equator, measured from the center of Earth (e.g., 49°N, 12°S).
- A line connecting all points along the same latitudinal angle is a parallel.

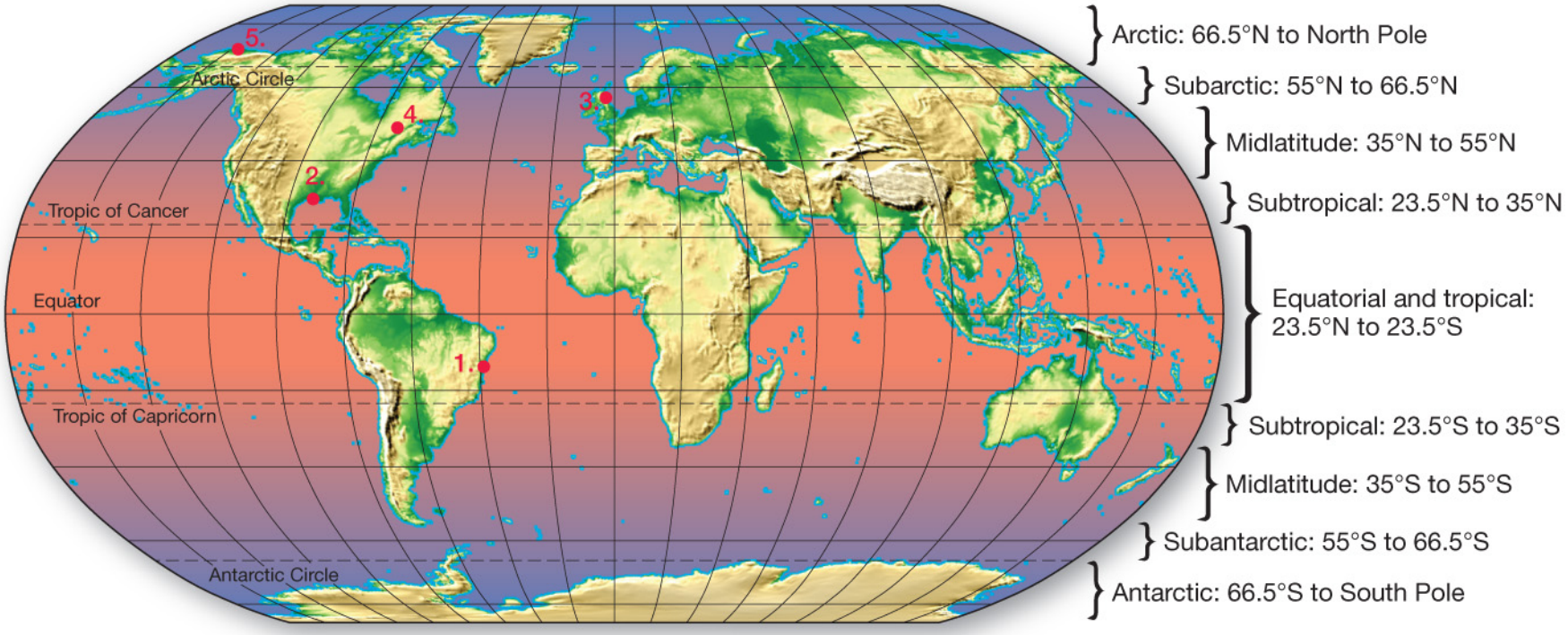


(a) Latitude is measured in degrees north or south of the Equator (0°). Earth's poles are at 90°. Note the measurement of 49° latitude.



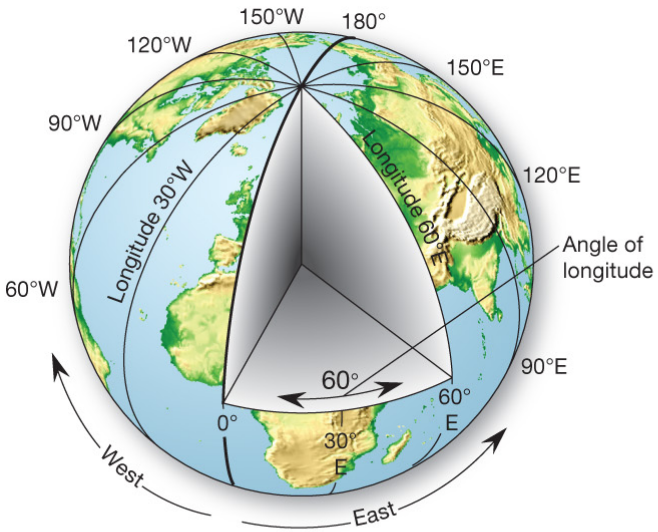
(b) These angles of latitude determine parallels along Earth's surface.

