Seasons & Biomes

Getting To Know Your
Terrestrial Biomes

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Getting To Know Your Terrestrial Biomes

Purpose

- To help students become familiar with the Terrestrial Biome Classifications that the Seasons and Biomes project has adopted.

Overview

Students will become familiar with the Seasons and Biomes' Terrestrial Biome Classifications. They will do background research using a variety of sources (world wide web, reference books, magazines, newspapers, etc.) to create a personalized description of each of the main biome classifications.

Student Outcomes

Students will be able to:
- Use appropriate sources of information.
- Synthesize data from different sources to create a coherent description of the main biomes.

Scientific Inquiry Abilities
- Identify appropriate sources of information
- Organize data into tables
- Draw conclusions by synthesizing a variety of data
- Communicate results and explanations

Time

Two or more class periods.

Level

Beginning, Intermediate, Advanced

Materials and Tools

- Access to the internet and/or reference materials
- Sources of images (internet, magazines, newspaper etc.) to complete the worksheet
- Access to printer
- Worksheet
- Pencils, pens, glue, etc.

Preparation

The teacher might want to compile a source of images and/or identify appropriate web sites.

Prerequisites

Familiarity with the Climate Zones and Biomes activity (optional)

Background

Climate plays a major role in determining biome type; conversely changes in vegetation structure or plant cover has been used to indicate change in climate type. The biome concept developed as a way of classifying Earth's terrestrial communities into major ecological units that correlated with regional climate types (Woodward 2003), More than a decade before the term biome was used, Wladimir Koppen (1923) had developed a classification system for world climate types using annual and seasonal patterns of temperature and moisture as well as global vegetation patterns. Koppen's climate classification correlates closely with terrestrial biomes and is a useful tool to increase understanding of the relationship between climate and vegetation. Biome types are based on similarities in the dominant vegetation, climate (precipitation, temperature, and water depth), geographic location (latitude, elevation) and other characteristics.

Terrestrial Biome Classifications

The Seasons and Biomes Project has decided to adopt the Biome Classification System developed by The Nature Conservancy and the World Wildlife Fund (WWF). This classification is also being used by the National Geographic Society (www.nationalgeographic.com/) and the Millennium Ecosystem Assessment (www.millenniumassessment.org/). This biome classification resulted from extensive collaboration with over 1,000 biogeographers, ecologists, taxonomists, and conservation biologists

from around the world (Olson et al., 2001). This classification has three tiers:

- ◦ 8 biogeographical realms
- ◦ 14 terrestrial biomes
- ◦ >800 ecoregions

1. A biogeographic realm is a large spatial region within which ecosystems share a broadly similar biological evolutionary history. Eight terrestrial biogeographic realms are typically recognized, corresponding roughly to continents. Although similar ecosystems (such as tropical moist forests) share similar processes and major vegetation types wherever they are found, their species composition varies markedly depending on the biogeographic realm in which they are found (www.greenfacts.org/en/biodiversity/figtableboxes/1013-biomes-map.htm). These are sometimes referred to as ecozones.

2. A biome is a climatically and geographically defined area of ecologically similar communities of plants, animals and soil organisms that interact with the abiotic components of the environment, and each community is a separate local ecosystem. When these local ecosystems are repeated many times over a large expanse of territory, then a biome is a particular landscape.. Biomes occur in latitudinal swaths and several also occur in altitudinal belts on mountains in middle latitudes (Woodward 2003). Whittaker's (1970) definition of a biome as a grouping of terrestrial ecosystems of plants and animals, on a given continent align more with the biogeographic realm described above. Biomes are also defined based on factors such as plant structures (such as trees, shrubs, and grasses), leaf types (such as broadleaf and needleleaf), plant spacing (forest, woodland, savanna), and climate

.

