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Earth's Rotation and Revolution

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Introduction

Scientists believe that the solar system was formed when a cloud of gas and dust in space was disturbed, maybe by the explosion of a nearby star. This explosion made waves in space which squeezed the cloud of gas and dust. Squeezing made the cloud start to collapse, as gravity pulled the gas and dust together, forming a solar nebula (Figure 1). Just like a dancer that spins faster as she pulls in her arms, the cloud began to spin as it collapsed. Eventually, the cloud grew hotter and denser in the center, with a disk of gas and dust surrounding it that was hot in the center but cool at the edges. As the disk got thinner and thinner, particles began to stick together and form clumps. Some clumps got bigger, as particles and small clumps stuck to them, eventually forming planets or moons. As the cloud continued to fall in, the center eventually got so hot that it became a star, the Sun, and blew most of the gas and dust of the new solar system with a strong stellar wind. By studying meteorites, which are thought to be left over from this early phase of the solar system, scientists have found that the solar system is about 4.6 billion years old! (WINDOWS TO THE UNIVERSE) The Earth was born in such a chaos. Ever since its birth, Earth began to spin and circulate the Sun. But how this can happen and what impacts do the aspects have on Earth itself? For years people have been studying on it.



Figure 1: Artists' concept of the solar nebula.

Revolution of the Earth

As it is shown before, the Earth used to be the nebula. As the gravity pulls the dust to the center, the nebular began to spin because of the conservation of the angular momentum. The angular momentum L can be shown in the equation below:

$$L=rmv$$

Which r is radius, m is mass and v is the linear velocity. Since angular momentum is consistent, when r decreases, or nebula collapses, it will

rotate faster and faster. So when Earth forms, it is always going around the Sun. The Earth has an elliptical orbit around the Sun and can complete it in 365.256 days, that's why one year has 365 days. (Figure 2) (Nola 2017)

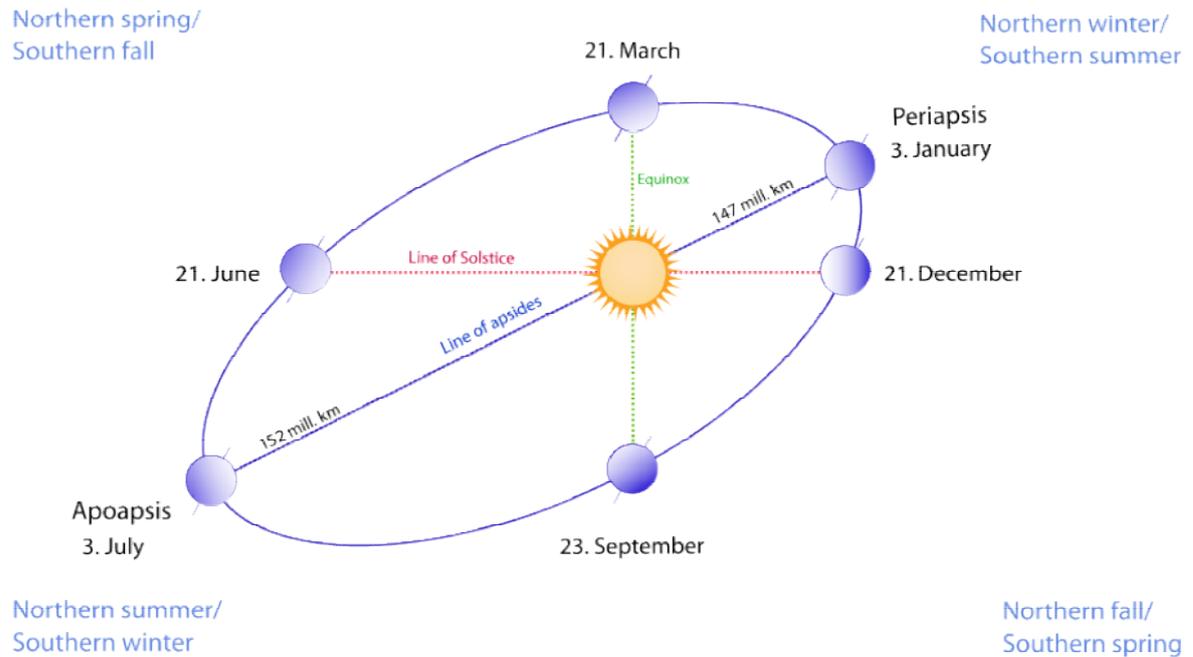


Figure 2 The Earth's orbit

From the figure it is clear that the orbit has a greatest distance (or aphelion) of 152 million kilometers and a least distance (or perihelion) of 147 million kilometers. The time of the aphelion is about July 3 while of perihelion is January 3 (Date & Time of Solstices & Equinoxes 2013), which is right the date of the summer and winter. The revolution also brings Earth different lengths of the daytime and height of the Sun in different seasons. By the way, the Tropics, Subtropics and Frigid Zone are divided by the difference of time of sunshine, which is still the result of the revolution. (Universe Today) For the Earth's orbit is the third nearest to the Sun, it is an ideal

