Chapter 2

CONCEPT 2.1 REVIEW

1. How would seasonality in temperature and precipitation be affected if the earth's rotation on its axis were perpendicular to its plane or orbit about the sun?
2. Why does the annual rainy season in regions near 23º N begin in June?

Answers

1. There would be little or no seasonality in either temperature or precipitation.
2. The sun is directly overhead at 23.5° N latitude on June 21, the beginning of summer in the Northern Hemisphere, which results in cloud formation and precipitation at that latitude.

CONCEPT 2.2 REVIEW

1. Desert soils and agricultural soils support greatly different amounts of plant growth, but both generally have limited organic layers. Why?
2. Can soils be developed in the absence of plants?

Answers

1. The development of an organic horizon is limited in deserts as a result of low production of organic matter by plants and removal of organic matter from the soil surface by wind and water (during infrequent, intense rainstorms).
2. No. Soils results from the interaction between plants, parent materials, soil organisms, and climatic conditions. Without plants, the majority of carbon inputs into the soil will stop, and soils, as we define them, will not form. (This answer was not originally in 6USe and had to be pulled from the 1Ce file)

CONCEPT 2.3 REVIEW

1. Compare the biological diversity of Canada's major terrestrial biomes. What factors account for the relative differences among these biomes?
2. Why are soils in tropical rain forest generally depleted of their nutrients more rapidly compared to soils in the boreal forest?
3. Why do biomes differ in the relative amount of plant biomass that is found below ground? Why is most biomass in tundra and grasslands below ground?

Answers

1. The major Canadian biomes include tundra, grasslands, boreal forest, and temperate forests. While all biomes have a diversity of certain groups (e.g. tundra ecosystems have a diversity of large herbivores), the moderate temperatures and high rainfall give temperate forests a high level of plant diversity (woody and herbaceous), and vertical structure. This supports high levels of animal diversity. Boreal forests and grasslands have moderate biological diversity as plant diversity (hence food resources and vertical structure for habitat) are limited by cold temperatures and limited rainfall, respectively. Tundras have the lowest plant diversity given the short growing seasons, low temperatures, and generally limited precipitation. As a result, they have lower animal diversity than other terrestrial biomes.
2. Greater rainfall, higher average temperatures, and higher levels of biological activity all contribute to higher rates of nutrient depletion in tropical rain forest soils.
3. Amount of belowground plant biomass varies with climatic conditions and rates of decomposition. In the tundra, decomposition of dead organic matter is very slow. In grasslands, living plants concentrate their biomass belowground to defend against fire, drought, and grazing. (This answer was not originally in 6Use and had to be pulled from the 1Ce file)

CONCEPT 2.4 REVIEW

1. Considering atmospheric circulation patterns and the effects of urbanization on hydrology, why might cities carved our of temperate forest biomes be particularly vulnerable to climate change?
2. Why has agricultural and urban development been more intense in prairies than in boreal forests?

Answers

1. Temperate forests are found in areas with moderate to high rainfall. This is a consequence of atmospheric circulation patterns. Given the extensive impermeable surfaces, rban development limits percolation of precipitation into soil to ground water. Cities can be vulnerable to flooding. Large cities in areas that are likely to experience increased rainfall with climate change will become substantially more vulnerable.
2. Development has been more intense in prairies as the climate is more suitable for grain crops, which have

replaced native vegetation throughout most of the prairies. Proximity to agricultural production, and warmer temperatures have made prairies more attractive as places to settle and build cities.

ACTIVITY #2
CONSTRUCTING CONCEPT MAPS

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Purpose

Three different variations for students to construct a concept map in class.

Learning Objective(s) Addressed by this Activity

The development of concept maps can be adapted to many different topics. The specific content objective varies with the topic you use for the concept map.

Understand the advantages and uses of concept mapping in your studying.
All objectives *(Variation 3).*
Organize and synthesize information.

- Create connections among the concepts in the text. *(Variation 3).*

Class Size and Required Time

This activity works with small classes and large lecture classes, depending on the variation. Variation 3 works best with smaller classes. Developing the concept map takes one to two class periods, and depending on the variation about five minutes of the previous class to prepare for the day's activity.

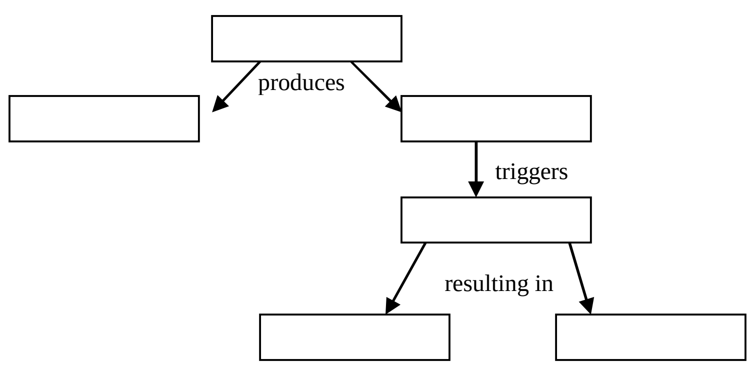
Materials Needed

Depending on the instructor's preferences, overhead transparencies (or large sheets of paper to ultimately be taped on the wall) and markers may be distributed for the students to prepare their map for Variation 3.

Description

This activity is very effective at getting students involved with course topics and to model the development of a concept map for students to use on their own. All of the following variations depend on group work in class, with a review of the concepts before the actual concept map is created. Based on your class size, you will want to determine how many groups you should have, and how many students should be in each group. In general, it is best to have three to five students in a group. As the students are creating their maps, circulate in the classroom, helping students and reminding them that most of the learning gains come from the process of creating the map rather than the finished map.

Since concept mapping is a tool that needs to be practiced it is a good idea to ease students into the process with less and less support as they master the skill. When the students are *first* introduced to the process provide a short list of terms or concepts, boxes, arrows, and linking terms:



The *second* time students are engaged in concept mapping hand out a list of concepts and/or terms and a framework of boxes, leaving out the linking terms. The *third* time students create maps have them develop the maps from a list of concepts and/or terms.

Variation 1: Challenging Concepts
Assign numbers to students using the following procedure, or another procedure you may prefer. Create a series of paper slips with numbers on them, drop them in a box, and then have each student randomly pick a slip of paper from the box. Students join other students with the same number to form groups. Present the challenging concepts in class and then direct the students to review the concepts you will be mapping by the next class meeting. Students join other students with the same number and create a concept map of the assigned topics.

Variation 2: Basic Concepts
Identify some of the more successful students to help serve as group facilitators. Create groups with two facilitators and three other students. Direct the students to review the concepts you will be mapping by the next class meeting. Have the students create a concept map of the concepts. Tapping the better students as facilitators works well because it helps them feel good about themselves, among other intangible benefits. Further, there are times when students can explain a concept to another student better than an instructor is, especially if a student is having trouble with terminology. Sometimes another student will explain the concept and make it clear.

