

Longwood University

Relationships Between the Sun and Earth
Dynamic Planet Final Project

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I. Introduction:

Interrelationships in Earth/Space Systems

1.6 The student will investigate and understand the basic relationships between the sun and Earth. Key concepts include

b) the sun's relative position in the morning is east and in the late afternoon is west.

We chose this SOL because we believe that these topics were thoroughly discussed throughout our Dynamic Planet class. The relationships between the Sun and the earth are critical topics for young students to master to better understand the planet they live in. This would be a great SOL to include a hands on activity with because the student's will be able to visually understand the material. On November 20th we conducted our lesson with the following participants, Jaimee Kersey and Theresa Officer, who are both students at Longwood University. We met at Sarah Boehling's apartment on that evening.

Article Summaries:

1. <https://www.education.com/science-fair/article/true-sun-sun-appears-move/>

According to the article from education.com, time is not completely accurate. Clocks were invented for convenience sake, before they existed people would tell time by where the sun was located in the sky. For example, if the sun was at the meridian it was assumed it was noon. Once investigated, it is clarified that each day is not technically 24 hours, that is just the mean time. Earth is constantly rotating on its axis while orbiting the sun and with each spin, earth continues further on its orbital journey. The orbit is basically a drug out circle that is not even and this is why we use a mean time instead of each day being 23 hours and some odd several minutes. The sun does not sit evenly on the ellipse, at different points in the year the Earth's speed, gravitational force, and distance from the sun change. Alike the winter and summer solstice, the perihelion and aphelion occur at similar times. Because of all these minor differences the time is never honest, that is why astronomers came up with "mean solar time."

2. https://www.windows2universe.org/sun/sunspots_and_wind.html

This article explains the widely questioned theory on the relationship between the solar cycle and Earth's weather. The solar cycle is a time frame 10.5-11 years long that documents the time between a solar minimum number of sunspots, maximum number of sunspots, followed by another minimum. As scientist began to test this theory they ran into several detrimental issues that caused their data to be incongruent. The weather is constantly changing which arose the problem of having a constant variable for their experiment. However, in the mid nineteen-hundred's, a scientist named H. C. Willett hypothesized an ever more detailed theory on the relationship between wind patterns and the solar cycle. He claimed that there is a definite effect but it is far to complicated to understand with our lack of instruments. After many failed attempts from other scientist to prove his theory, it was ruled that there were no significant correlations between the solar cycle and wind patterns. With the developing technology and instruments we have today, they more so found that there is a strong relationship between all aspects of the sun and the solar cycle than any type of weather output.

3. <https://www.universetoday.com/26987/earth-sun-and-moon/>

Since the moon and the sun are not tangible items it is hard to comprehend the fact that the two are completely different sizes since they look the same from Earth. The distance from the Earth to the moon and the Earth to the Sun are relatively close, however it is how the two work together to create eclipses. These spectacular space shows occur rarely because of the moon's orbit being away from the Earth's, which is around the sun. Tides are also another thing we are exposed to because of the relationship between the two. When the Sun and the moon are on the same side of the Earth, this is when we get the extremely high or low tides, when they are not at this position it is just the opposite. One last thing creatures of Earth get to witness is the

brightness of the moon thanks to the Sun! The sun is the brightest object we have discovered so far, the moon is not even comparable. Therefore, we can thank the Sun for reflecting light off the moon to give us a tad bit of light at night.

4. <https://news.nationalgeographic.com/2016/02/160226-leap-year-science-time-world-cultures-february/>

The Earth takes 365 and $\frac{1}{4}$ days to rotate completely around the Sun. The $\frac{1}{4}$ day is added up roughly over four years and this is what causes a Leap Year. Although it seems like an even bigger inconvenience to forget about the fourth of a day, this is false. If the time frame is forgotten about it agricultural and religious chaos. The eleven-day lag will eventually lead for people to be offset in their seasons. The Gregorian calendar is what most of the modern world has adopted too in order to avoid this mess. Leap years are calculated by their divisibility relationship with 100 and 400, however there are three dropped leap years every 400 years to even further keep time with Earth's rotation. With that being said, this developed calendar is only 30 seconds longer than the 365.225-day rotation. Meaning it would take 3,300 years for the Gregorian Calendar to become a day too fast than the solar cycle.

