

# Energy Systems, Structures and Processes

## **Essential Standard:**

Analyze patterns of global climate change over time

## **Learning Objective:**

Differentiate between weather and climate

# Global Climate

## Focus Question

How are weather and climate different?

## Vocabulary

Primary

Secondary

weather

climate

carbon dioxide

ozone

# Climate Verses Weather

Is there a difference?

# Climate Vs. Weather

- Climate

- Long-term weather patterns of an area

- Weather

- Current state of the troposphere
- Short term variations



# Climatology

- The study of Earth's climate and the factors that affect past, present, and future climatic changes



# Normals

- Standard values for a location
- Average values over a long period of time



# Elements of weather and climate

1. Properties that are measured regularly
2. Most important elements
  - a. Temperature
  - b. Humidity
  - c. Cloudiness
  - d. Precipitation
  - e. Air pressure
  - f. Wind speed and direction



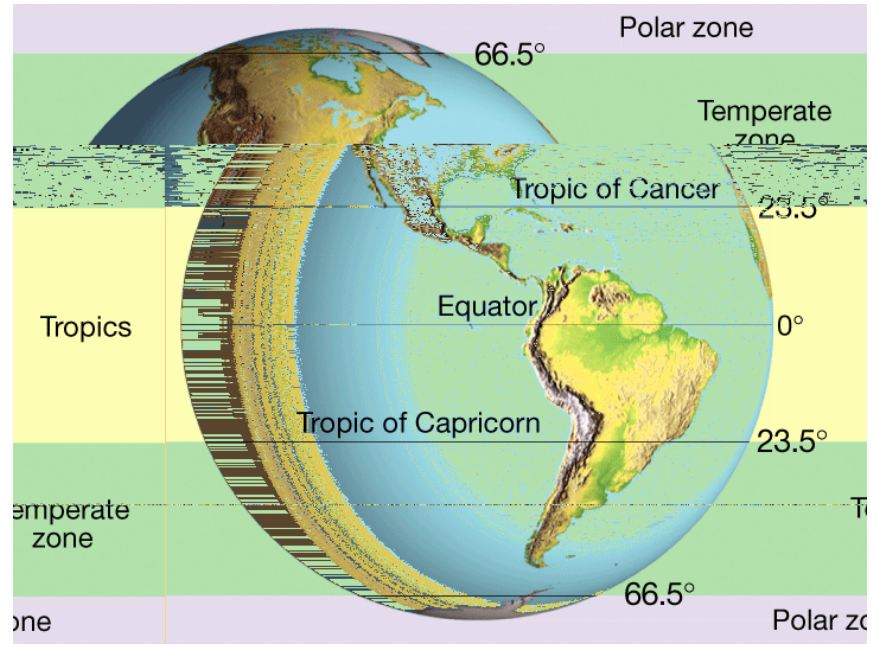
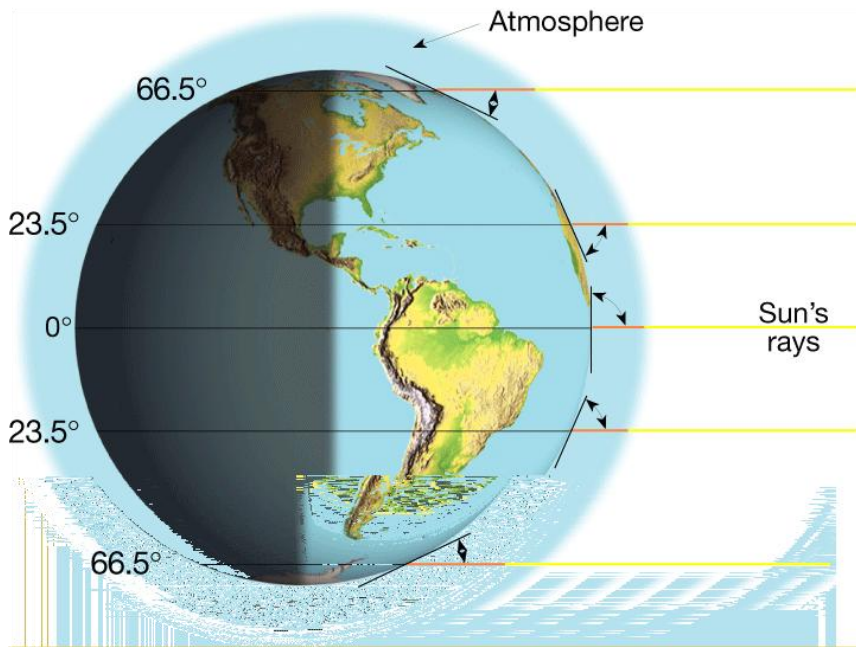
# Earth's Tilt at Seasonal Change