Variation 3: Connecting the Concepts
Create the student groups the day before the activity and assign sections of a chapter (or other reading) to be read and reviewed in preparation for the map making activities the next day. Have the students decide on a spokesperson for the group who will write on the overhead transparency (or large sheet of paper) used for presenting the maps to the rest of the class. During the next class meeting, have the students create concept maps in different groups. After the concept maps are finished, direct the class to connect all of the maps with the appropriate linking terms, etc. After the groups have created their maps on overhead transparency film (or large sheets of paper), have the whole class connect the different maps in the appropriate places, with appropriate linking terms. This last activity can be an excellent way for the students to see the connections among the different concepts, but can be challenging for the students if they are having a hard time with the maps. If there are problems, the instructor can start the connecting process and model it for the students. This will usually get a few students to start seeing the connections and the instructor can “hand over” the pen for the students to continue the connecting activity. Students usually want copies of the overall map so copies can be made, depending on the instructor’s preferences.

Assessment

For a total of 20 points (*Note:* The numbers can be changed to fit your assessment needs.)

Level	
20 =	Used appropriate/accurate linking terms; Used appropriate hierarchy; Used all the terms; Drew a concept map
15 =	Mostly used appropriate/accurate linking terms; Mostly used appropriate hierarchy; Used at least six of the terms; Drew a concept map
10 =	Sometimes used appropriate/accurate linking terms; Sometimes used appropriate hierarchy; Used between three and six of the terms; Drew a concept map
5 =	Used inappropriate/inaccurate or no linking terms; Used inappropriate hierarchy; Used at least three of the terms; Drew a concept map
0 =	Did not use appropriate/accurate linking terms; Did not use appropriate hierarchy; Used less than three terms; Did not draw a concept map

Darby Nelson
Amanda Woods McConney

Answers to Review Questions

Chapter 2 – Life on Land

1. Draw a soil profile for the area around your university. Indicate the principal layers, or horizons. Describe the characteristics of each layer.

This exercise will require a good shovel and a place to dig that is both safely away from any buried services (gas, electric, etc.), and will not raise the ire of property owners! Dig down about a metre, if you can, and notice the changes in soil texture and colours. Drawings should reflect figure 2.5 and discussions under concept 2.2, as well as soil descriptions for the applicable biome (concept 2.3). You can consult with your instructor for further help in identifying things you see in your pit.

2. Describe global patterns of atmospheric heating and circulation. What mechanisms produce high precipitation in the tropics? What mechanisms produce high precipitation at temperate latitudes? What mechanisms produce low precipitation in the tropics?

Use figure 2.2 and the associated discussion as a guide. High precipitation in the tropics is produced by high rates of evaporation and subsequent condensation of water vapor in ascending air masses. The clouds formed in this way produce the heavy precipitation associated with the tropics. High precipitation at temperate latitudes is produced when warm, moisture-bearing subtropical air meets cold polar air, which forces condensation of the water vapor in the subtropical air mass. Many tropical environments experience drought during periods of El Niño (see chapter 23).

3. Use what you know about atmospheric circulation and seasonal changes in the sun's orientation to earth to explain the highly seasonal rainfall in the tropical dry forest and tropical savanna biomes. (Hint: Why does the rainy season in these biomes come during the warmer months?)

The seasonal rainfall of these biomes is produced by shifts in the latitude at which the sun is directly overhead. Figure 2.2a, which shows the sun directly overhead at the equator (generating storms through the processes of evaporation, condensation and precipitation of water), is really a snapshot of a dynamic system. The latitude at which the sun is directly overhead shifts between 23.5°N and 23.5°S, as the earth orbits the sun (fig. 2.1). This shifting latitude is sometimes called the "solar equator," and acts as a generator of tropical storms. In tropical dry forests, the wet season comes during the warmer time of the year when the sun is more nearly overhead. The dry season comes when solar input is less direct (sun's angle is more oblique).

4. We focused much of our discussion of biomes on their latitudinal distribution. The reasonably predictable relationship between latitude and temperature and precipitation provides a link between latitude and biomes. What other geographic variable might affect the distribution of temperature and precipitation and, therefore, of biomes?

Other major factors are altitude, distance from the oceans (the interiors of large continents are often dry), and the presence of mountains which can force release of precipitation in rising air masses, forming a "rain shadow" in the leeward (downwind) side.

5. You probably suggested altitude in response to the previous question because of its important influence on climate. Some of the earliest studies of the geographic distribution of vegetation suggested a direct correspondence between latitudinal and altitudinal variation in climate. Our discussion in this chapter stressed the similarities in climatic changes with altitude and latitude. What are some major climatic differences between high altitude at mid-latitudes and high altitude at high latitudes?

Since high altitude and high latitude have similar climatological effects, their co-occurrence amplifies these effects. Therefore, one of the greatest differences is the presence of permanent snow and ice on mountains at high latitudes.

6. How is the physical environment on mountains at mid-latitudes similar to that in tropical alpine zones? How do these environments differ?

The main similarity between midlatitude and tropical mountains is that, on both types of mountains, average annual temperature is lower at higher altitudes. One of the main differences is that tropical mountain environments lack the very strong seasonality in temperature that occurs on midlatitude mountains. Another difference is that daily variation in temperature in the alpine zone of high tropical mountains is nearly as great as seasonal temperature variation, with warm temperatures occurring each day and freezing temperatures occurring each night.

7. English and other European languages have terms for four seasons: spring, summer, autumn, and winter. This vocabulary summarizes much of the annual climatic variation at midlatitudes in temperate regions. Are these four seasons useful for summarizing annual climatic changes across the rest of the globe? Look back at the climate diagrams presented in this chapter. How many seasons would you propose for each of these environments? What would you call these seasons?

At very high latitudes it is cold much of the year with a brief cool growing season. In tropical climates the dominant seasonal change is from wet season to dry season. In other words, seasonal terms associated with midlatitudes do not fit the annual variations that occur in other parts of the earth. It would be interesting to catalog the traditional terms for seasonal changes used by native peoples living in different climatic zones. For example, Costa Ricans have categorized seasonal changes more thoroughly than is customary in temperate climates: in the middle of the wet season, for instance, there is a period of reduced rainfall which Costa Ricans call *veranillo*, meaning "little summer."

8. Biologists have observed much more similarity in species composition among boreal forests and among areas of tundra in Eurasia and North America than among tropical rain forests or among Mediterranean woodlands around the globe. Can you offer an explanation of this contrast based on the global distributions of these biomes?

There has been much greater connection and exchange across the tundra and boreal forests which form nearly continuous bands in the northern hemisphere. In contrast, the Mediterranean woodland and tropical rain forest biomes are highly fragmented with few opportunities for biotic exchange over long periods of evolutionary history.