5. <http://earthsky.org/earth/can-you-explain-why-earth-has-four-seasons>

It is widely assumed that because of the distance between the Earth and the Sun that is why we experience seasons. Although this is a logical theory, it is not true. The seasons are actually based on the Earth's 23.5° tilt that is similar to the obliquity. This particular degree tilt will never drastically change, the northern hemisphere will forever point in the same direction. The thing that changes is the orientation, this causes each hemisphere to face the sun or away for half the year. Logically when a hemisphere is aligned with the sun that would be summer; the opposite goes for winter. Therefore, if it is summer in the northern hemisphere it is winter in the southern. With that being explained, when the Earth experiences a decrease in obliquity it causes warmer winters and colder summers. The same scenario of opposite spheres goes for an increase in obliquity, more extreme seasons.

6. <https://sciencing.com/sun-affect-ecosystem-8585882.html>

The sun is the main source of energy for every living object on Earth. Because of this, the Sun affects several different types of ecosystems. Before understanding this, one must understand global warming. This occurs when a buildup of CO₂ traps rays from the sun that should extend past the atmosphere. Instead of reflecting the rays Earth continues to absorb them, which causes the entire planet to warm up even more. The main layer this effects is the ozone layer, which causes the oceans to be suitable for the growth of phytoplankton. The Sun affects the land just as much as it does the sea. With the slimming ozone, the land may experience longer drought periods which can lead to famine in both humans and animals.

7. <https://kids.nationalgeographic.com/explore/space/mission-to-earth/#earth-planet.jpg>

To understand the relationship between the sun and the earth it's important to understand both individually. According to this article from National Geographic for kids, the Earth has a significant spot in our solar system. Because of where it's located we are able to breathe oxygen, and drink water to survive. Also, the position of the Earth gives humans protection from solar radiation and debris that are in space. In other words, the Earth is almost sort of a force field. The article continues to discuss the position of the axis of the earth, and how it creates day and night. The article states, the "axis tilt" exposes more or less light from the sun in our northern and southern hemispheres. Depending on the time of year, some parts of the planet can see 24 hours of full daylight or all darkness. Because of the position of the Earth, humans are able to breathe oxygen, drink water, and get the sunlight they need to survive.

8. http://www.kidsastronomy.com/our_sun.htm

According to this article from Kids Astronomy, the Sun is just a relatively average size star in the solar system. It was born as a gas cloud once 5 billion years ago. The gas fell to a common center from its own force of gravity. The center began to grow, and as matter continued to fall inward an immense amount of heat and pressure formed. When the Sun reached around 1 million degrees, the core ignited causing nuclear fusion. When this process was completed the Sun began producing its own heat in light for as long as we have known it. The article gives a basic understanding of how the Sun came to be, and its processes and functions. For example, the article discusses how the Sun produced convection. As the heat rises, cooler gases fall, and this process continues keeping the Sun as hot as it is. Other astronomical vocabulary such as solar winds, sunspots, and solar flares are all briefly discussed in the article. Because of the production of the Sun, humans are able to get the sunlight they need to survive on Earth.

9.

http://global.oup.com/us/companion.websites/9780199965557/student/ch20/animation_quiz/sun-earth/

This article provides a visual that shows the relationship between the declination and daylight at different latitudes on Earth in the Northern and Southern Hemispheres. According to the animation and article, the Sun at noon intercepts with the Earth's latitudes at different angles. As the seasons begin to change from one to the other the animation is able to depict how the declination of the Earth's axis changes. This also affects daylight of the seasons. For instance, in the Northern Hemisphere they receive their longest day in the summer season, and the Southern Hemisphere receives their longest day in the winter. This is all because of the axis of the Earth's tilt and how the sun hits the Earth at specific latitudes. The article also explains how the

animation shows what it looks like when the Solstice and Equinox happen. The animation shows the declination reaching its maximum at the Solstice, and the declination at zero during the Equinox.

10. <https://www.timeanddate.com/astronomy/seasons-causes.html>

This article from timeanddate.com discusses the reasons for seasonal changes. Recurring explanations for experiencing day and night on Earth also fall into similar categories on why Earth experiences seasons. Because of the Earth's axial tilt revolving around the Sun on a slant the Earth receives varying amounts of light in the Northern and Southern Hemispheres during certain times of the year. When the Southern Hemisphere is pointing away from the Sun, they experience winter in the months of June, July, and August. This is also when they experience the least amount of light. While the Southern Hemisphere is going through winter in these months, the Northern Hemisphere is experiencing summer. This is when they are pointing toward the sun and receiving the most light.