Less direct sun light causes lower  
temperatures

More direct sun light causes warmer  
temperatures



# Seasonal Changes





# Natural Impacts on Climate

Focus Question: How can you explain the impact of natural climate controls on climate?

# Climate

## Factors That Affect Climate

### I. Atmospheric Circulation

- Global winds are another factor that influences climate because they distribute heat and moisture around Earth.

# Factors That Affect Climate

## II. Vegetation

- Vegetation can affect both temperature and the precipitation patterns in an area.
- Areas with large amounts of vegetation absorb more sunlight. These areas have low albedo.
- More sunlight causes an increase of transpiration. More oxygen and water vapor are emitted.
- Plants also release particles (pollen) that act as condensation nuclei that form clouds.

# III. Topography

- Coastal Regions, areas near water, are warmer in the winter and cooler in the summer
- Mountains play an important role in the amount of precipitation that falls over an area.

## IV. Water Bodies

- Large bodies of water such as lakes and oceans have an important effect on the temperature of an area because temperature of the water body influences the temperature or the air above it.

# V. Latitude

- As latitude increases, The intensity of solar energy decreases.
- **Tropics**
  - Most solar radiation, generally warm
  - Between Tropics of Capricorn and Cancer
  - The Sun's rays are most intense

# Climate Regions

- **Temperate**

- Between 23.5 and 66.5 Latitude North and South of the equator
- Mild temperatures