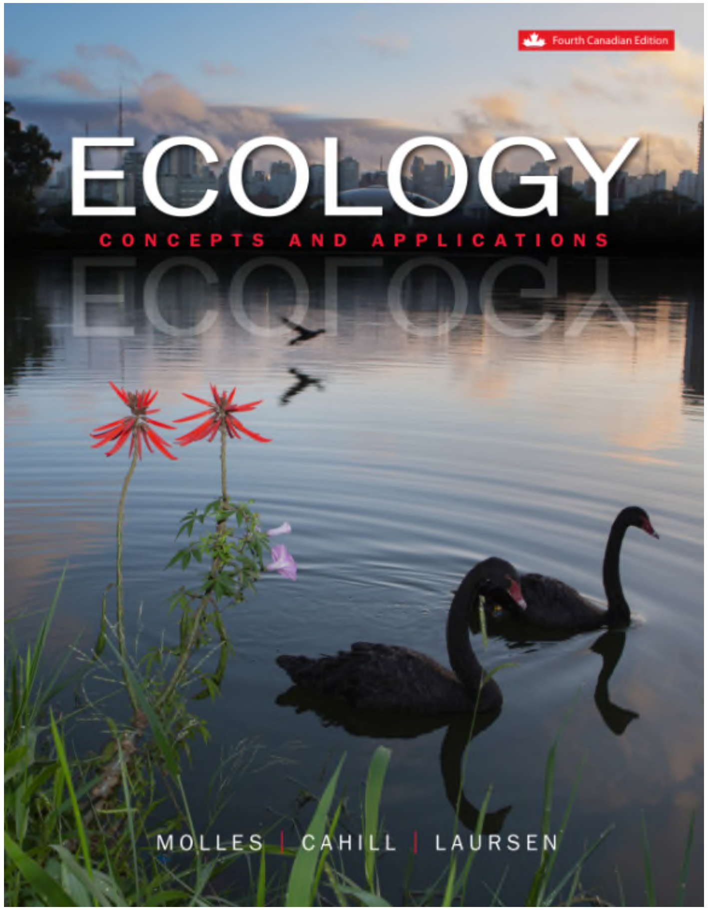
9. To date, which biomes have been the most heavily affected by humans? Which seem to be the most lightly affected? How would you assess human impact? How might these patterns change during this century?

Historically, the most heavily impacted biomes have been temperate forest, temperate grassland, desert, and Mediterranean woodland. Areas of tropical dry forest have also been heavily affected. Tropical rain forest, boreal forest, and tundra have been less influenced. The density of human-induced change on landscapes could be assessed using satellite imagery. The very high rates of human population growth in tropical countries and increasing resource extraction in the northern biomes will likely increase human impact in these areas in the future.

10. Draw a climate diagram for the location at your university. Climate data for Canada can be found at the Environment and Climate Change Canada Web page
http://www.ec.gc.ca/dccha-ahccd/

.Format should follow figure 2.4.

Chapter 2 Life on Land



PowerPoint Presentation prepared by:
Brian Cowan

- Large Scale Patterns of Climatic Variation
- Soil: Foundation of Terrestrial Biomes
- Terrestrial Biomes
- Human Dominated Systems

Chapter Concepts

2.1 Uneven heating of the earth's spherical surface by the sun and tilt of the earthy on its axis produce predictable latitudinal variation in climate.

2.2 Soil structure results from long-term interaction of climate, organisms, topography and parent mineral material.

2.3 Geographic distribution of terrestrial biomes corresponds with climate variation, especially temperature and precipitation.

2.4 Human activities (e.g. agriculture, urbanization) modify climate, biomes, soil and hydrology, reshaping biological communities.

Climatic Variation Part 1

- Climatic variation is due to uneven heating of earth's surface caused by it's spherical shape and angle of rotation.

