

Chapter 13
Atmosphere and Climate Change
Section 1
DAY ONE

Climate

- _____ is the average weather conditions in an area over a long period of time.
- Climate is determined by a variety of factors that include:
 - _____
 - _____
 - _____
 - _____
 - _____
 - _____
- The most important of these factors is _____ from the equator.

Latitude

- _____ is the distance north or south from the equator and is expressed in degrees.
 - _____ = equator
 - _____ = North Pole, most northerly
 - _____ = South Pole, most southerly
- Latitude strongly affects climate because the _____ of solar energy an area of the Earth receives _____ on its latitude.

Low Latitudes

- _____ solar energy falls on areas near the equator than on areas closer to the poles.
- In regions near the equator, night and day are both about _____ long throughout the year.

High Latitudes

- In regions closer the poles, the sun is _____ in the sky, reducing the amount of energy arriving at the surface.
- In the northern and southern latitudes, sunlight hits the Earth at an _____ angle and spreads over a larger surface area than it does at the equator.
- The hours of daylight also vary.
 - At _____ latitude, there is as much as 16 hours of daylight each day during the summer and as little as 8 hours of sunlight each day in the winter.

Atmospheric Circulation

- Three important properties of air illustrate how air circulation affects climate.
 - Cold air _____ because it is denser than warm air. As the air sinks, it compresses and warms.
 - Warm air _____. It expands and cools as it rises.

- Solar energy _____ the ground, which warms the air above it.
 - This warm air rises, and cooler air moves in to replace it.
- Movement of air within the atmosphere is called _____.
- Because the Earth rotates, and because different latitudes receive different amounts of solar energy, a pattern of _____ results.
- This circulation pattern determines Earth's _____ patterns.
- As a result, areas near the equator receive _____ of rain.

Prevailing Winds

- Winds that blow predominantly in one direction throughout the year are called _____.
- _____ of prevailing winds are produced in both hemispheres between 30° north and south latitude and the equator.
- These belts of winds are called the _____.
- Prevailing winds known as the _____ are produced between 30° and 60° north latitude and 30° and 60° south latitude.
- In the Northern Hemisphere, these westerlies are _____, and in the Southern Hemisphere, these winds are _____.
- The _____ blow from the poles to 60° north and south latitude.

Oceanic Circulation

- _____ have a great effect on climate because water holds large amounts of heat.
- The movement of surface ocean currents is caused mostly by _____ of the Earth.
- These _____ redistribute warm and cool masses of water around the world and in doing so, they affect the climate in many parts of the world.

El Niño–Southern Oscillation

- _____ is the warm phase of the El Niño–Southern Oscillation.
- It is the _____ in the eastern Pacific Ocean in which the surface-water temperature becomes unusually warm.
- Rainfall follows this warm water eastward and produces _____ rainfall in the southern half on the U.S., but drought in Australia.
- _____ is the cool phase of the El Niño–Southern oscillation.
- It is the _____ in the eastern Pacific Ocean in which the surface water temperature becomes unusually cool.

Global Circulation Patterns

- Cool air normally sinks, but cool air over the equator cannot descend because hot air is rising up below it.
 - This cool air is forced away from the equators toward the North and South Poles where it _____ at about 30° north latitude and 30° south latitude.

- Some of the air sinks back to the Earth's surface and becomes _____ as it descends.

Pacific Decadal Oscillation

- The _____ (PDO) is a long-term, 20 to 30 year change in the location of warm and cold water masses in the Pacific Ocean.
- PDO _____ the climate in the northern Pacific Ocean and North America.
- It affects _____.

Topography

- Height above sea level (_____) has an important effect on climate. Temperatures fall by about 6°C (about 11°F) for every 1,000 m increase in elevation.
- Mountain ranges also influence the _____ of precipitation.
- As the air rises, it cools, causing it to rain on the western side of the mountain. When the air reaches the eastern side of the mountain it is dry.
 - This effect is known as a _____.