Latitudinal Geographic Zones

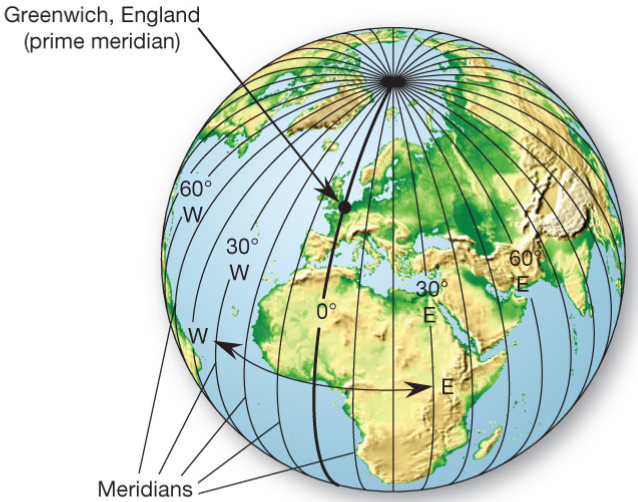


Longitude

- Longitude is an angular distance east or west of a point on Earth's surface measured from the center of Earth (e.g.,10°E, 10°W).
- A line connecting all points along the same longitude is a meridian. Prime meridian is a meridian designated as 0°.
- In 1884, at the International Meridian Conference held in Washington, D.C., 22 countries voted to adopt the Greenwich meridian as the prime meridian of the world.



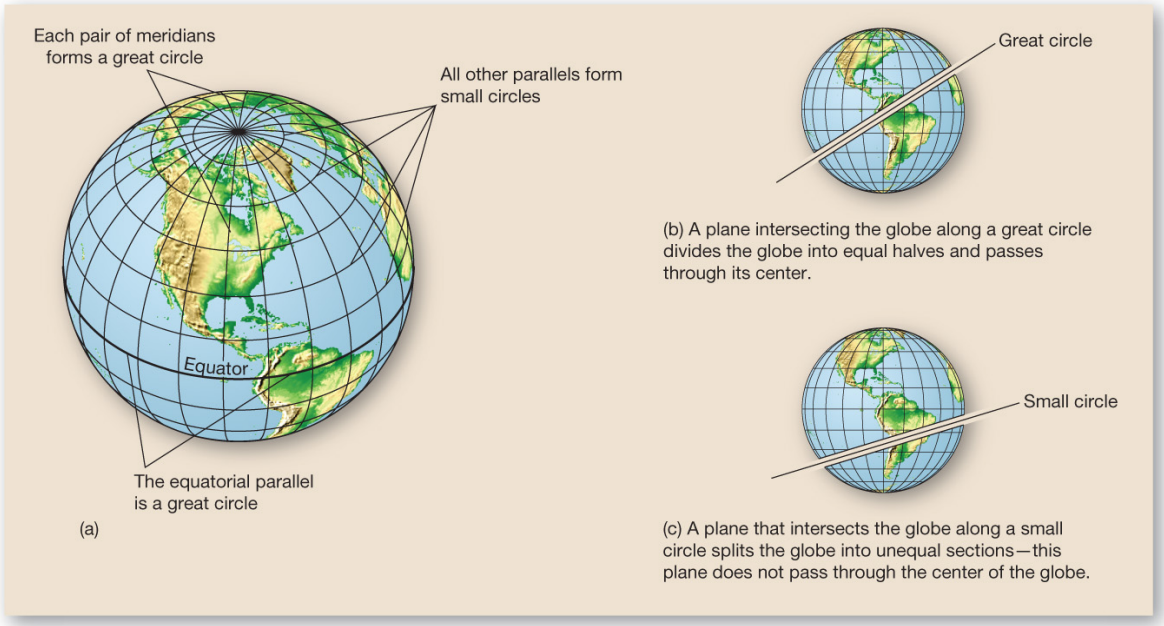
(a) Longitude is measured in degrees east or west of a 0° starting line, the prime meridian. Note the measurement of 60°E longitude



(b) Angles of longitude measured from the prime meridian determine other meridians. North America is west of Greenwich; therefore, it is in the Western Hemisphere.

