

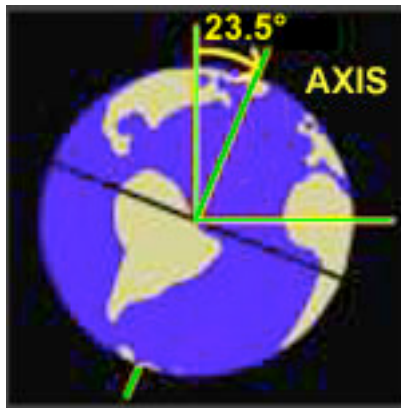
## Unit 3 – Seasonal Cycles

Before discussing seasons, it is necessary to understand how the Earth spins and moves, because the Earth's movement is what determines seasons around the world.

### The movement of the Earth

The Earth, like all objects in our solar system, *rotates* (spins) around a center point called an *axis*. One full rotation of the Earth takes 23 hours and 56 minutes. We call this rotation a “day.” As the Earth rotates on its axis, it also makes a near-perfect circle around the sun. This circular motion is called an *orbit*, and the orbit occurs on a flat *plane* around the sun. The Earth orbits the sun on this plane in just over 365 days, and we call this orbital period a “year.” During this time, the Earth maintains almost the exact distance from the sun (about 93 million miles).

It is important to understand that the Earth is not in an upright position as it orbits the sun. Instead, the Earth is tilted 23.5 degrees on its axis. It is this tilt that causes the Earth to experience different seasons because the tilt determines how much sunlight hits a particular part of the Earth at different times of year.



The Earth tilts at a 23.5 ° angle on its axis.

Image From:

<http://www.bbc.co.uk/science/space/solarsystem/earth/solsticescience.shtml>

### The Earth's tilt and its hemispheres

Halfway between the top point of the Earth's axis (the North Pole) and the bottom point of the Earth's axis (the South Pole) is an imaginary line that circles the Earth. This line is called the *equator*. The equator divides the Earth into two equal halves, or *hemispheres*: the Northern Hemisphere and the Southern Hemisphere.

The amount of sunlight the earth receives is called *insolation* (*incoming solar radiation*). When the North Pole points toward the sun, insolation in the Northern Hemisphere is more direct and intense, and this part of the Earth experiences warmer summer temperatures. The day when the Earth receives the most insolation, around June 21, is called the *summer solstice*. The summer solstice is the longest day (and shortest night) in the Northern Hemisphere (the North Pole gets 24 hours of sunlight!), and it marks the beginning of the summer season in the Northern Hemisphere. Every day after the summer solstice is a little bit shorter than the day before.

Because the Earth is tilted 23.5 degrees on its axis as it orbits the sun, the top axis (the North Pole) is not always pointed directly toward the sun. When the North Pole points away from the sun, the Northern Hemisphere receives less direct exposure to the sun, and the sun's warmth has to be distributed over a larger area of land. Therefore, the Northern Hemisphere experiences colder winter temperatures. The day that this part of the Earth receives the least insolation, around December 21, is called the *winter solstice*. The winter solstice is the shortest day in the Northern Hemisphere (and the longest night) and it marks the beginning of the winter season in the Northern Hemisphere. Every day after the winter solstice is a little bit longer than the day before, until we reach summer solstice once again.