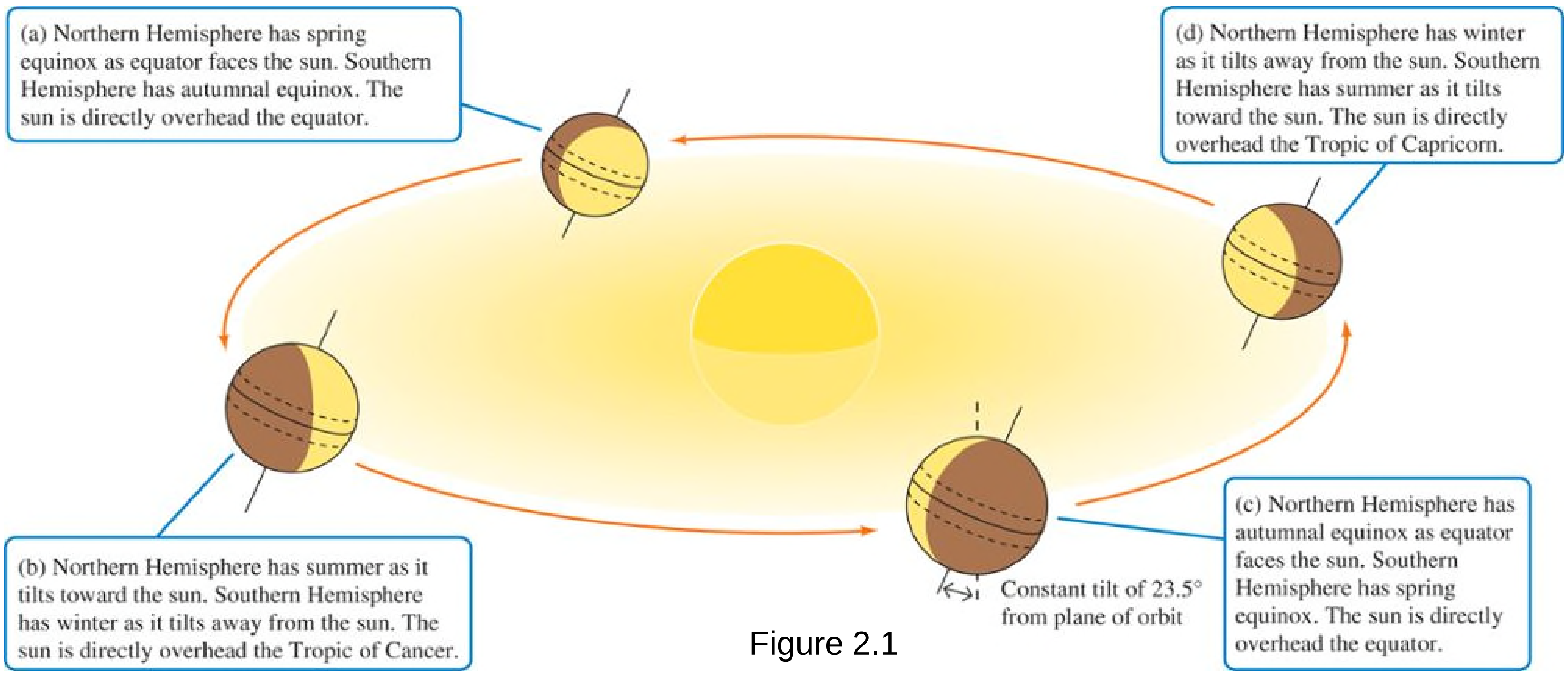


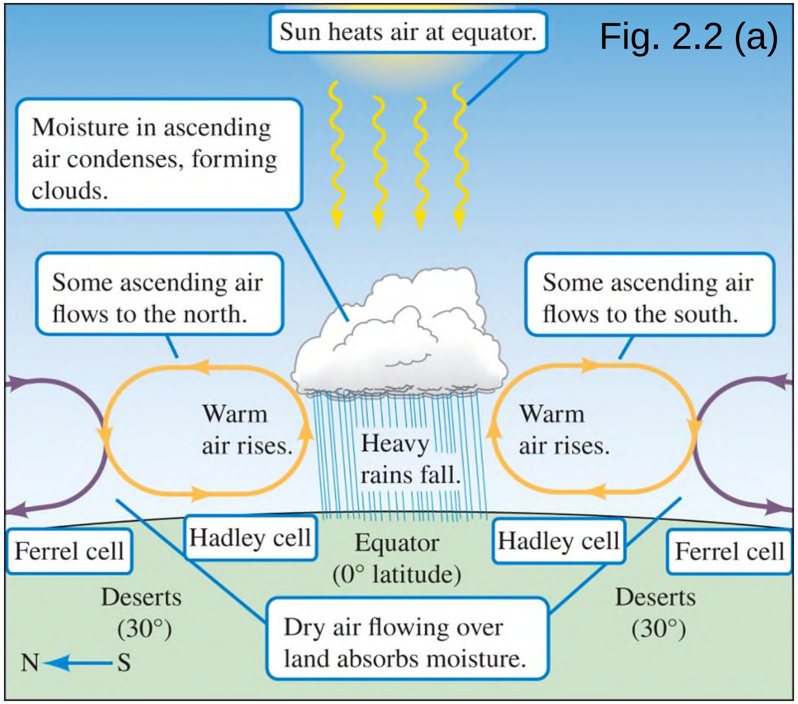
Figure 2.1

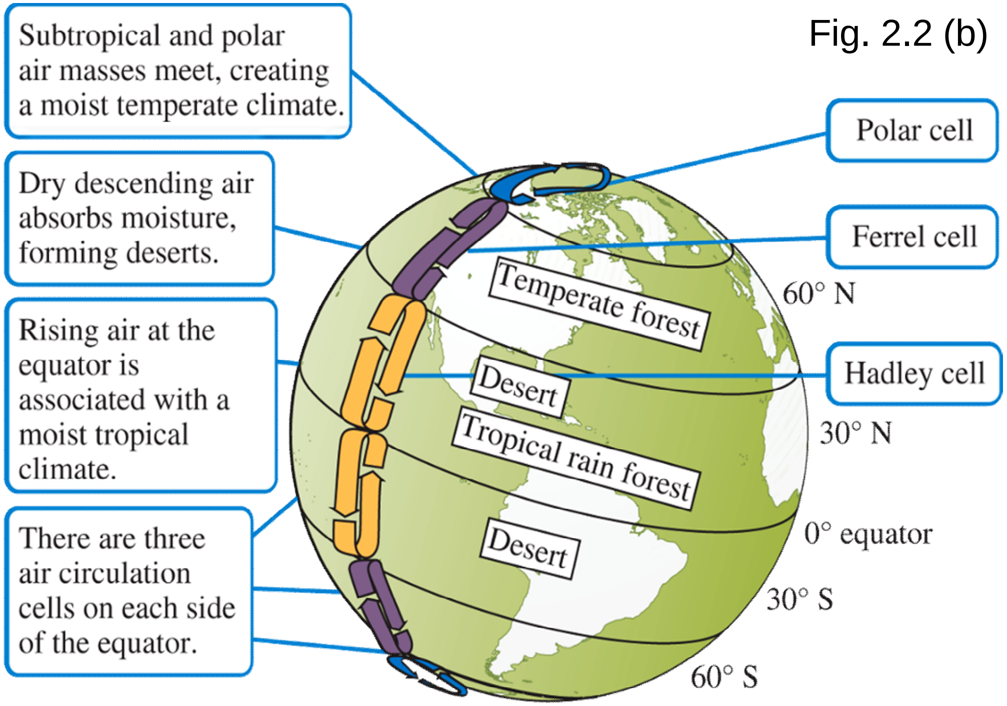
Climatic Variation Part 2

- Regular shifts in the latitudes at which the sun is directly overhead drives the changes associated with the seasons.
- At high latitudes of the both Hemispheres, seasonal shifts in of solar energy produce winters with low average temperatures and shorter day lengths; summers with high average temperatures and longer day lengths.
- Between the tropics of Cancer and Capricorn, seasonal variations in temperature and day length are slight, while precipitation may vary greatly.
- Air convection movement boundaried by specific latitudes create thermal loops called *cells*.

Climatic Variation Part 3

- Warm air rises. Dense cool air descends to take its place, creating looping currents of air (convection currents), bordered by specific latitudes. The currents are named ***cells*** (Fig. 2.2 b).





Climatic Variation Part 4

- As earth rotates West - East dragging air cells with it, a *Coriolius effect* creates prevailing wind patterns.