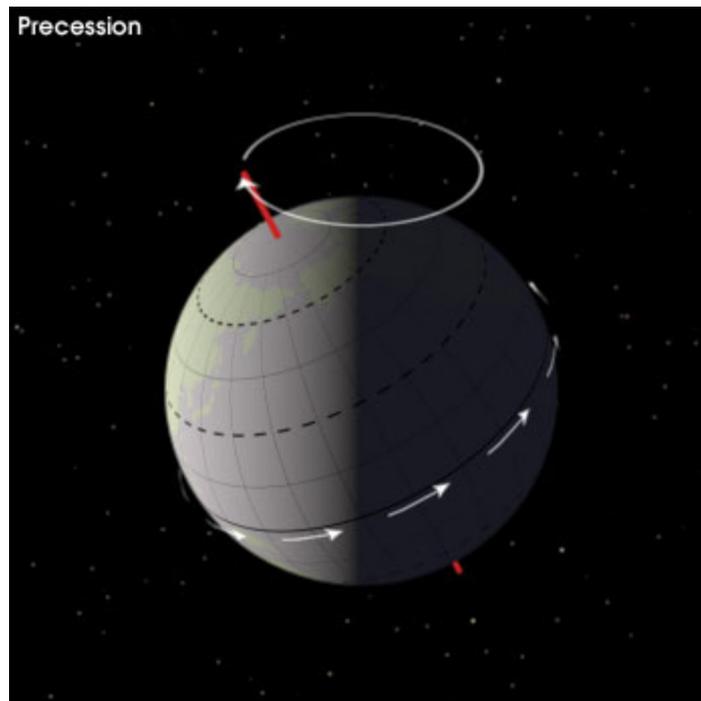
place for the lives as it is not too close or too far, before the Earth is Venus and Mercury while after Earth is Mars. And also, as the Earth is changing its position in the space all over the year, we can see different constellations. Something interesting is that constellations are actually moving and changing shapes. But as they are consisted by stars really far away, people cannot distinguish the distance it moved in just two thousand years (NASA Space Place).

Earth's Rotation

Besides moving around the Sun, the Earth is also spinning itself. Now since that the Earth's rotation is because of angular momentum, why the Earth is spinning? The Earth spins because it formed in the accretion disk of a cloud of hydrogen that collapsed down from mutual gravity and needed to conserve its angular momentum. It continues to spin because of inertia (Universe Today).

However, unlike a huge UFO in the space, the Earth doesn't spin with an axis perpendicular. In fact the earth is tilted towards the Sun at an angle of 23.5 degrees to 25.5 degrees. The tilt varies by about one degree.(Morris 2016) (Figure 3) Remember that the Earth used to be nebula at first. After millions of years passed enough matter collided to gain mass and its own gravity and become small versions of planets called planetessimals and

protoplanets. These pre-planets collided to create even larger planets. This set the stage for how the Earth approached its final form. It looks like it probably collided with another proto-planet and in the process it was tilted.



(Jessa 2016)

Figure 3 Earth's tilting axis

Because of the rotation, there are days and nights on the Earth. When one side of the Earth faces the Sun, the other side doesn't. That is, when people in New York having the lunch, Chinese have already been asleep. The rotation brings people days and nights, which is beneficial for the growth of the plants and other living things. As Earth rotates on its axis, it moves about 15 degrees every 60 minutes. After 24 hours, it has completed a full circle rotation of 360 degrees. The scientists used this information to

divide the planet into 24 sections or time zones. Each time zone is 15 degrees of longitude wide. (Wonderopolis) (Figure 4)