Other Influences on Earth's Climate

- Both the _____ influence Earth's climate.
- UV radiation produces more _____, which warms the stratosphere.
- In large-scale volcanic eruptions, _____ gas can reach the upper atmosphere.
- This reaction forms a _____ that reflects enough sunlight to cause the global temperature to decrease.

Seasonal Changes in Climate

- The seasons result from the _____, which is about _____ relative to the plane of its orbit.
- During summer in the Northern Hemisphere, the Northern Hemisphere tilts toward the sun and receives _____.
- The number of hours of daylight is _____ in the summer.
 - Therefore, the amount of time available for the sun to heat the Earth becomes greater.
- During summer in the Northern Hemisphere, the Southern Hemisphere tilts away from the sun and receives _____.
 - But, during the summer in the Southern Hemisphere, the situation is reversed.

Chapter 13

Atmosphere and Climate Change

Section 1

DAY TWO

The Ozone Shield

- The _____ is the layer of the atmosphere at an altitude of 15 to 40 km in which ozone absorbs ultraviolet solar radiation.
 - _____ is a molecule made of three oxygen atoms.

- _____ is harmful to organisms because it can damage the genetic material in living cells.
- By shielding the Earth's surface from most of the sun's UV light, the ozone in the _____ acts like a sunscreen for the Earth's inhabitants.

Chemicals That Cause Ozone Depletion

- _____ are hydrocarbons in which some or all of the hydrogen atoms are replaced by chlorine and fluorine.
- Used in:
 - _____ for refrigerators and air conditioners
 - _____
 - _____ of everyday products
 - deodorants, insecticides, and paint.
- Their use is now restricted because they destroy ozone molecules in the stratosphere.
- At the Earth's surface, CFCs are chemically _____.
- But, CFC molecules _____ high in the stratosphere, where UV radiation is absorbed.

The Ozone Hole

- In 1985, studies by scientists working in Antarctica revealed that the ozone layer above the South Pole had thinned by 50 to 98 percent.
- The _____ is a thinning of stratospheric ozone that occurs over the poles during the spring.
- This was the first news of the hole, and was published in an article in the scientific journal _____.
- After the results were published, NASA scientists reviewed data that had been sent to Earth by the *Nimbus 7* weather satellite.
 - Able to see the first signs of ozone thinning in the data from _____.
- Although the concentration of ozone fluctuated during the year, the data showed a _____.

How Does the Ozone Hole Form?

- During the dark polar winter, strong circulating winds over Antarctica, called the _____, isolate cold air from surrounding warmer air.
 - Air within the vortex is extremely cold.
- _____ are clouds that form at altitudes of about 21,000 m during the Arctic and Antarctic winter or early spring, when air temperatures drop below -80°C .
- On the surfaces of polar stratospheric clouds, the products of CFCs are converted to molecular _____.
- When sunlight returns to the South Pole in the spring, molecular chlorine is split into two chlorine atoms by _____.
 - The chlorine atoms rapidly _____ ozone.

- The destruction of ozone causes a thin spot, or _____, which lasts for several months.
- Ozone produced by pollution _____ with other substances in the troposphere long before it can reach the stratosphere to replace ozone that is being destroyed.

Effects of Ozone Thinning on Humans

- As the amount of ozone in the stratosphere _____ is able to pass through the atmosphere and reach Earth's surface.
- UV light is dangerous to living things because it _____, the genetic material that contains the information that determines inherited characteristics.

Effects of Ozone Thinning on Animals and Plants

- High levels of UV light can kill single-celled organisms called _____ that live near the surface of the ocean.
- In addition, a reduction in the number of phytoplankton would cause an _____ in the amount of carbon dioxide in the atmosphere.
- In fact, ecologists often use the health of amphibian populations as an _____ of environmental change due to the environmental sensitivity of these creatures.

Protecting the Ozone Layer

- In 1987, a group of nations made an agreement, called the _____, to sharply limit their production of CFCs.
- At a second conference in Copenhagen, Denmark in 1992, developed countries agreed to _____ most CFCs by 1995.
- After developed countries banned most uses of CFCs, chemical companies developed _____.
- Aerosol cans no longer uses _____ as propellants, and air conditioners are becoming CFC free.
- CFC molecules remain active in the stratosphere for _____.