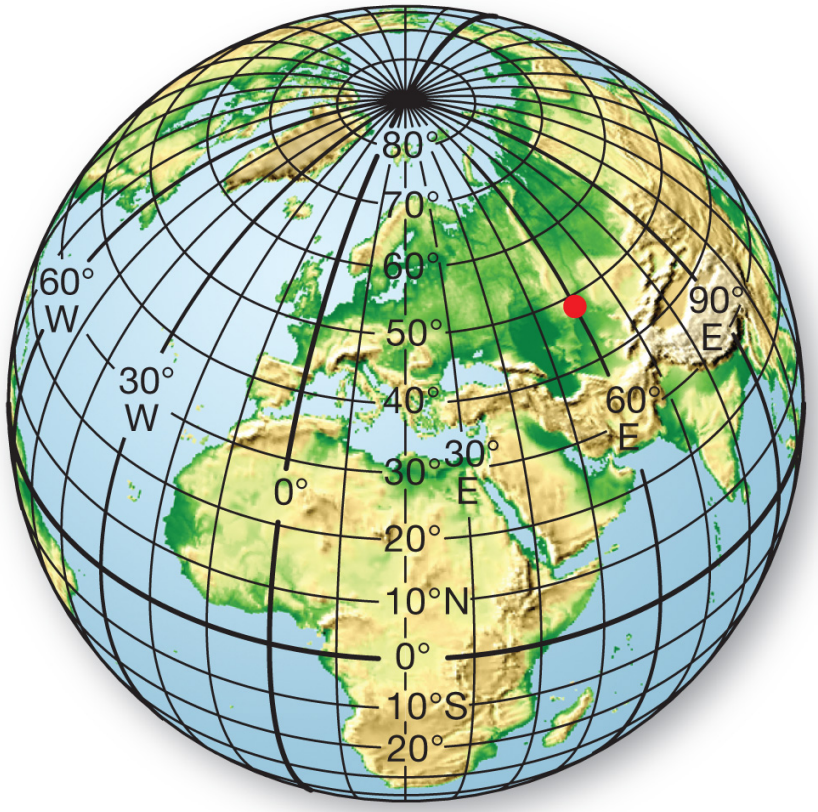
Great Circles and Small Circles

- A great circle is any circle of Earth's circumference whose center coincides with the center of Earth.
- Only one parallel is a great circle—the equatorial parallel. All other parallels decrease in length toward the poles, which are called *small circles*.