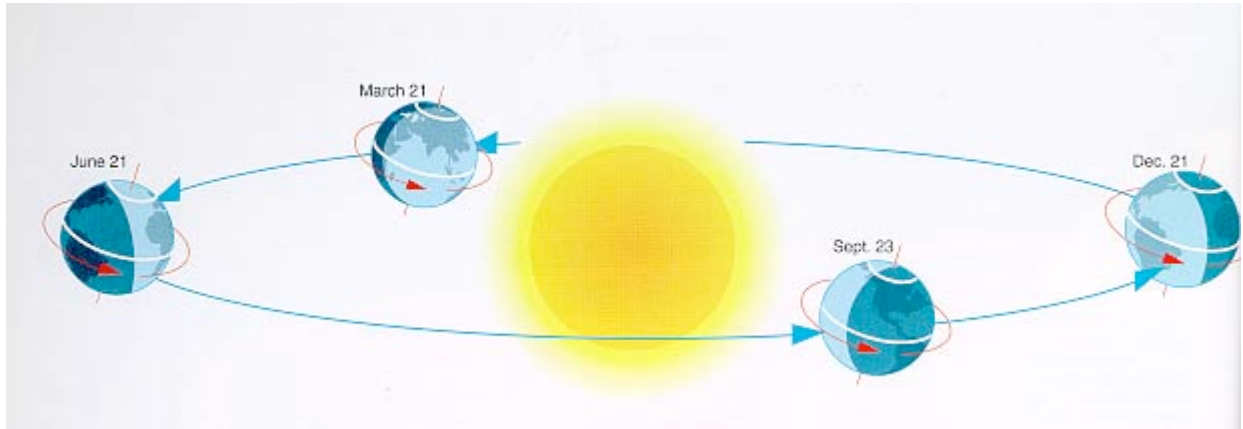


Image: <http://www.uwm.edu/~kahl/CoVis/Seasons/>

The Earth's tilt and its orbit around the sun are directly linked to the different seasons experienced around the world.

How does this work in the Southern Hemisphere? If the North Pole is pointed toward the sun around the summer solstice, exposing the Northern Hemisphere to more direct sunlight and summer temperatures, just the opposite happens in the Southern Hemisphere. Consider the tilt of the Earth. When the North Pole is pointed toward the sun, the South Pole must be pointed away. Therefore, sunlight hits the Southern Hemisphere at a less direct angle so the sun's warmth is spread over a larger area and it is winter—in June! The summer solstice in June, then, marks the beginning of winter for areas south of the equator.

What causes summer in the northern hemisphere? What season is it in the Southern Hemisphere at the same time? What causes this?

The opposite is true around the winter solstice. When the North Pole is pointed away from the sun and the Northern Hemisphere is experiencing winter temperatures, the South Pole is pointed toward the sun. Therefore, after winter solstice in December, the Southern Hemisphere receives more direct exposure to the sun and experiences warmer summer weather.

During the *autumnal equinox* on or around September 23 and the *vernal equinox* on about March 21, halfway between the summer and winter solstices, day and night at the Poles are equal: there are exactly 12 hours of daylight and 12 hours of night. Exposure to the sun is less intense during

the equinoxes, and temperatures are therefore less extreme. The autumnal equinox marks the beginning of autumn for the Northern Hemisphere and the beginning of spring for the Southern Hemisphere. Subsequently, the vernal equinox marks the beginning of spring for the Northern Hemisphere and the beginning of autumn for the Southern Hemisphere.

**So what *are* seasons?** Seasons, then, are defined by the amount of insolation, or sunlight, that particular parts of the Earth receive at specific times of the year. Each season – spring, summer, autumn and winter – brings changes in temperature, weather, and sunlight. The seasons in temperate regions keep changing because the tilt of the Earth never changes while the Earth orbits the sun.