- **Polar**

- 66.5 latitude North and South to the Poles
- Cold Temperatures

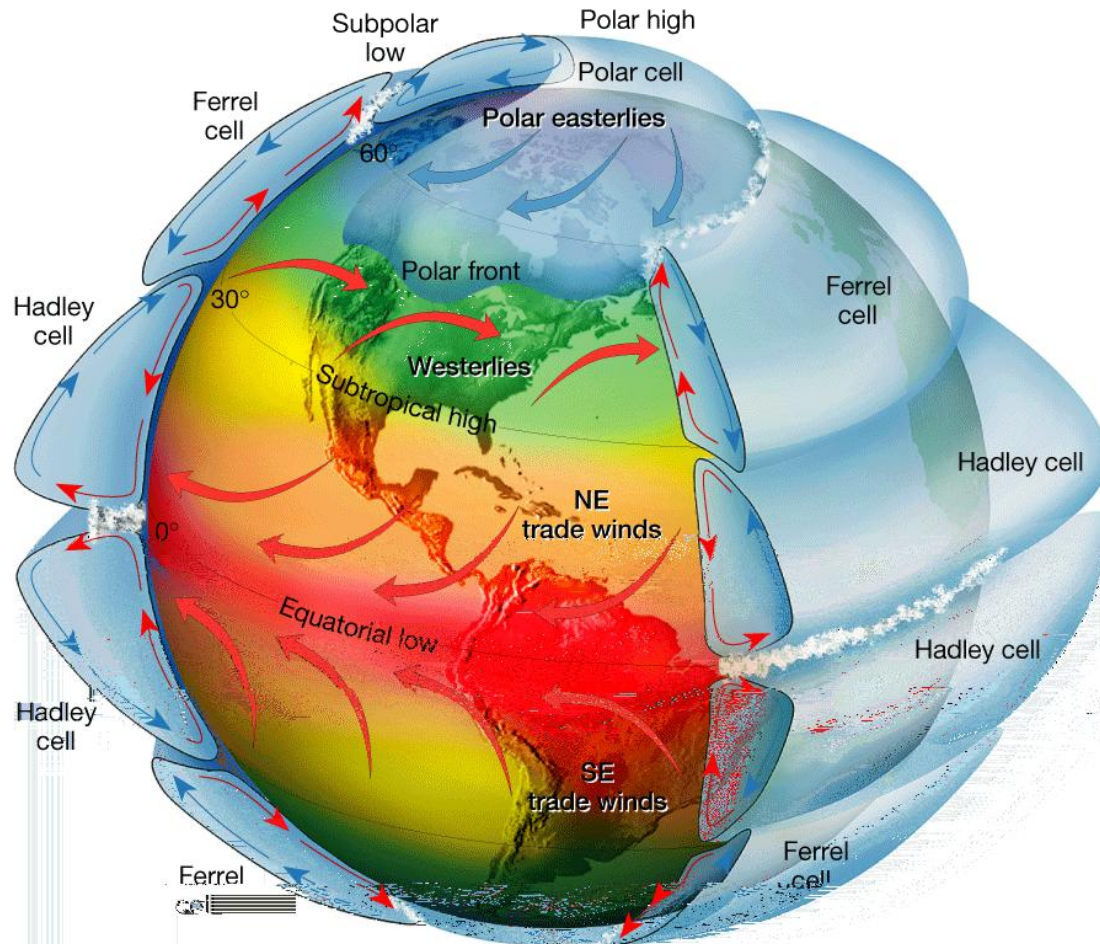


## VI. Elevation

- Elevation or height above sea level, is another factor that affects climate.
- The higher the elevation the colder the climate
- The elevation of an area determines the amount of precipitation that falls

# Climate

## Global Winds and Pressure Cells



# World Climates

## Focus Question

How is the Köeppen climate classification used to describe the world's five major climate groups?

## What should I learn?

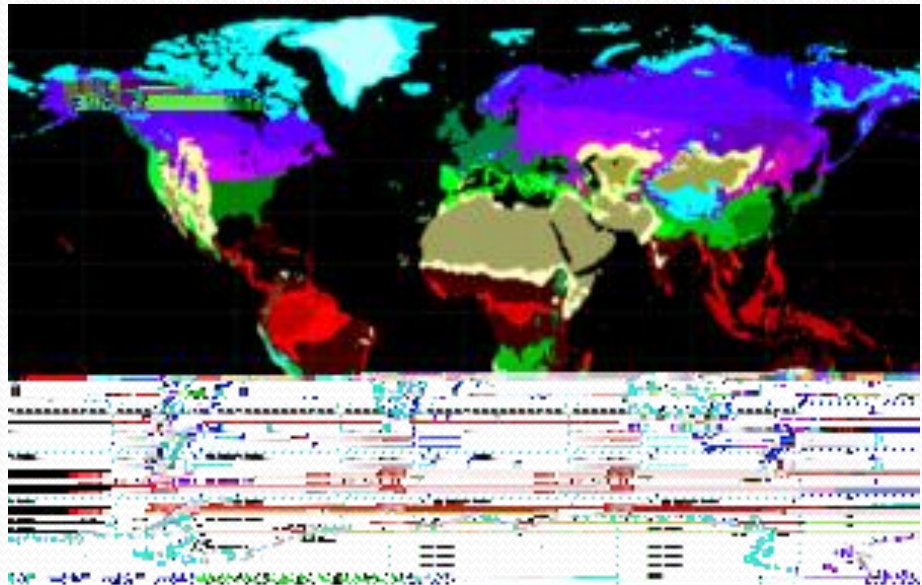
- What is the Köppen climate classification system?
- What are humid tropical climates?
- Contrast the different types of humid mid-latitude climates.
- What are the characteristics of dry climates?
- What are the characteristics of polar climates?
- How do highland climates compare with nearby lowlands?

