Seasons – Video Tutorial

How long does it take the Earth to make one complete rotation around its axis? 24 hours or 1 **day**. If we look at the same image of the globe but from the top (looking down the axis from the North Pole), we see the Earth is rotating counterclockwise around the North Pole.

If we look more carefully at this axis of rotation, we see that it is tilted relative to Earth's orbit around the Sun. Instead of being perpendicular, it's tilted 23.5°.

How long does it take the Earth to make one complete orbit around the sun? 365 days or one **year**. During Earth's orbit around the Sun, it follows a nearly circular path, but with a small elliptical eccentricity. The Sun is not in the center of the ellipse, but one of the focal points. Bottom line? The Earth is a little closer to the Sun every January and a little further away every July. Does that cause us to have seasons? Let's think about it. We'd expect the planet to be a bit warmer overall when we're closer to the Sun. When does that happen? January. Is that our warmest season in the Northern Hemisphere? No. So the seasons must result from something entirely different.

Let's return to the tilted axis of the Earth. As the Earth orbits the Sun, it goes through 365 daily rotations, while the axis maintains its tilt. On the June 22nd solstice, the tilt causes the north pole to face towards the sun while the south pole faces away. When the earth's orbit takes it all the way around to the Dec. 22 **solstice**, the north pole is now tilted away from the sun and the south pole towards. This tilt explains why the north pole experiences winter in January WHILE the south pole is experiencing the opposite season, summer. The north pole is facing away from the sun and gets less overall sunlight. The south pole is facing towards the sun and gets more.

To understand this more fully, let's look more closely at how the sun's rays hit the earth. First, notice that halfway in between July and January (during the September 23rd **equinox**), the tilt causes neither pole to face away or towards the sun. As the Earth rotates every 24 hours, each area of Earth's surface will receive 12 hours in view of the sun and 12 hours out of sight of the sun. 12 hours of day. 12 hours of night. Equal lengths of day and night is why this time is called an equinox. As the sun's rays hit the surface, they are strongest at the equator, directly in the middle, where they hit at a 90 degree angle. As Earth moves towards the Dec. 22 solstice, the north pole tilts further and further away from the sun. At its maximum tilt on solstice day, the sun's rays are now hitting directly at 23.5 degrees south latitude, or the **Tropic of Capricorn**. Notice that every location within the **Antarctic circle** at the south pole is getting 24 hours of sunlight. As the earth rotates, none of these locations is ever lacking in sunlight. This creates the summer season for the southern hemisphere. In the northern hemisphere, inside the **arctic circle**, the reverse happens – 24 hours of darkness – winter season for the north.

As we watch the earth continue its orbit, the earth's tilt again moves towards the sun, such that when we reach the March 22nd equinox, we once again have all parts of the planet receiving equal amounts of sunlight and darkness. The equator once again receives the direct sunlight (at high noon, the sun would be directly overhead here). Returning back to the June 22nd solstice, we see the tilt move the north pole towards the sun, so that the north pole receives more and more hours of sunlight each day. At the solstice, the northern hemisphere experiences summer. All points within the arctic circle experience 24 hours of sunlight. And the sun is directly overhead providing its most intense heating at the **tropic of cancer** at a location 23.5 degrees north of the equator.

As we continue to watch this process, we can see that the southern hemisphere moves, through this one year orbit from its winter through its spring, summer, fall, and back to winter, while the northern hemisphere experiences the opposite season. Note that each solstice and equinox represents opposite seasons in opposite hemispheres. The winter solstice in the northern hemisphere is the summer solstice in the southern. That means that sun lovers can plan trips to maximize their sun exposure, traveling to the southern hemisphere in December, January, and February, and the northern hemisphere during June, July, and August. And if you're looking for the most intense sun on the planet, be sure to travel to the equator at the equinoxes, 23.5 degrees North in June, and 23.5 degrees South in December.

Pause now.

For more information and more detail, continue on to the next video in this series.

[End credits]

Air-Sea Interactions Series:
Part I: Seasons
Part II: Relative Humidity
Part III: Atmospheric Gases, Heats, and Pressures
Part IV: Atmospheric Circulation
Part V: Weather Phenomena

Seasons
Geoscience Video Tutorial
Produced by Katryn Wiese
City College of San Francisco

All media produced by Katryn Wiese unless indicated below:
**Intro and exit music: used with permission © Alexis Harte*
**Review music: used with permission © Proceed With Caution*
**Rotating Satellite Globe of Earth and stills of Earth Globe: © Google Earth – data from: SIO, NOAA, US Navy, NGA, GEBCO, IBCAO; Image Landsat, USGS, PGC/NASA*
**Rotating Earth animations – sources unknown*
**Seasons and Ecliptic Simulator (screen record) – used with permission: Astronomy Education at the University of Nebraska-Lincoln Web Site (http://astro.unl.edu).*