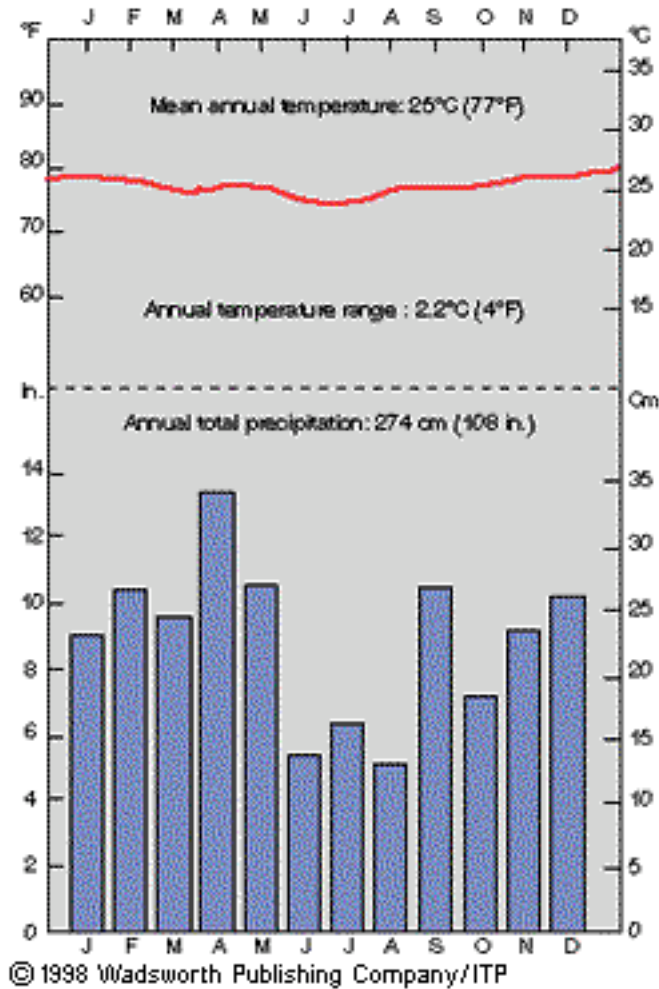
### Seasons of the Amazon rainforest

The equator, due to its equal distance from the North and South Poles, receives direct or near-direct sunlight throughout the year. Temperatures in the equatorial regions (areas near the equator) remain fairly constant, rarely going higher than 93 °F (34 °C) or dropping below 68 °F (20 °C). Since temperatures in this region don't vary much, what are seasons near the equator like?

Tropical areas, such as the Amazon rainforest, don't have seasons like spring, summer, autumn and winter. Instead, seasons in the Amazon are divided into the *dry season* and the *wet season*, each lasting about six months. Warm air rises when and where the Earth is being heated most strongly (the equator). As this warm air rises, it produces heavy rainfall, resulting in the wet season. In the tropical areas just south of the equator, the wettest part of the wet season occurs between December and May. During the wet season, the Amazon rainforest receives an impressive 6 to 12 feet or more (1.8 to 3.6 meters) of rain! Surprisingly, during the driest part of the dry season (June through August) the Amazon rainforest receives an average of only 15 centimeters (about 6 inches) of rain.



Smaller fish love to hide in the forest during the flooded times of the year. More species of freshwater fish can be found in the flooded forest than anywhere else on Earth



Look at the pattern of rainfall. Even the 'dry season' has a lot of rain compared to other parts of the world.

The large quantity of rain that falls in the Amazon rainforest during the wet season causes the mighty Amazon River to rise and fall by as much as 40 feet (12 meters) each year. Since the Amazon basin is quite flat, the annual rise in the river's water level causes flooding many areas of the Amazon rainforest. Fortunately, the trees, plants and animals in Amazon rainforest have learned to adapt to this seasonal flooding. For example, some trees produce seeds that are eaten and dispersed by fish, and some fish have adapted to eat the fruit that falls from the submerged trees.



The tambaqui, a fish found in the Amazon Rainforest, eats the fruit and disperses the seeds from rainforest trees, thus helping with rainforest regeneration.

Image:

[http://www.mct.gov.br/prog/ppg7/revista\\_PPD/Desenv/desen\\_08.htm](http://www.mct.gov.br/prog/ppg7/revista_PPD/Desenv/desen_08.htm)

Humans typically find it harder to adjust to nature's ways than plants and animals. Flooding is a huge problem for people who live around the Amazon's flood banks. These residents have learned to adapt to the large amounts of rain by building their houses on stilts. If and when the area floods, water passes below their houses. Others choose to build their houses on rafts. Their houses rise during a flood and fall when the floods recede!

Houses on the flood plains are often built up on stilts so that floodwater can pass beneath the house



Image:

<http://www.vitruvius.com.br/arquitextos/arq000/esp226.asp>

### **Deforestation and the change of Amazonian seasons**

Unfortunately, some humans have been clearing rainforest land for cattle, farming and agriculture, and logging. In fact, more forest has been destroyed in the last 30 years than in the preceding 450 years since Europeans first came to the Amazon. Since 1978, over 193,050 square miles (500,000 square kilometers) of Amazon rainforest have been destroyed – equivalent to a dozen football fields per minute!