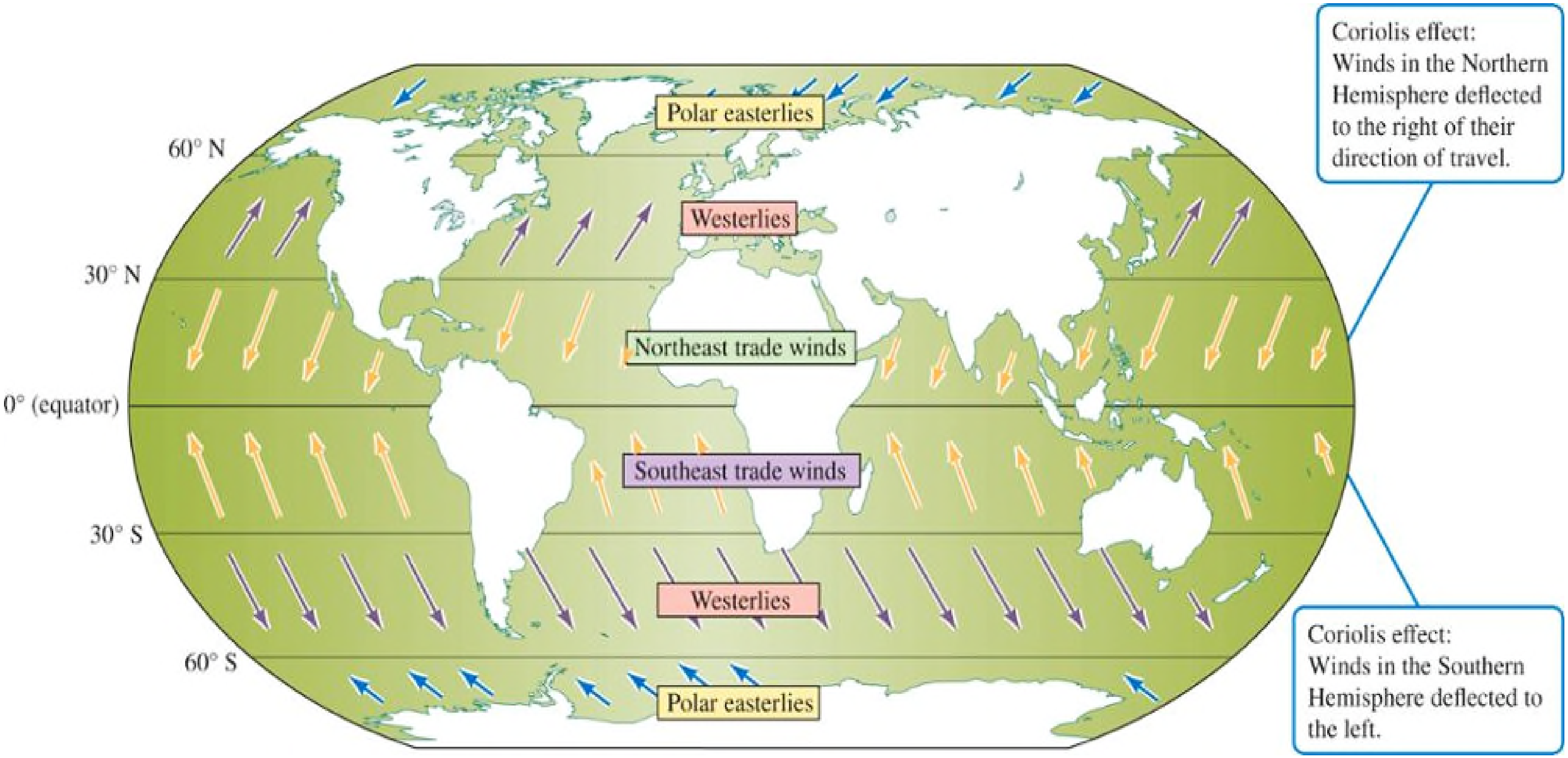


Figure 2.3 The Coriolis effect and wind direction.

Climatic Variation Part 5

- Climate diagrams explore relationships between climate and distribution of vegetation.
- They are structured summary of climate information:
  - seasonal variation in temperature/precipitation,
  - length and intensity of wet and dry seasons,
  - portion of year during which average minimum temperature is above and below 0 C.

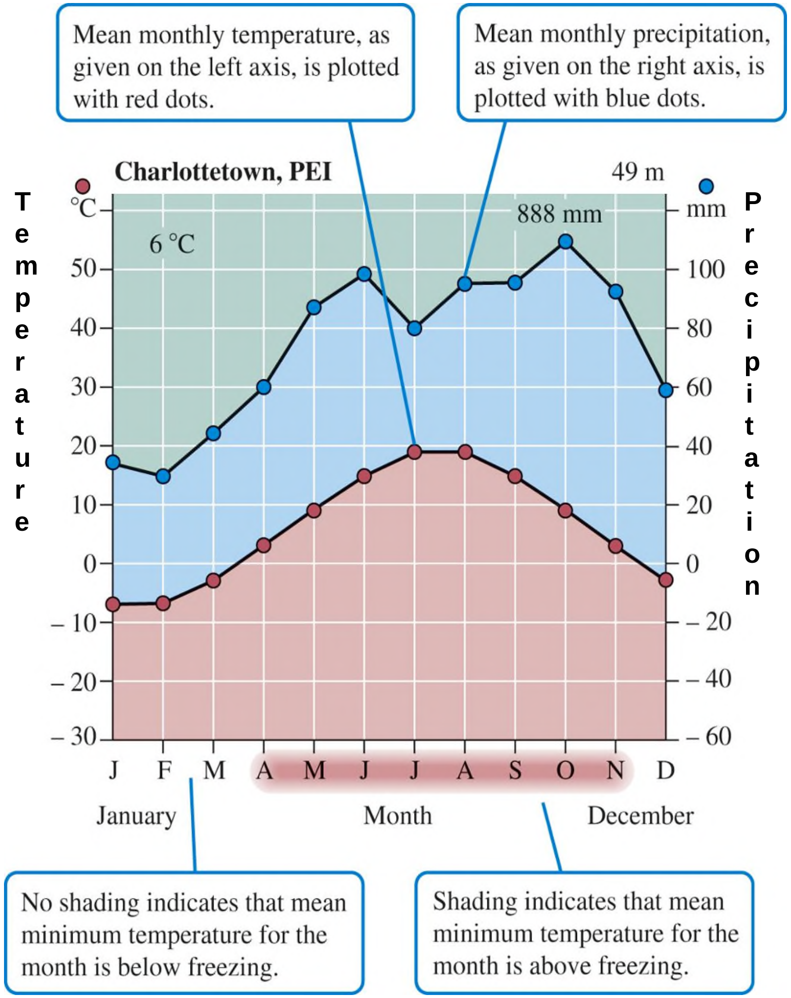


Fig. 2.4 (a)

Soil Part 1

- Soils are complex ecological systems; mixtures of living and nonliving material upon which most terrestrial life depends.

- Digging soil will often reveal distinct layers designated: LFH, A, B & C as above.