11. <https://sciencing.com/causes-day-night-cycle-earth-15684.html>

According to Serm Murson, and writer from sciencing.com, he explains that the rotation of Earth on its axis is the reason for day and night on our planet. He states that if the Earth did not rotate as it does, then the day and night cycle as we know it would be very different, or maybe even non-existent. Murson discusses why we have longer and shorter days. He explains that although the solar day is technically 24 hours not all places on Earth will receive the same amount of sunlight, for the main reason that the Earth rotates on its axis. The article then begins to discuss Solstices, which we know is the marking of the longest and shortest days in a specific hemisphere on the planet. Lastly, Murson explains that your relative position to the equator on Earth will largely impact how much sun you have in a given day. For example, the further North you go in the summer in the Northern Hemisphere, the longer it'll be light. As the seasons change the daylight hours will differ in hemispheres.

12. <http://www.theplanetstoday.com>

The Planets Today.com gives a visual as to what the solar system looks like at the specific day, time, and season. This is a good reference for understanding the relationship between the Sun and Earth, because according to the visual it is evident where sunlight is hitting the Earth at a specific hour and where it is not. This also is a good visual because this shows that the Earth rotates around the Sun, instead of the Sun rotating around the Earth. The article explains in depth the specific locations of each of the planets. In regards to the Earth the article states that the reasons for day and night is because of the Earth's tilt, which is 23.4 degrees.

13. <https://www-spod.gsfc.nasa.gov/stargaze/Sun1lite.htm>

According to this article the Sun is the brightest and most familiar object in the sky. The article states that life on Earth would be impossible without it. The sunlight carries energy to the Earth which heats it. The energy of the Sun is the main force of the weather and climate on Earth, and because of this the Earth is the only livable planet as we know it today. The article discusses the “greenhouse effect” which produces three strong effects on Earth that make it livable. This includes the following: clouds that reduce the heat on the ground, light radiated to keep the ground warmer, and production of weather. Because of the specific location of the Sun and Earth, the Sun is able to provide the heat to the Earth that it needs to provide a safe living environment for people.

14. <http://new-learn.info/packages/clear/thermal/climate/sun/relationship.html>

The article by CLEAR talks about the relationship between the earth and the sun, as well as the earth’s equinoxes and the solstice. When talking about the equinoxes, it explains what an equinox is and when the summer, autumn, spring, and winter equinox happens. The earth is tilted at 23 and a half degrees which causes the different seasons we experience here on earth. That being said when the Northern Hemisphere is pointing directly toward the sun, it is experiencing winter and the Southern Hemisphere is experiencing summer and vis versa when the Northern Hemisphere is pointed away from the sun.

15. <https://www.universetoday.com/18013/sun-and-earth/>

In this article published by universe today and written by Fraser Cain, it explains the relationship between the earth and the sun and how it affects the earth. Without the sun, there would be no life on earth. That means there would be no plants or humans. It explains what the sun is made up of and that the core of the sun is made up of hydrogen. It explains how the sun’s energy that is given off heats up the earth during the day and how at night it cools off. The earth’s atmosphere traps the heat, acting like a blanket, warming the earth and making the earth a comfortable temperature.

16.

http://www.ucsusa.org/global_warming/science_and_impacts/science/effect-of-sun-on-climate-faq.html#.WhnLqUqnHIU

In this article by The union of concerned scientist, talks about how the sun affects the Earth’s climates. It says that the sun is the earth’s main energy source. Over millions of years it is said that the earth’s orbit can affect the geographical distribution of the sun’s energy. Scientist say that this may affect Earth’s climate by changing the rate of solar heating. Over years the power of the sun has changed. For example, the ice age, since the climate had changed the earth is no longer experiencing an ice age.