The eight biogeographic realms and the 14 major biomes (major habitats) are listed below and illustrated in Figure 1:

BIOGEOGRAPHIC REALMS
- **Nearctic** – North America, Greenland and the highlands of Mexico
- **Neotropic** –Central and South America, the Mexican lowlands, the Caribbean Islands and southern Florida
- **Palearctic** – Eurasia and northern Africa
- **Afrotropic** – Africa south of the Sahara Desert. Madagascar and the southern and eastern fringes of the Arabian Peninsula
- **Indo-Malay** – Southern and Southeast Asia
- **Australasia** –Australia, New Zealnd, Papua New Guinea and neighboring islands
- **Antarctic** – Antarctica, South Georgia and the South Sandwich Islands, South Orkney Islands, the South Shetland Islands, Bouvet Island, the Crozet Islands, Prince Edward Islands, Heard Island, the Kerguelen Islands and the McDonald Islands
- **Oceania** – Pacific Ocean islands of Micronesia, the Fijian Islands, most of Polynesia (not New Zealand)

BIOMES (MAJOR HABITATS TYPES)
- Tundra
- Boreal forest/ Taiga
- Montane grasslands and shrublands
- Temperate coniferous forests
- Temperate broadleaf and mixed forests
- Tropical and sub-tropical moist broadleaf forests
- Tropical and sub-tropical dry broadleaf forests
- Tropical and sub-tropical coniferous forests
- Mediterranean forests , woodlands and scrub
- Tropical and sub-tropical grasslands, savannas and shrublands
- Temperate grasslands, savannas and shrublands
- Deserts/Xeric shrublands
- *Flooded grasslands* and savannas
- *Mangroves*
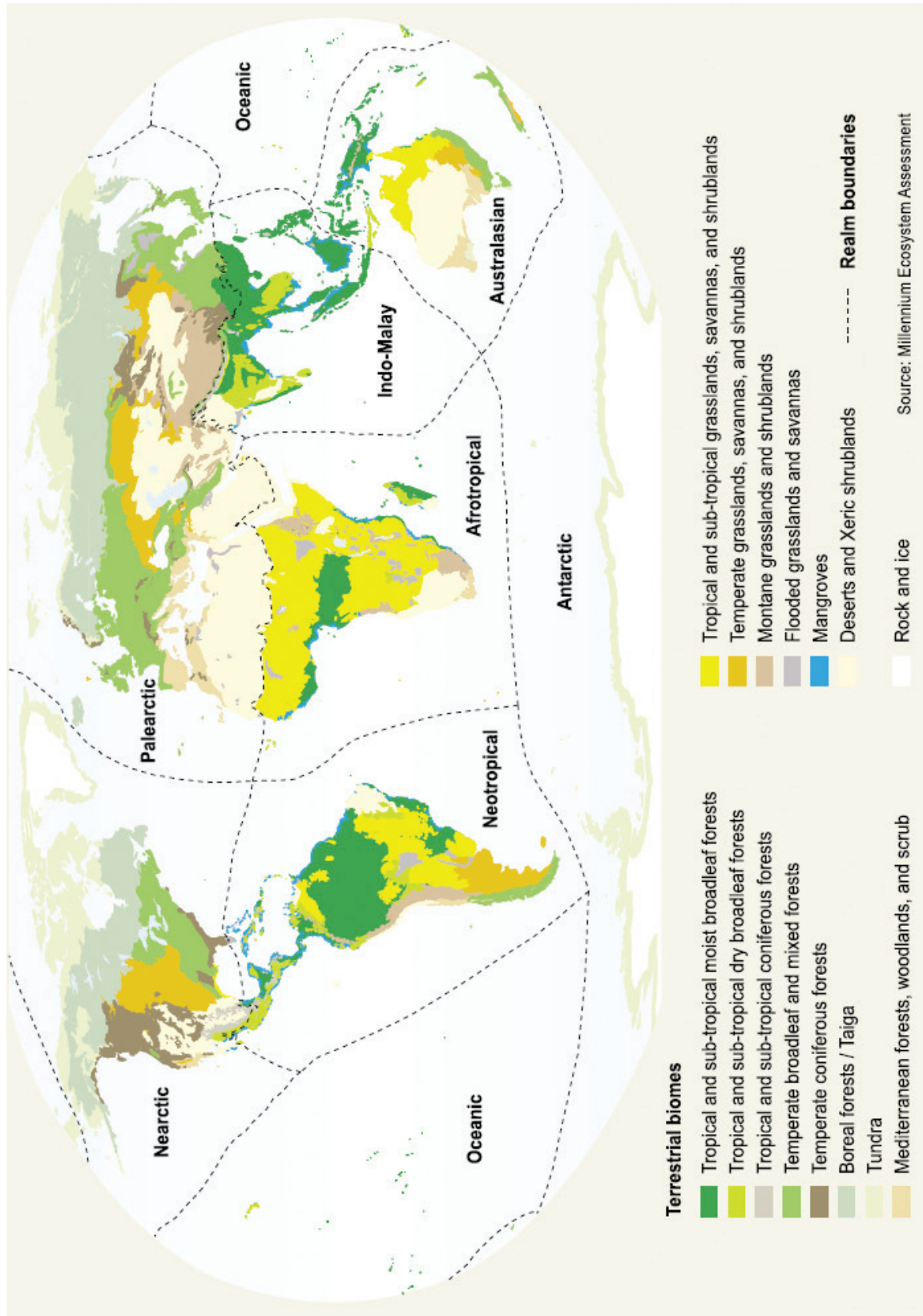
Figure 1. The global distribution of the eight biogeographic realms and the 14 major biomes.