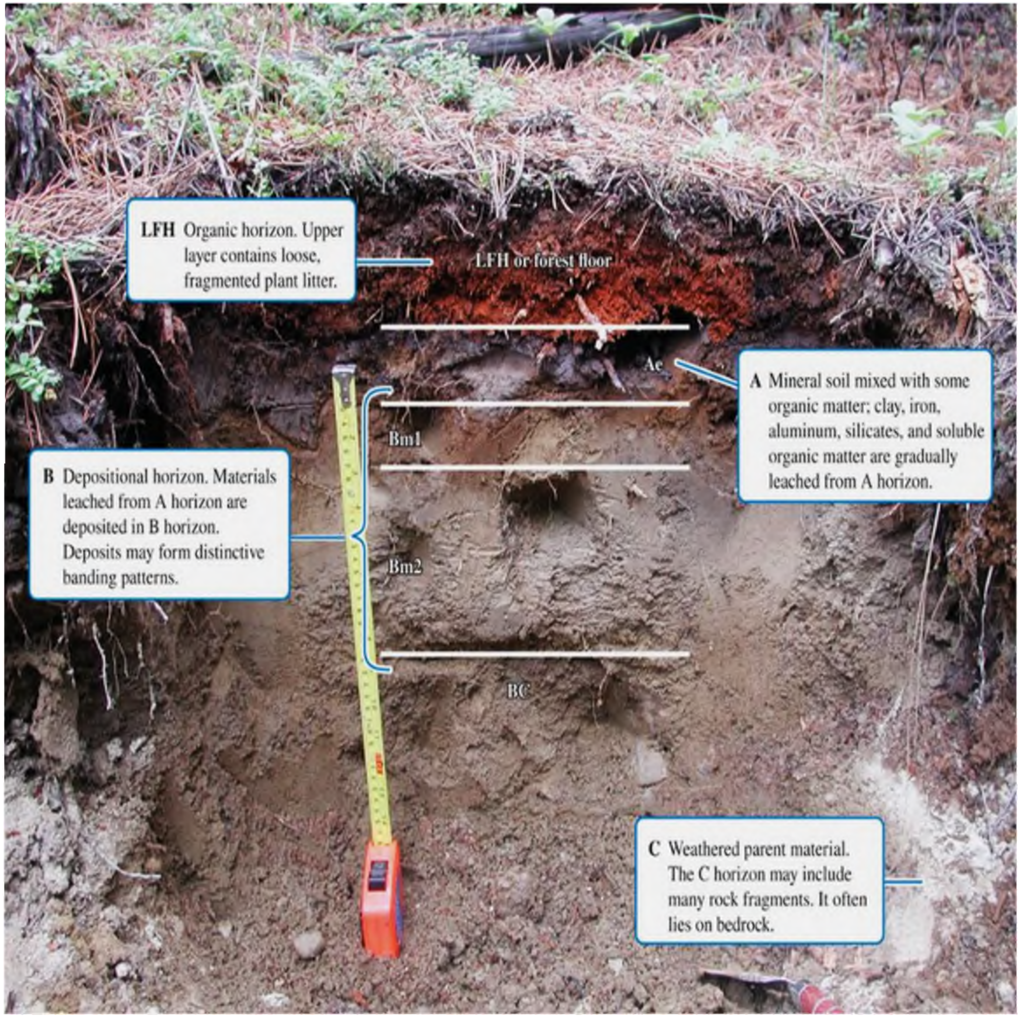


Fig. 2.5

Soil Part 2

- Not only does most land life depend on what grows from the soil, there is an abundant ecology living within the soil.
- These organisms provide nutrients useful to herbaceous growth, as well as food and habitat for larger organisms and are key to development of soil structure.

Fig. 2.6

Terrestrial Biomes Part 1

Terrestrial Biomes Part 2

- *Biomes* are major divisions of land environment based on specific climate with common plant species.
- Biomes constantly evolve. Boundaries can be rather subjective.

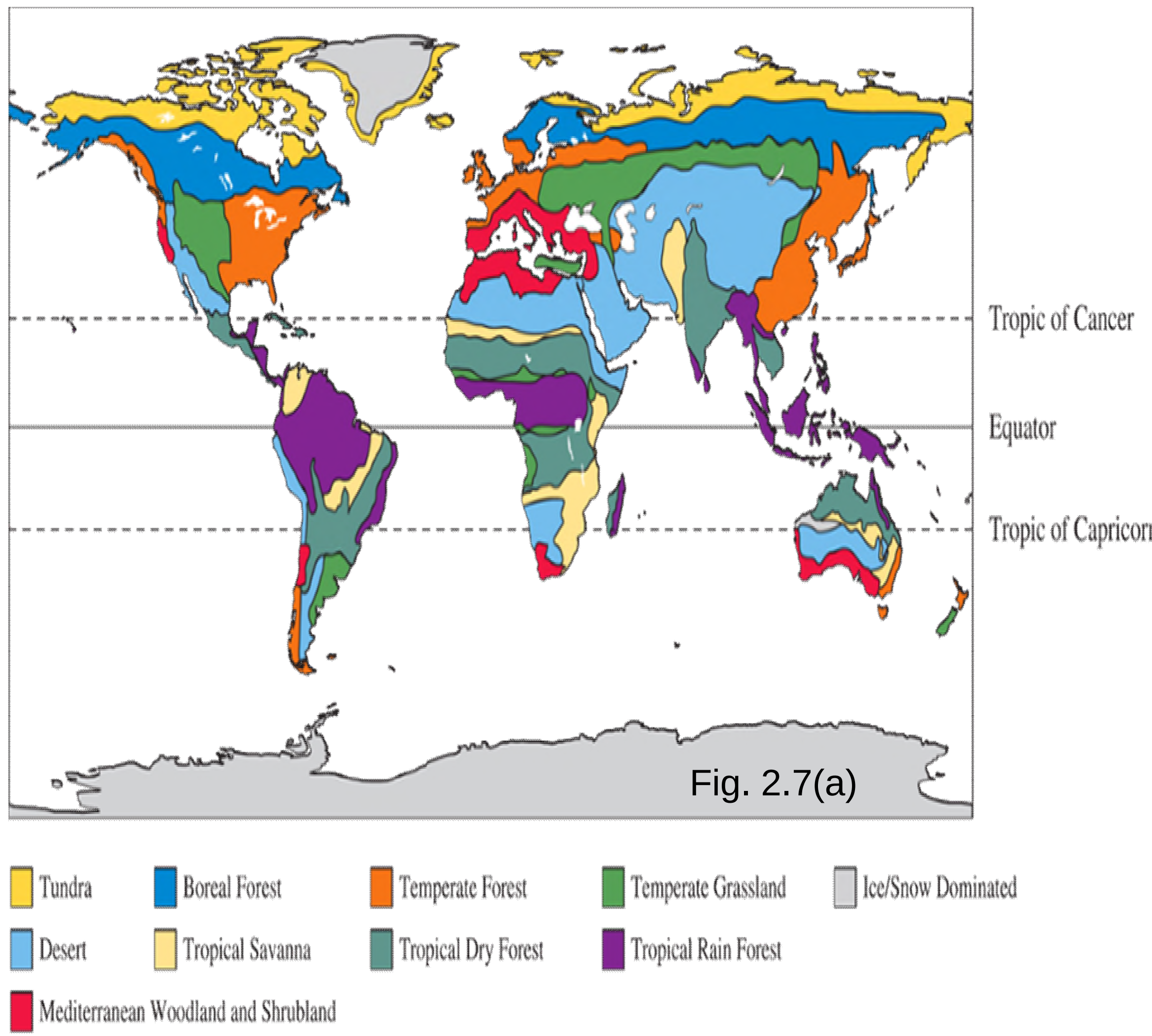


Fig. 2.7(a)

Terrestrial Biomes Part 3

Tundra Biome

Starting at the most northerly areas of vegetation, it covers most lands north of the Arctic Circle.

- open landscape,
- mosses, lichens, dwarf willows,
- dotted with small ponds and clear streams.

Terrestrial Biomes Part 4

Climate

- cold and dry
- short summers
- precipitation on the tundra varies <200 mm to > 600 mm.

Soils

- peat/humus (slowly decomposing organic matter),
- permafrost (frozen soil layer).