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The Greenhouse Effect

- The Earth is similar to a _____. The Earth's atmosphere acts like the glass in a greenhouse.
- The rest of the heat is absorbed by gases in the _____ and warms the air.
- This process of heat absorption is called the _____.
- A _____ is a gas composed of molecules that absorb and radiate infrared radiation from the sun.
- The major greenhouse gases are _____.

- Water vapor and carbon dioxide account for most of the absorption of that occurs in the atmosphere.

Measuring Carbon Dioxide in the Atmosphere

- In 1985, a geochemist named _____ installed an instrument at the top of a tall tower on the volcano _____ in Hawaii.
- In a forest, carbon dioxide levels rise and fall with the daily rhythms of _____.
- Keeling reasoned that at Mauna Loa, the _____ carbon dioxide levels for the entire Earth could be measured.
- Keeling's first measurement, in March of 1958, was _____, and the levels rose slightly the next month.
- During the summer, growing plants use more carbon dioxide for photosynthesis than they release in respiration, causing the levels to _____.
- In the winter, dying grasses and fallen leaves decay and _____ the carbon that was stored in them, causing levels to rise.

Rising Carbon Dioxide Levels

- After a few years of measurement, it was obvious that the levels were undergoing _____ other than seasonal fluctuations.
- In 42 years, carbon dioxide has gone from 314 to 386 parts per million, an increase of 54 parts per million.
 - This increase may be due to the _____.

Greenhouse Gases and the Earth's Temperature

- Many scientists think that because greenhouse gases trap heat near the Earth's surface, more greenhouse gases in the atmosphere will result in an _____ in global temperature.
- Millions of tons of carbon dioxide are released into the atmosphere each year from _____.

How Certain is Global Warming?

- _____ is a gradual increase in the average global temperature that is due to a higher concentration of gases such as carbon dioxide in the atmosphere.
- Some scientists believe that the warming is part of _____.

The Consequences of a Warmer Earth

- These problems range from the disruption of _____ to adverse impacts on human health, agriculture, and animal and plant populations.

Melting Ice and Rising Sea Levels

- If the global temperature increased, the amount of ice and snow at the poles would _____, causing sea levels around the world to rise.
- Coastal wetlands and other low-lying areas could be _____. People who live near coastlines could lose their homes and sources of income.

- The salinity of bays and estuaries might _____, adversely affecting marine fisheries. Also, freshwater aquifers could become too salty to be used as sources of fresh water.

Global Weather Patterns

- If the Earth warms up significantly, the surface of the oceans will _____ more heat, which may make hurricanes and typhoons more common.

Human Health Problems

- Greater numbers of heat related deaths could occur. Very young and very old people would have the greatest risk of _____.
- Concentrations of ground level ozone could _____ as air temperatures rise, causing respiratory illnesses, especially in urban areas, to increase.
- Warmer temperatures might enable _____, which carry diseases such as malaria and encephalitis, to greatly increase in number.

Agriculture

- Agriculture would be most severely impacted by global warming if extreme weather events, such as drought, became _____.
- Higher temperatures could result in _____.

Effects on Plants

- A warmer climate could cause trees to _____ into cooler areas.

Effects on Animals

- Global warming could cause a _____ in the geographical range of some animals. For example, Northern birds may not migrate as far south during the winter.

Recent Findings

- The IPCC reported that the average global surface temperature increased by _____ during the 20th century, snow and ice cover has dropped, and the global sea level has risen.
- The IPCC also reported that concentrations of atmospheric gases have continued to _____ as a result of human activities.

Reducing the Risk

- The _____ is an international treaty according to which developed countries that signed the treaty agree to reduce their emissions of carbon dioxide and other gases that may contribute to global warming by the year 2012.
- In March of 2001, the United States decided _____ to ratify the Kyoto Protocol. However, most other developed nations are going ahead with the treaty.