Original source for Map: D.M. Olson et al. 2001

Terrestrial biomes

- Tropical and sub-tropical moist broadleaf forests
- Tropical and sub-tropical dry broadleaf forests
- Tropical and sub-tropical coniferous forests
- Temperate broadleaf and mixed forests
- Temperate coniferous forests
- Boreal forests / Taiga
- Tundra
- Mediterranean forests, woodlands, and scrub

- Tropical and sub-tropical grasslands, savannas, and shrublands
- Temperate grasslands, savannas, and shrublands
- Montane grasslands and shrublands
- Flooded grasslands and savannas
- Mangroves
- Deserts and Xeric shrublands
- Rock and ice

- - - - - - **Realm boundaries**

Source: Millennium Ecosystem Assessment

Terrestrial Biome Classification Category Descriptions

Here we provide a general description of each biome. A full description of each biome, including location, plant communities, climate, biodiversity patterns, minimum requirements, sensitivity to disturbance and a list of ecoregions that fall into the biome designation, can be found at (http://wwf.panda.org/about_our_earth/ecoregions/about/habitat_types/selecting_terrestrial_ecoregions/)

Terrestrial Biomes

Tropical and subtropical moist broadleaf forests (tropical and subtropical, humid): Generally found in large, discontinuous patches centered on the equatorial belt and between the Tropics of Cancer and Capricorn, Tropical and Subtropical Moist Forests are characterized by low variability in annual temperature and high levels of rainfall (>200 centimeter annually). Forest composition is dominated by semi-evergreen and evergreen deciduous tree species.
(http://wwf.panda.org/about_our_earth/ecoregions/about/habitat_types/selecting_terrestrial_ecoregions/habitat01.cfm)

Tropical and subtropical dry broadleaf forests (tropical and subtropical, semi-humid): Though these forests occur in climates that are warm year-round, and may receive several hundred centimeters or rain per year, they deal with long dry seasons which last several months and vary with geographic location. These seasonal droughts have great impact on all living things in the forest. (http://wwf.panda.org/about_our_earth/ecoregions/about/habitat_types/selecting_terrestrial_ecoregions/habitat02.cfm)

Tropical and subtropical coniferous forests (tropical and subtropical, semi-humid): These tropical regions experience low levels of precipitation and moderate variability in temperature. Tropical and Subtropical Coniferous Forests are characterized by diverse species of conifers, whose needles are adapted to deal with the variable climatic conditions (http://wwf.panda.org/about_our_earth/ecoregions/about/habitat_types/selecting_terrestrial_ecoregions/habitat03.cfm)

Temperate broadleaf and mixed forests (temperate, humid): This biome is characterized by rainfall broadly distributed throughout the year and consists of deciduous trees, sometimes mixed with species of evergreens. Species such as oak (Quercus spp.), beech (Fagus spp.), birch (Betula spp.), and maple (Acer spp.) typify the composition of the Temperate Broadleaf and Mixed Forests (http://wwf.panda.org/about_our_earth/ecoregions/about/habitat_types/selecting_terrestrial_ecoregions/habitat04.cfm)