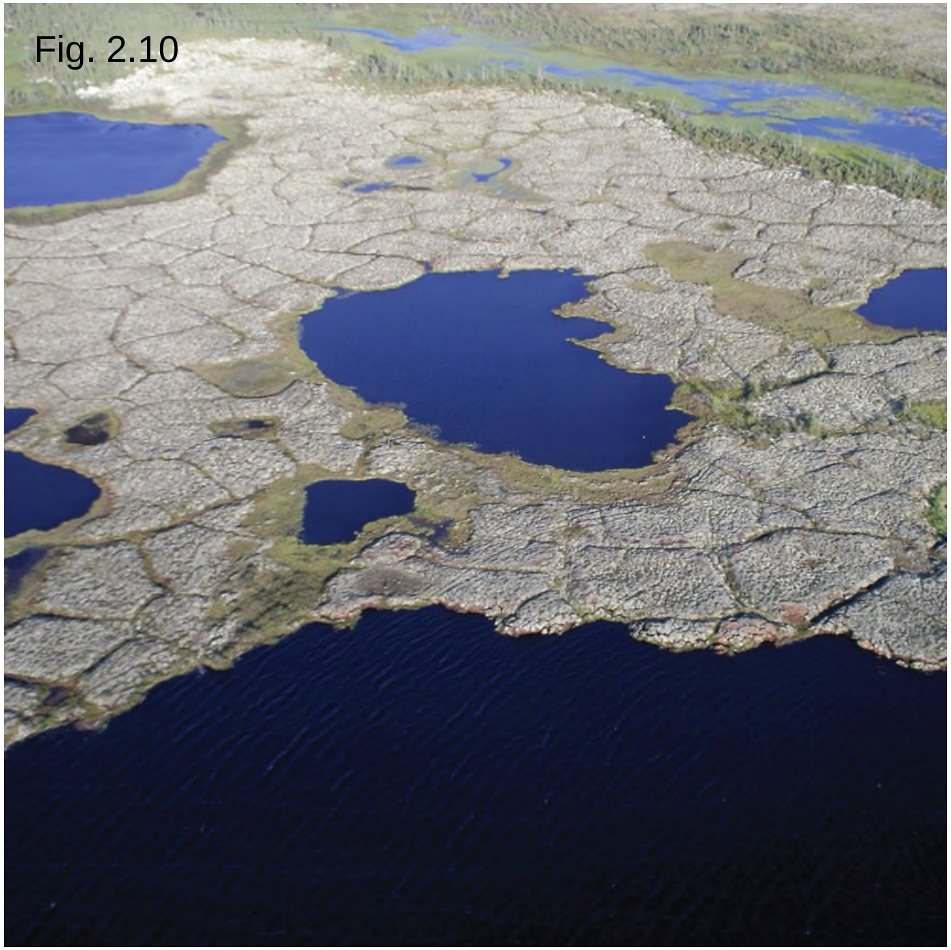


Fig. 2.10

Terrestrial Biomes Part 5

Biology

- perennial herbaceous plants (grass, sedge, moss, lichen),
- slow-growing dwarf willow and birch, low shrubs,
- reindeer, caribou, musk-ox, ptarmigan, lemmings, mosquitoes, migratory species.

Terrestrial Biomes Part 6

Boreal or **Taiga Biome**

Wood and water covering over 11% earth’s land area, around the globe in a repeating pattern of forest-water.

Fig. 2.11

- dense, coniferous forest,
- temperate forests and grasslands (south); tundra to north,
- no southern hemisphere version.

Terrestrial Biomes Part 7

Climate

- winters are usually longer than six months,
- summers too short to support temperate forest,
- low temperatures/long winters mean less evaporation rates, drought is infrequent or brief.

Soils

- thin, acidic, low fertility to thick, organic layers high fertility,
- low temperatures and low pH slow rates of decomposition and soil building,
- specific soil characteristics influenced by type/depth of bedrock,
- topsoil is thin, northern area subsoil may be permafrost.

Terrestrial Biomes Part 8

Biology

- generally dominated by evergreen conifers, willows along shores of rivers and lakes,
- plants have adapted to cold winters and low nutrient availability,
- mosses and other non-vascular plants that trap rainfall and shelter a diversity of insects and other organisms.
- scattered with expanses of bogs and fens dominated by a variety of moss species.
- mammals include: caribou, reindeer, moose, woodland bison, wolves, bear, lynx, wolverine, snowshoe hare, porcupines and red squirrels.

Terrestrial Biomes Part 9

Temperate Forest Biome
Old-growth temperate forest contains the largest living organisms on Earth, perhaps the largest that have ever lived.

- deciduous and coniferous,
- with milder winters, deciduous trees usually dominate forests,
- with severe winters or drier summers, conifers dominate.

Terrestrial Biomes Part 10

Climate

- moist growing season 4+ months long,
- winters last 3 – 4 months,
- snowfall may be heavy, but winters usually mild.

Soils

- fertile but variable, most fertile in deciduous areas having neutral to slightly acidic pH,
- rich in organic/inorganic matter and nutrients,
- soil to vegetation nutrient movement more dynamic in deciduous forest.

Terrestrial Biomes Part 11

Biology

- vertically stratified forest
  - lower layered vegetation (herb layer) at bottom
  - shrubs and saplings
  - shade-tolerant understory trees
  - canopy layer at top,
- all forest strata used by mammals (deer mice - bear),
- vast number of fungi/bacteria consume huge quantities of tree deadfall recycling essential nutrients.

Terrestrial Biomes Part 12

Temperate Grassland Biome

This is the largest biome in North America.

- southern Canada to Mexico,
- Rocky mountains to eastern forests,
- eastern Europe to eastern China,
- Uruguay, Argentina, Brazil, Australia, New Zealand.

Terrestrial Biomes Part 13

Climate

- maximum precipitation during summer growing season,
- can experience years-long drought.

Soil

- productive soils are deep, basic or neutral, fertile and contain large quantities of organic matter,
- black prairie soils (fertile) contain the most organic matter,
- brown soils (arid grassland) contain less organic matter.

Biology

- dominated by herbaceous vegetation with great diversity,
- trees and shrubs often limited to banks of streams/rivers,
- up to 80% biomass of some grasslands lives underground.

Terrestrial Biomes Part 14

Desert Biome

Desert occupies about 20% of Earth's land surface.

- drought and flash floods,
- heat/bitter cold,
- desert latitudes correspond to where dry subtropical air descends

Fig. 2.21(b)

Terrestrial Biomes Part 15

Climate

- conditions vary considerably from one desert to another,
- some have very little rainfall, others get 300 mm annually,
- water loss due to evaporation/transpiration by plants exceeds precipitation during most of the year,
- lack of available water, rather than hot temperatures, makes a desert,
- large expanses of Antarctica and Canada’s North are deserts.

Terrestrial Biomes Part 16

Soil

- generally low in organic matter, primarily sand and rock,
- soils beneath desert shrubs contain organic matter, forming islands of fertility,
- poorly drained valleys and lowlands often contain high concentrations of salts caused as water evaporates from the soil surface increasing aridity of the desert,
- animals can affect soil properties by burrowing/seed hoarding making it harder for plants to extract water.

Terrestrial Biomes Part 17

Biology

- plant cover is mostly absent leaving soil exposed,
- typically grey-green vegetation; lighter colours protect plant surfaces from intense light; reduce evaporation,
- plants may have small leaves or none at all; some produce leaves in response to rain then drop them in dry periods,
- others grow directly toward the sun reducing exposed surface area, reducing transpiration and heat imbalance,
- some plants remain in soil as dormant seeds to germinate and grow only during infrequent wet periods,
- wet periods can be short-lived, growth rates of many desert annual plant species are among the fastest on the planet.