# World Climates

- ◆ The **Köppen climate classification system** uses mean monthly and annual values of temperature and precipitation to classify climates.

# Koeppen Classification System

- Classified based on temperature and amount of precipitation
  - Tropical
  - Dry
  - Mild
  - Continental
  - Polar



# World Climates

- ◆ **Humid tropical climates** are without winters. Every month in such a climate has a mean temperature above 18°C. The amount of precipitation can exceed 200 cm per year. There are 2 types of humid tropical climates: Wet Tropical climates and tropical wet and dry climates.

# I. Wet Tropical

- **Wet tropical climates** have high temperatures and much annual precipitation.

An example is a rainforest

- Sun's intensity consistently high
- Located on either side of the equator
- Humid unstable air

# World Climates

## II. Tropical Wet and Dry

- **Tropical wet and dry climates** are climates that transition between the wet tropics and the subtropical steppes.
- Temperature and total precipitation is similar to wet tropical but there are distinct periods of low precipitation.



# African Savanna



Tropical grasslands with drought resistant trees

# World Climates

- ◆ Climates with mild winters have an average temperature in the coldest month that is below 18°C but above -3°C.
- ◆ Climates with severe winters have an average temperature in the coldest month that is below -3°C.

# World Climates

## ◆ Humid Mid-Latitude with Mild Winters

- A **humid subtropical climate** is generally located on the eastern side of a continent between  $25^{\circ}$  to  $40^{\circ}$  and is characterized by hot, sultry summers and cool winters. The greatest rainfall is in the months of May, June, July and August.
- A **marine west coast climate** is found on windward coasts from latitudes  $40^{\circ}$  to  $65^{\circ}$  and is dominated by maritime air masses. Winters are mild, and summers are cool. This climate is found in a narrow belt in the northern most part of California to southern Alaska.

# World Climates

- ◆ Humid Mid-Latitude With Mild Winters
- A **dry-summer subtropical climate** is a climate located on the west sides of continents between  $30^{\circ}$  and  $45^{\circ}$  latitude. It is the only humid climate with a strong winter precipitation maximum. This climate is found only in California.

# Humid Mid-Latitude with severe winters

- There are 2 types of this kind of climate Humid Continental climate and subarctic climate
- Subarctic climate is south of the tundra
- Winters are long and extremely cold
- An example is Russia

# World Climates

- ◆ A dry climate is one in which the yearly precipitation is not as great as the potential loss of water by evaporation.
  - **Arid or Desert**
    - Great Basin, rain shadow deserts
    - Temperature range 57°C to 1.7°C
  - **Semi-Arid – Steppe**
    - Transition zone surrounding desert and separates from humid climates

# World Climates

- ◆ Polar climates are those in which the mean temperature of the warmest month is below 10°C.
- ◆ Nearly always night
- ◆ Extremely cold
- ◆ Very little precipitation
- ◆ Evaporation is very limited
- ◆ Tundra ( treeless region)
- ◆ Ice cap

# An Ice Cap Climate Is a Polar Climate







**CLIMATE  
CHANGE**

# Long-Term Climatic Change

- Climates change over extremely long periods of time
- Ice Ages – Periods of extensive glacial coverage
  - Most recent ended  
10,000 years ago
  - Temperatures dropped 5°C



# Long-Term Climate Change

- Volcanic Eruptions

- Reduction incoming solar radiation
- Inject large amounts of dust and sulphur dioxide gas into the stratosphere that scatter incoming solar radiation.
- Studies indicate a global cooling of 0.3°C lasting 1 to 2 years.
- Incoming solar radiation reduction can be offset by an increase in diffuse radiation and by the absorption of outgoing terrestrial radiation (the greenhouse effect).

# Short-Term Weather Change

- Caused by regular variations in daylight, temperature, and weather patterns
- Volcanic eruptions inject dust and gases into the lower atmosphere.
  
- Examples:
  - Seasons
  - El Nino (Warm ocean current)