Temperate coniferous forests (temperate, humid to semi-humid): Temperate evergreen forests are found predominantly in areas with warm summers and cool winters, and vary enormously in their kinds of plant life. In some, needleleaf trees dominate, while others are home primarily to broadleaf evergreen trees or a mix of both tree types. Temperate evergreen forests are common in the coastal areas of regions that have mild winters and heavy rainfall, or inland in drier climates or montane areas. Many species of trees inhabit these forests including pine, cedar, fir, and redwood (http://wwf.panda.org/about_our_earth/ecoregions/about/habitat_types/selecting_terrestrial_ecoregions/habitat05.cfm)

Boreal forests/taiga (subarctic, humid): Low annual temperatures characterize northerly latitudes; precipitation ranges from 40-100 centimeters per year and may fall mainly as snow. This combination, along with nutrient poor soils - largely a result of permafrost and the resultant poor drainage - favors the preponderance of conifer species (Abies, Picea, Larix, and Pinus), although species of deciduous trees are also rather common: Betula spp. and Populus spp. Ground cover in Boreal Forests and Taiga is dominated by mosses and lichens (http://wwf.panda.org/about_our_earth/ecoregions/about/habitat_types/selecting_terrestrial_ecoregions/habitat06.cfm).

Tundra (Arctic, Antarctic, alpine): The tundra is a treeless polar desert found in the high latitudes in the polar regions, primarily in Alaska, Canada, Russia, Greenland, Iceland, and Scandinavia, as well as sub-Antarctic islands. The region's long, dry winters feature months of total darkness and

extremely frigid temperatures (http://wwf.panda.org/about_our_earth/ecoregions/about/habitat_types/selecting_terrestrial_ecoregions/habitat11.cfm)

Mediterranean forests, woodlands, and shrub (temperate warm, semi-arid with winter rainfall): This biome is characterized by hot and dry summers, while winters tend to be cool and moist. Most precipitation arrives during these months. Most plants are fire adapted, and dependent on this disturbance for their persistence (http://wwf.panda.org/about_our_earth/ecoregions/about/habitat_types/selecting_terrestrial_ecoregions/habitat12.cfm).

Tropical and subtropical grasslands, savannas, and shrublands (tropical and subtropical, semi-arid): This biome is characterized by rainfall levels between 90-150 centimeters per year (http://wwf.panda.org/about_our_earth/ecoregions/about/habitat_types/selecting_terrestrial_ecoregions/habitat07.cfm).

Temperate grasslands, savannas, and shrublands (temperate, semi-arid): This biome differs largely from tropical grasslands in the annual temperature regime as well as the types of species found here. Generally speaking, these regions are devoid of trees, except for riparian or gallery forests associated with streams and rivers. However, some regions do support savanna conditions characterized by interspersed individuals or clusters of trees (http://wwf.panda.org/about_our_earth/ecoregions/about/habitat_types/selecting_terrestrial_ecoregions/habitat08.cfm).

Montane grasslands and shrublands (alpine or montane climate): This major habitat type includes high elevation (montane and alpine) grasslands and shrublands. They are tropical, subtropical, and temperate. The plants and animals of tropical montane paramos display striking adaptations to cool, wet conditions and intense sunlight. Around the world, characteristic plants of these habitats display features such as rosette structures, waxy surfaces, and abundant pilosity (http://wwf.panda.org/about_our_earth/ecoregions/about/habitat_types/selecting_terrestrial_ecoregions/habitat10.cfm).

Flooded grasslands and savannas (temperate to tropical, fresh or brackish water inundated): Common to 4 of the continents on Earth are large expanses or complexes of flooded grasslands. These areas support numerous plants and animals adapted to the unique hydrologic regimes and soil conditions. Large congregations of migratory and resident waterbirds may be found in these regions (http://wwf.panda.org/about_our_earth/ecoregions/about/habitat_types/selecting_terrestrial_ecoregions/habitat09.cfm).

Mangrove (subtropical and tropical, salt water inundated): Mangroves occur in the waterlogged, salty soils of sheltered tropical and subtropical shores. They are subject to the twice-daily ebb and flow of tides, fortnightly spring and neap tides, and seasonal weather fluctuations. They stretch from the intertidal zone up to the high-tide mark. These forests are comprised of 12 genera comprising about 60 species of salt-tolerant trees (http://wwf.panda.org/about_our_earth/ecoregions/about/habitat_types/selecting_terrestrial_ecoregions/habitat14.cfm).