Terrestrial Biomes Part 18

Biology con’d

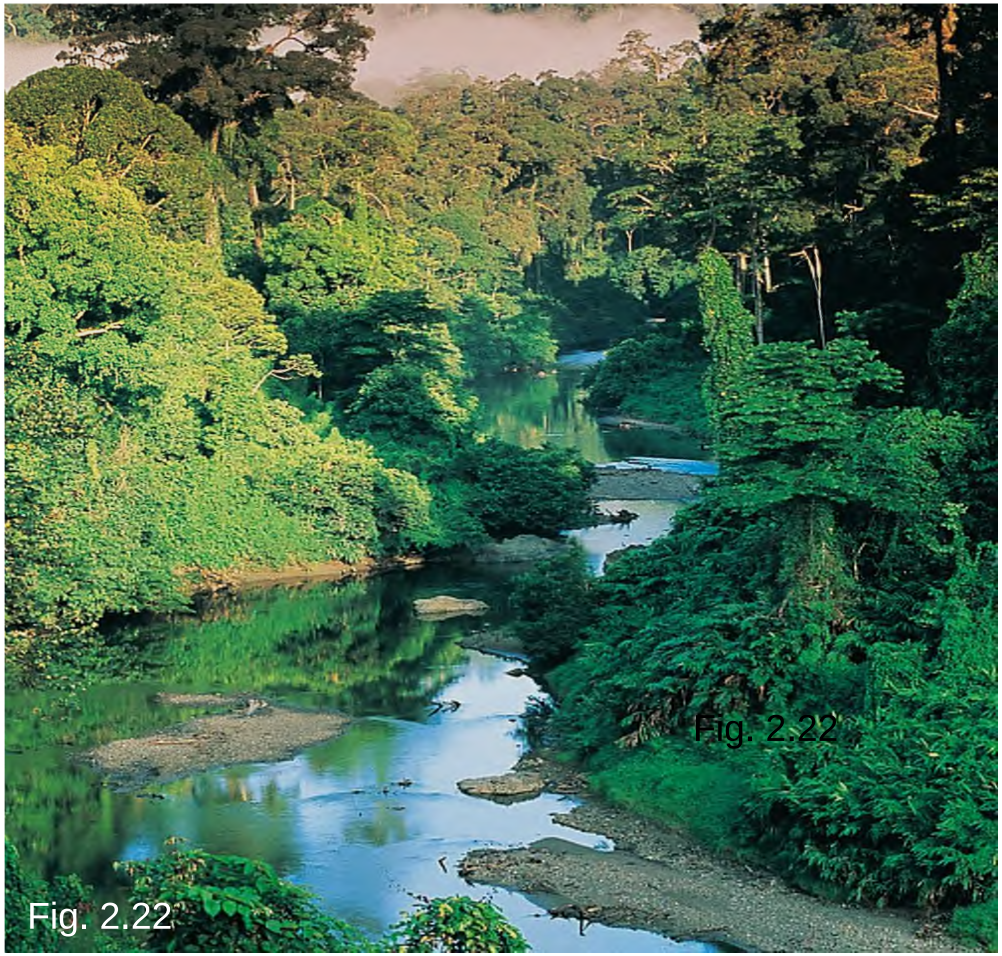
- animal life is sparse, but diverse,
- most desert animals use behaviour to cope with environmental extremes, avoiding heat of the day in summer and being active at dusk, dawn or night,
- in winter, the same species may be active during the day,
- animals also use body orientation to minimize heat absorption.

Terrestrial Biomes Part 19

Tropical Rain Forest Biome

Tropical rain forests straddle the equator in Southeast Asia, West Africa, and South and Central America.

- distribution coincides with year-round warm, wet conditions,
- temperatures vary little month to month; often change in a day as much as in a year.



Terrestrial Biomes Part 20

Soil

- often nutrient-poor, acidic, thin and low in organic matter,
- heavy rains leach nutrients from soil; rapid decomposition in warm, moist climate keeps organic horizon narrow,
- *lateritic soils* (high in iron, aluminum, low in essential nutrients) due to extensive weathering of parent rocks.
- free-living fungi, bacteria, soil animals scavenge nutrients from plant litter/animal wastes, depleting nutrients,
- rain forests growing on young volcanic soils, not yet leached of nutrients, are very fertile,
- fertile rain forest soils occur along rivers, where a fresh nutrient supply is delivered with each flood.

Terrestrial Biomes Part 21

Biology

- many organisms have evolved to live in trees,
- despite their great heights tropical rain forest trees form very shallow root systems to absorb nutrients as soon as they are available through activity of the soil food web.
- some plants grow roots up the stems of their neighbours to absorb nutrients leached out of their leaves,
- many trees use buttress roots (large roots on all sides of a tree that occur above the soil surface) to provide structural support rather than nutrient capture,
- 1 hectare of tropical rain forest can have >300 tree species,

Terrestrial Biomes Part 22

Biology con'd

- insects are the most diverse animal life form,
- some plants that cannot live without particular species of ants, mites that make their homes in the flowers of plants and depend on hummingbirds to get them from flower to flower, and trees and vines that continuously compete for access to light.

Human Dominated Systems Part 1

Human Dominated Systems

Human settlement largely follows resource abundance: food, water, suitable climate and access to trade routes.

Fig. 2.26

- >50% earth’s population is urban,
- located in temperate/tropical dry forests/grassland biomes
- urban and agricultural ecosystems are NOT biomes.

Human Dominated Systems Part 2

Agricultural & Urban Ecosystems

- all living things affect and are affected by environments,
- humans affect environment more than any other animal species in ways not always positive,
- cities are less productive ecosystems than those they replace,
- agricultural productivity has increased due to chemicals.

Fig. 2.28

Human Dominated Systems Part 3

Agricultural & Urban Ecosystems

- altering drainage paths may export more nutrients to coast,
- demands for water can outstrip natural resupply through precipitation and aquifer,
- chemical nutrients used to stimulate crop growth can cause algae and cyanobacteria in water.

Fig. 2.29

Human Dominated Systems Part 4

Human Impacts on Biomes

- human habitation mostly affects woodlands/grasslands,
- global agricultural development has left grasslands among the most critically endangered biomes,
- 35 to 40 years continuous agriculture has caused the loss of 35% - 40% of soil organic matter,
- tundra enterprises have caused rapidly rising permafrost temperatures and increased rates of decomposition releasing CO_2 into the atmosphere,
- ecological responses that occur as a result of human activities can have dramatic consequences for humans across the planet.

Summary

1. Regular shifts in the latitudes at which the sun is directly overhead drives the changes associated with the seasons.
2. Rising warm air is replaced by denser cool air in a recycling loop which is called a *cell*.
3. ***Coriolis effect*** - as air cells loop, earth rotates imparting an east-west or west-east (depending on latitude) direction to the cells which is called the Cariolis effect.
4. Climate diagrams are graphs designed to show the relationship between temperature, precipitation (climate) and the distribution of vegetation.
5. *Biomes* are major divisions of land environment related to climate and distinguished by common plant species.

Summary

6. There are six major terrestrial biomes: Tundra, Boreal (Taiga), Temperate Forest, Temperate Grassland, Desert, and Tropical Rain Forest.
7. Human dominated systems are human-inhabited which are related to resource abundance (mostly temperate/tropical dry forest and grasslands).
8. All living things affect, and are affected by, the environment. Humans affect all ecosystems more than any other land animal.
9. Agriculture has most critically endangered grasslands.
10. Tundra enterprises increase warming of the permafrost and rates of tundra decomposition.