This deforestation of the Amazon Basin has contributed to a subtle but steady change in the region's climate and seasons. During the dry season, the land in deforested areas heats up faster than in non-deforested areas, causing warm air to rise. This upward motion of warm air, as we discussed earlier, causes clouds to form and rainfall to increase unseasonably.

These warmer and wetter conditions have made it difficult for some plant and animal species to survive. Some river-dwelling animals, for example, survive in specific water temperatures. When the water temperatures rises abnormally, the animals may move away from the area or, in some cases, may even become *extinct* (die out completely). The loss of even a single species due to migration or extinction can damage an entire *ecosystem* (a biological community that depends on interaction among species for survival).

### **Rainforest seasons and our survival**

The changes in the Amazon rainforest's climate are affecting us too. The Earth depends on the tropical rainforests to absorb carbon dioxide from the air and to convert it into oxygen. In fact, the Amazon rainforest alone produces more than 20 percent of the world's oxygen supply! By absorbing carbon dioxide and giving us clean air to breathe, tropical forests help regulate the

world's temperatures and weather patterns, creating livable climates for plants, animals and people all over the world. Unfortunately, as the rainforest disappears, more carbon dioxide and less oxygen are released into the air. As a result, temperatures increase and global weather patterns change, and as weather patterns change so do the seasons. Therefore, it is extremely important for all of us to learn about the Amazon and other tropical rainforests and the critical role they play in the survival of our planet.

## **The Flooded Forest During Project Peru 2**

The Wilderness Classroom Expedition Team will be traveling in the flooded forest during the end of the high water season. As Project Peru 2 unfolds, the floodwaters will begin to recede. What impact do you think the changing flood season will have on the adventure? What time of year would you choose to explore the flooded forest?

### **Questions for Discussion:**

What causes seasons?

Are there seasons in the tropics? What causes the tropics to have such huge differences in cycles of rainfall?

How have the indigenous people learned to adapt and rely on the changing water levels inside the rainforest?

Do plants and animals have to adapt in order to survive during times of flood? What about during times of relative dryness?

How does the forest benefit from the annual floods?

Does the flooding encourage or restrict travel in the rainforest?

Where are the other flooded forests of the world? Do they share any similarities with the Amazon's flooded forest?

How do you have to adapt to seasonal changes in your habitat?

Do seasonal changes impact survival? What living things rely on the changing seasons?

What role do the seasons play in food production?

Do seasonal changes impact your culture? Think about holidays and cultural traditions.

## **Further Exploration and Sources**

<http://www.oceansonline.com/seasons.htm>

<http://liftoff.msfc.nasa.gov/News/2001/News-AutumnalEquinox.asp>

<http://www.uwm.edu/~kahl/CoVis/Seasons/>

<http://www.blueplanetbiomes.org/climate.htm>

[http://www.windows.ucar.edu/tour/link=/kids\\_space/period.html&edu=elem](http://www.windows.ucar.edu/tour/link=/kids_space/period.html&edu=elem)

[http://www.mhhe.com/earthsci/geology/mcconnell/earths\\_climate/intro.htm](http://www.mhhe.com/earthsci/geology/mcconnell/earths_climate/intro.htm)

<http://www.blueplanetbiomes.org/rainforest.htm>

<http://www.pbs.org/teachersource/scienceline/archives/feb00/feb00.shtm>

<http://www.csupomona.edu/~biotrek/aquatic/habitats.html>

[http://www.mongabay.com/external/Deforestation\\_Affects\\_Climate.htm](http://www.mongabay.com/external/Deforestation_Affects_Climate.htm)

<http://library.thinkquest.org/21395/textonlyb/climate.html>

<http://www.rainforest-alliance.org/resources/forest-facts/lives.html>