Deserts and xeric shrublands (temperate to tropical, arid): Worldwide, Deserts and Xeric Shrublands vary greatly in the amount of annual rainfall they receive; generally, however, evaporation exceeds rainfall in these ecoregions, usually less than 10 inches annually. Temperature variability is also extremely diverse in these remarkable lands. Many deserts, such as the Sahara, are hot year-round but others, such as Asia's Gobi, become quite cold in winter (http://wwf.panda.org/about_our_earth/ecoregions/about/habitat_types/selecting_terrestrial_ecoregions/habitat13.cfm).

List of Terrestrial Ecoregions
There is also a list of ecoregions (terrestrial and water) at http://wwf.panda.org/about_our_earth/ecoregions/ecoregion_list/. This list is organized by biome and then biogeographic realm; that is, the main headings are the biome categories and under these there are lists of ecoregions sorted by biogeographic realm. For example:

BIOME	BIOGEOGRAPHIC REALM	ECOREGION
Tropical and Subtropical Moist Broadleaf Forests	Indo-Malayan	Philippines Moist Forest
Boreal Forests/Taiga	Palearctic	Eastern Siberian Taiga
Montane Grasslands and Shrublands	Australasia	Central Range Subalpine Grasslands
Deserts and Xeric Shrublands	Afrotropical	Madagascar Spiny Thicket
Tundra	Nearactic	Alaskan North Slope Coastal Tundra

The link to each ecoregion contains information about the region. This includes the size, geographical location, climate description, plant and animal species, etc. as well as links to supporting information on other web sites.

Human Alterations to Natural Biomes

The Seasons and Biomes Project also recognizes that the natural landscape is altered to one extent or another by human activities. To address this issue a set of secondary identifiers has been adopted. This set of human activity identifiers consists of:
1. Urban (dense settlement, pop. >2500)
2. Rural (villages)
3. Cropland/Agricultural
4. Rangeland/Grazing
5. Forestry
6. Little Human Influence
7. No Human Influence

What to do and how to do it

Ask the students what they know about biomes and make sure that they have a good understanding of the variables that produce a biome (climate, geography and topography) and the easily identifiable elements that describe a biome (soils, plants and animals).

This activity will revolve around the Terrestrial Biome Classification System. As a consequence, a map of it should either be projected on the wall so it is easily visible or copies of it should be passed out to the students. If you are distributing biome maps, you may want to use the continental biome maps from the Climate Zones and Biomes activity.

- Divide the class into 14 groups (one for each biome classification).
- Quickly review the worksheet so that everyone understands what is expected.
- Have each group choose a site that is located in their biome. This will probably be a town or city because these are the places where weather data are acquired.
- Give the students enough time to locate the relevant data and complete the worksheet.
- Have the students present their results to the class.
- Discuss the overall results (similarities and differences).
- Address any difficulties the students had assembling their data (lack of data, conflicting data) and how these problems might be resolved.

Extension

A single biome, i.e., Temperate Deciduous/Mixed, may be chosen and a number of sites distributed around the world within the biome may be characterized using the worksheet categories.

References

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Welcome

Introduction

Learning Activity

Protocols

Appendix

World Biomes Characterization - Work Sheet

A biome can be characterized by its climate (general air temperature and precipitation patterns), soils, vegetation and animal life. Use reference materials and personal knowledge to complete the table below.

BIOME	Picture/ Location	Air Temperature	Precipitation	Soils	Vegetation	Animals
Tundra						
Boreal forests/Taiga						
Montane grasslands and shrublands						
Temperate coniferous forests						
Temperate broadleaf and mixed forests						
Tropical/sub-tropical moist broadleaf forests						
Tropical/subtropical dry broadleaf forests						
Tropical/sub-Tropical coniferous forests						
Mediterranean forests, woodlands and scrubs						
l/sub-tropical grasslands, savannas and shrublands						
Temperate grasslands, savannas and shrublanfs						
Deserts/Xeric shrublands						
Flooded Grasslands and savannas						
Mangroves						

(Sites such as http://www.eoearth.org/article/Terrestrial_biome for some general information on terrestrial biomes, may be useful.)