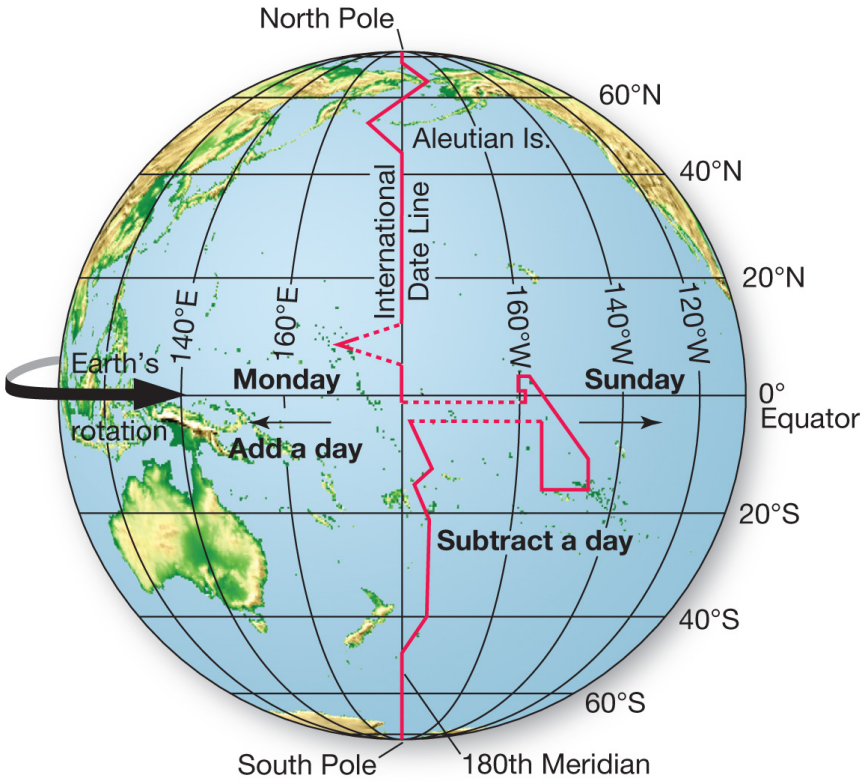
Earth's Coordinate Grid System

- Latitude and parallels, longitude and meridian allow all places on Earth to be precisely located.



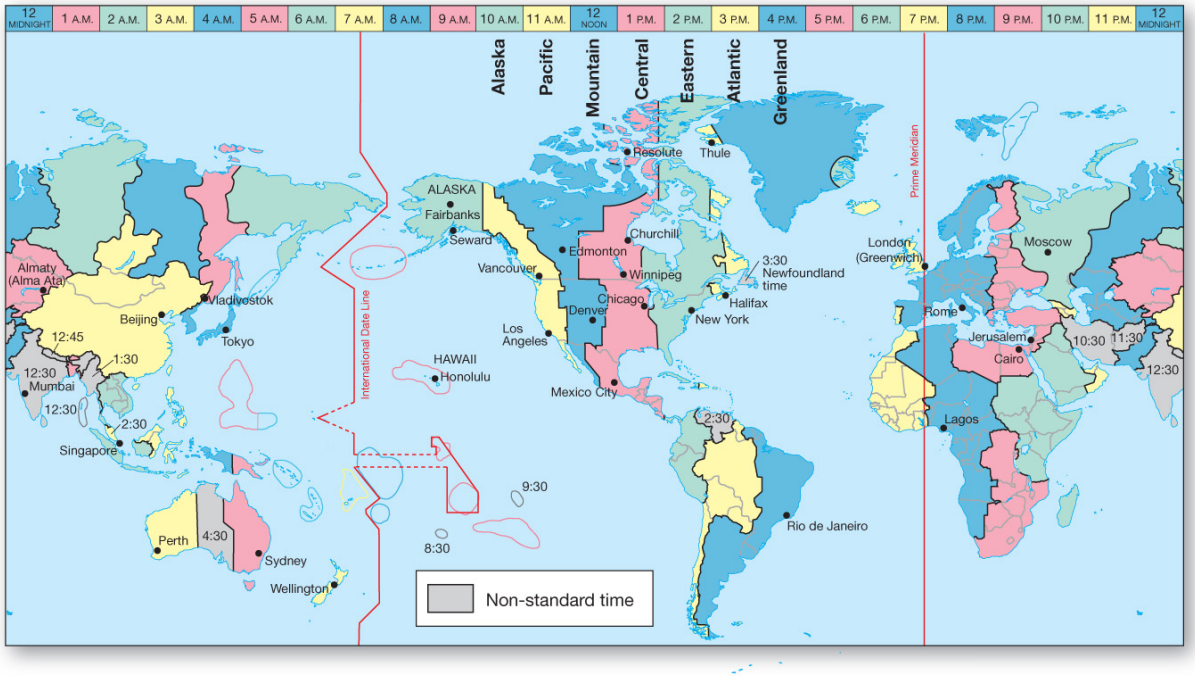
International date line

- **International Date Line** is **approximately** along the 180th meridian (180°E or 180°W, 180°E = 180°W).