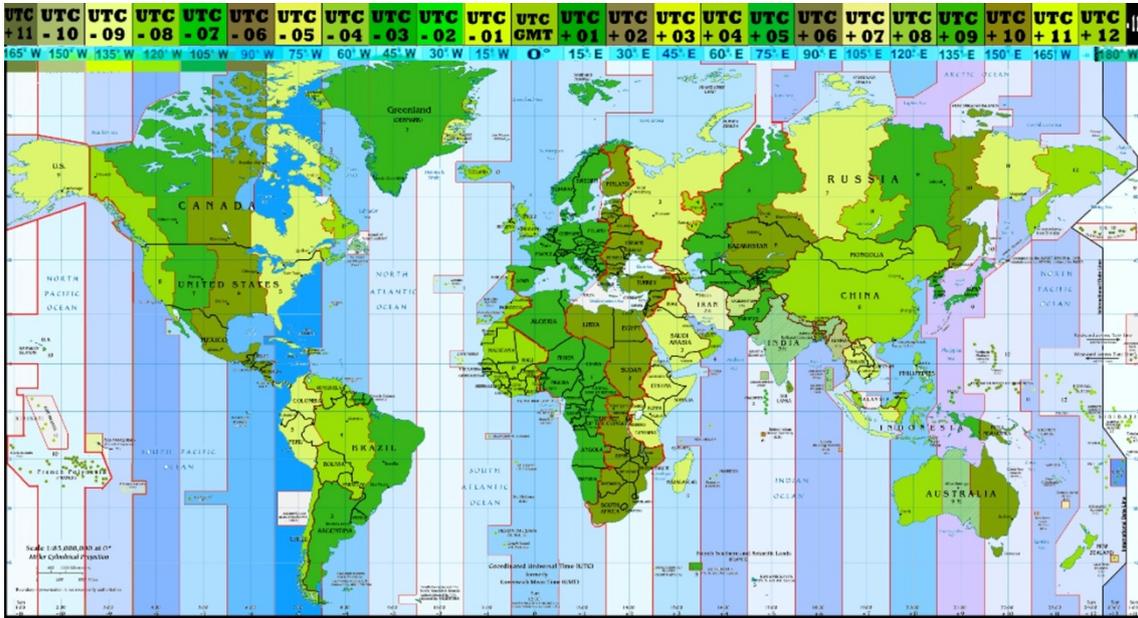


Figure 4 World Time Zone

If Earth did not rotate on its axis, winds would blow from the north toward the south and from the south toward the north. As you probably already know, the earth rotates on its axis from west to east. This rotation causes both the wind and ocean currents to move from east to west. Thus, the wind movement and ocean currents in the northern hemisphere go clockwise and counter clockwise in the southern hemisphere.

Because Earth rotates on its axis from west towards the east, air near the surface from the tropics is moved toward a westerly direction (toward right as it is often called) in the northern hemisphere. (Utah Science)

The change of the wind directions above is actually called the Coriolis Effect. (Figure 5) Because of this phenomenon, there are trade winds near

the equator, which is the wind blow from 30 degrees North or South to the Equator. The old-time navigators then used the trade wind to plan their voyages.

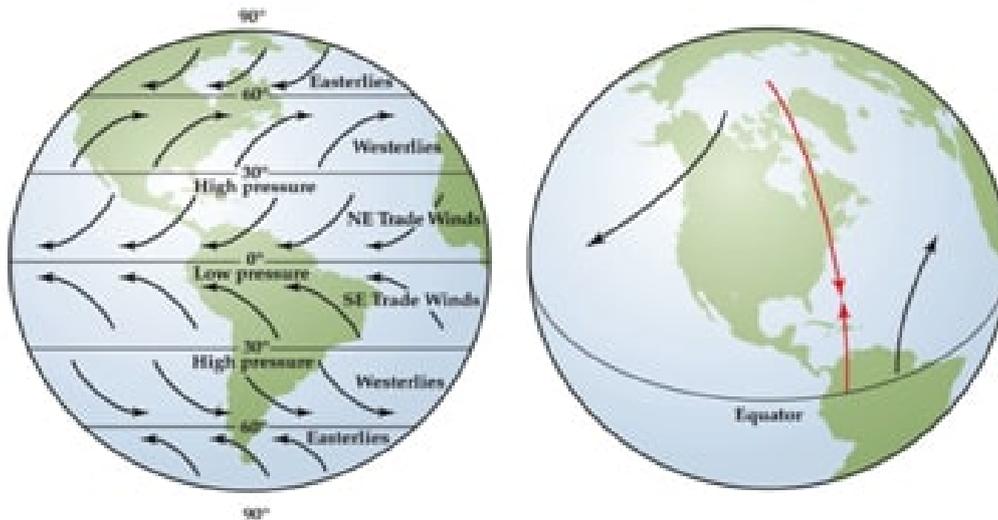


Figure 5 The Coriolis Effect on the Earth's wind

Water also moves vertically as deeper water rises toward shallower depths. This is referred to as Upwelling. Upwelling can occur during a La Nina event where warmer surface waters and air temperatures are blown from the western coasts of South America toward Indonesia and Australia. Deeper water rises toward the surface, replacing the horizontally moving water. The upwelling water is cooler and nutrient rich, causing a decrease in air temperatures near the surface. (Schoolwork Helper)

Conclusion

The spinning masses in the universe formed the Earth. After the Earth's

birth, the momentum gave Earth the ability to rotate and move around the Sun. These two attribute for the Earth's days and nights, four seasons, five zones, time zones and Coriolis Effect. The rotation and revolution are then indispensable with human civilization.

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