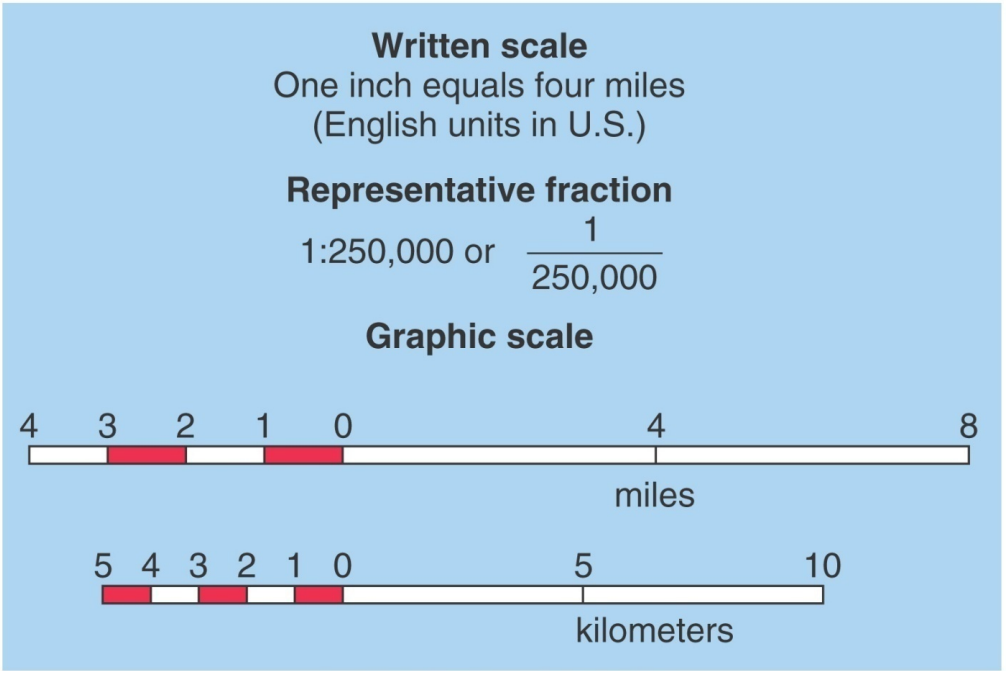
Modern International Standard Time Zones

- 24 time zones
- Earth revolves 360°/24 hours = 15°/hour
- Each time zone is 15º of longitude



The Scale of Maps

- Three map scales: representative fraction, written scale, and graphic scale
- There is one advantage associated with the graphic scale, because if a map is enlarged or reduced, the graphic scale enlarges or reduces along with the map.



Remote Sensing and GIS

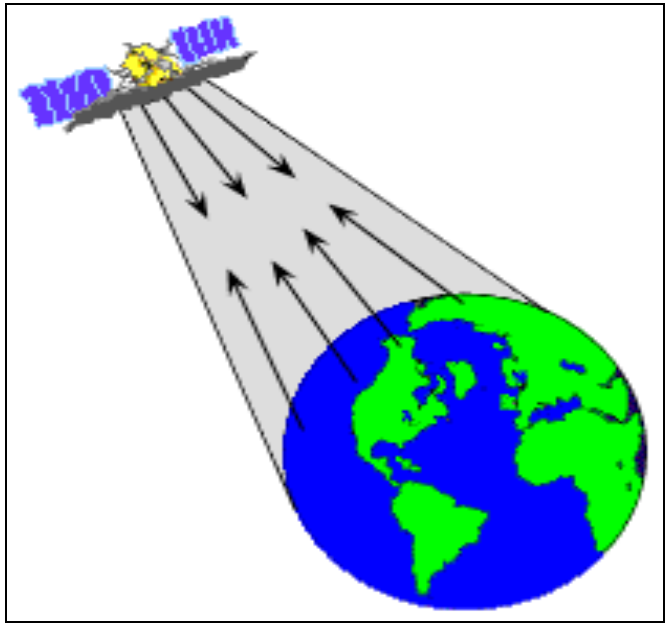
- Geographers observe, analyze, and map Earth using remote sensing and geographic information systems (GIS).
- Remote sensing: observing Earth from space
- GIS is a computer-based, data processing tool for gathering, manipulating, analyzing, and displaying geographic information.

Active and Passive Remote Sensing

- Active remote-sensing systems direct a beam of energy at a surface and analyze the energy reflected back.
- Passive remote-sensing systems record wavelengths of energy radiated from a surface, particularly visible light and infrared.

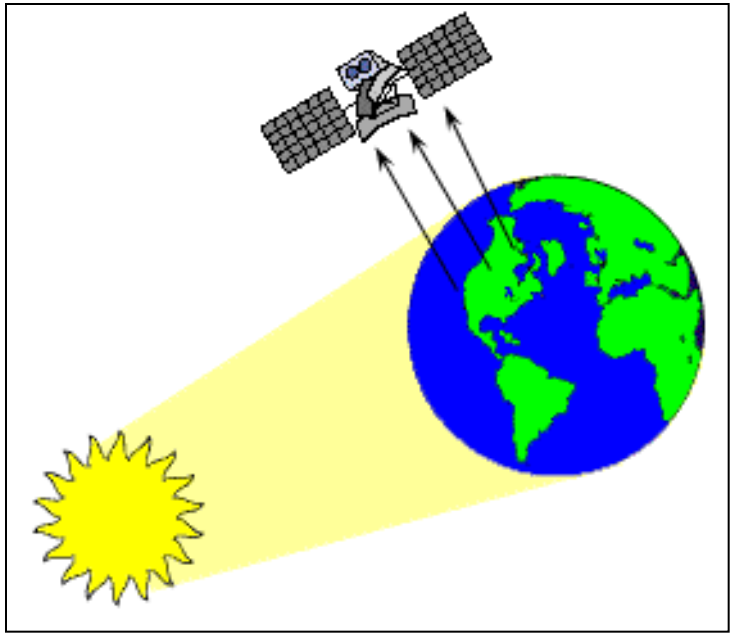
Remote Sensing

- Active Remote Sensing



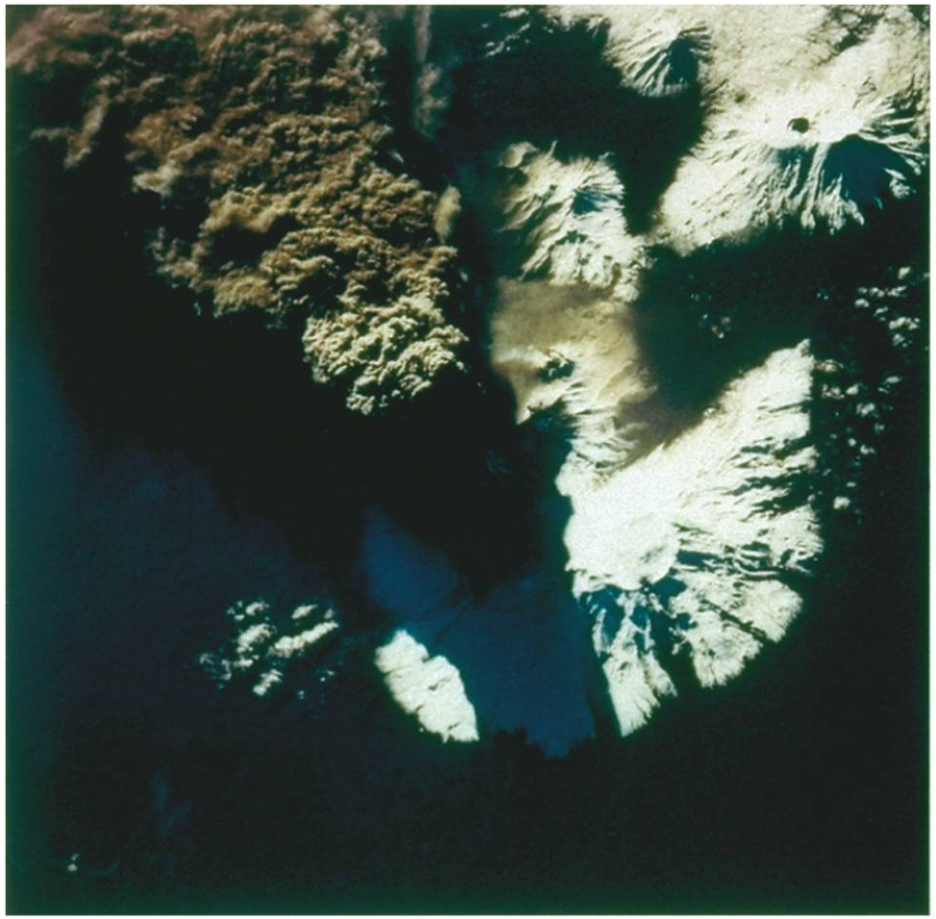
- Microwave (0.001-0.3m), example: Radar = *ra*dio *d*etection *a*nd *r*anging

- Passive Remote Sensing



- Visible and infrared
- Taking pictures using a camera.

Active and Passive Remote Sensing



Visible light

Radar

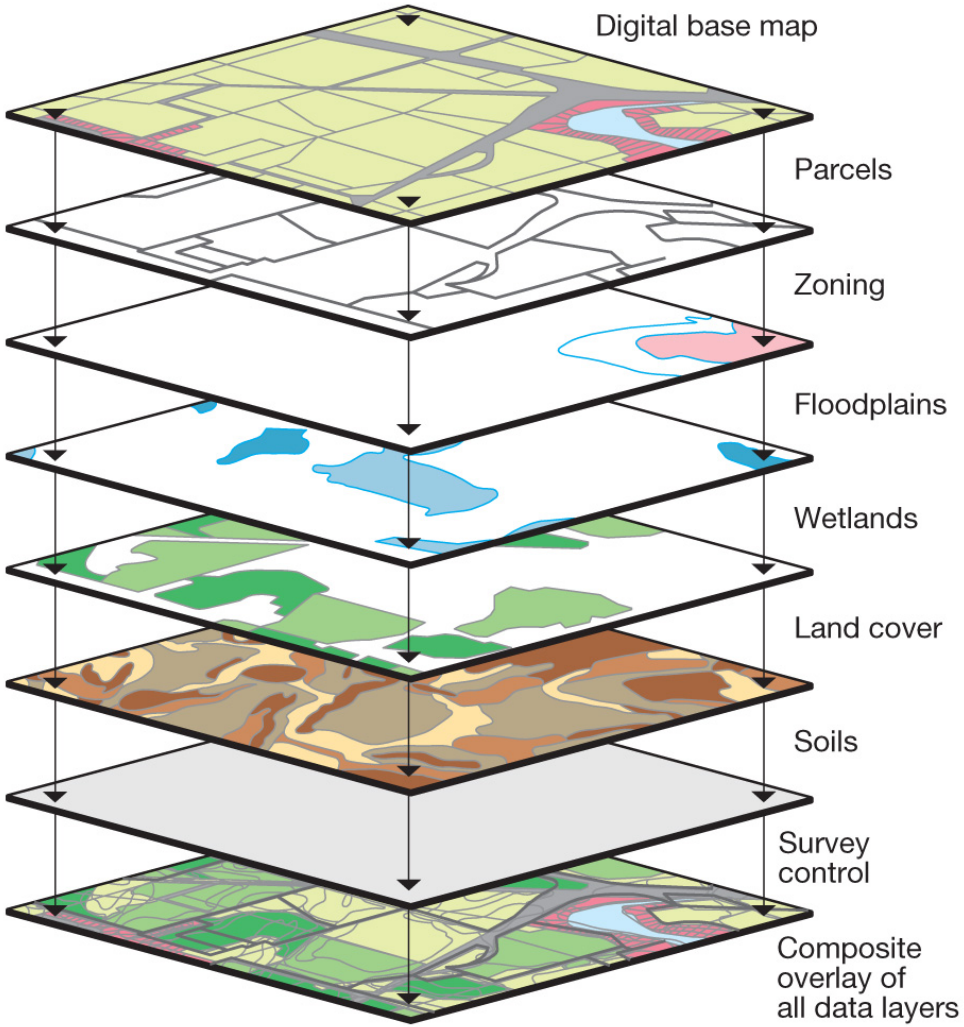
Passive

Active

Geographic Information Systems (GIS)

- GIS is a computer-based, data-processing tool for gathering, manipulating, and analyzing geographic information.
- Maps can contain multiple data layers:
  - Physical features
  - Cultural features
- Layers can be added to create composite overlay.

GIS Model



(a) Layered spatial data in a GIS format.

Summary of Chapter 1

- Geography is the science that studies the relationships among geographic areas, natural systems, society, cultural activities, and the interdependence of all of the above through space.
- The scientific method is essential to understanding Earth and the complex relations between Earth's physical systems and human society.
- Earth consists of three abiotic, or nonliving, systems: the atmosphere, hydrosphere, and lithosphere. It has one biotic, or living, system—the biosphere.
- Latitude and parallels, longitude and meridian allow all places on Earth to be precisely located.
- A map is a generalized depiction of the layout of Earth's surface area.
- Remote sensing obtains information about Earth systems from great distances without the need for physical contact.
- GIS is a computer-based, data-processing tool for gathering, manipulating, and analyzing geographic information.