17. <https://spaceplace.nasa.gov/seasons/en/>

This article by NASA talks about earth's tilt and what causes the earth's tilt. The article corrects people's theory about the earth being closer to the sun in the summer and farther from the sun in the winter. It does say that the earth is closest to the sun at some parts during the orbit because the orbit is not a perfect circle. The earth's Northern Hemisphere is closest to the sun when it is experiencing winter. When it is farthest from the sun the Northern Hemisphere is experiencing summer. However, that being said the earth's distance does not make that much of a difference in the weather. This article also explains what caused the earth's axis. What caused the earth's axis is called a Theia. A Theia was something that hit the earth billions of years ago causing the earth to tilt. The article also gives a visual explaining where the sun hits the earth during the different seasons.

18. <http://environ.andrew.cmu.edu/m3/s2/01earth-sun.shtml>

In this article by Environmental Decisions gives a visual on the earth and the sun. The visual shows the gravitational force that affects the sun and the earth. It also shows how the gravitational force maintains the earth's orbit around the sun. The diagram shows the sun and earth, it lets us know what the sun is made up of and the gravitational pull of the earth and the sun. It also explains that over billions of years that the interaction has produced the ozone and the climate that we have here on earth.

19.

<http://www.illinoishomepage.net/weather/weather-101-early/wx-101-sun-and-earth-relationship/82520251>

In this article by the Illinois homepage it explains what the sun is, the distance the earth is from the sun and the rotation, orbit, and tilt of the earth. It says the sun is a big star that is the center of our universe. It also says that the sun is 430,000 miles in diameter and about 27,000,000 degrees fahrenheit. The earth is about 93 million miles away from the sun. Which is good because we can have life on earth. It makes a good living condition for living things. Also in this article it explains the earth's rotation which takes 24 hours. This explains how we have a daytime and a nighttime. It explains what the earth's orbit is and how it take 365 days to make its complete orbit.

20. <http://sciencenetlinks.com/science-news/science-updates/tilted-earth/>

The Earth's tilt serves many purposes, one including the distinguishment between seasons. How the Earth is tilted is constantly being questioned still. The solar system was assumingly formed by debris of other objects self-accumulating because of gravity. As the soon to be plants were forming, their gravitational pull became stronger and stronger. Some independent debri would occasionally knock into a forming planet because of this growing

gravitational pull. This happened several times to Earth. Scientist assume that Earth had to take on many harsh impacts over a period of time to cause the entire planet to shift 23 degrees. Before the Earth was tilted, history has shown that one rotation only took roughly six hours. The absent tilt as well as a small planet were variables of this shorten day. However, the moon and tilt play roles in slowing down the rotation from six to twenty-four hours.

II. Description

To start the lesson the teacher explained to the participating members that Earth experiences day and night because the Earth revolves around the Sun on an axis. To further understand this the teacher explained the following activity that would give them a better visual to understand the relationship between the Sun and the Earth. First, the teacher told the students to color the Sun and Earth with appropriate colors (Earth, blue and green) and Sun (yellow). The students then cut out their Sun and Earth, and glued the Sun down on the black paper that represents space. The teacher assisted the students in putting a hole in their paper with brass prongs. Then they connected the earth to the paper giving them a visual model of the Earth rotating around the Sun. This model explains on a first grade level why the Sun does not revolve around the Earth, and why we experience day and night.

Problem; Teacher should have had a model beforehand to demonstrate to the students what the finished product would look like. Second, the teacher could have had black paper that represented space already cut out for the students labeled North, South, East, and West.

III. Discussion

The visual model we had our “students” create is appropriate for a first grade level. They are required to color a globe cut out along with a Sun and then cut both objects out once they are finished. After everything is cut out students are prompted to glue the Sun down on the black sheet of paper representing space. The teacher will then explain to them why we are gluing down the Sun and not the Earth. When the lesson is over, the teacher then goes around the classroom to each student’s project to put the brass prong in the middle of their Sun. This will attach a rectangular piece of paper glued to the Earth to show the students that Earth orbits the Sun. The materials for this project were not costly at all; colored pencils, construction paper, and brass prongs together cost under \$5. The cuttable print outs of the Earth and Sun were free downloads which can be printed at the school. Regardless if the classroom that uses this lesson is big or

small, the materials are plentiful and cost next to nothing. The main problem we ran into was the fact the black construction paper was too large. We decided after the lesson was done that it would have been more beneficial and possibly less time consuming, had we cut the “space” paper and labeled north, south, east, and west. As well as labeling the directions, we needed to incorporate where the Sun rises and sets in the lesson after the Earth is glued down. If the teacher would have done this before, he or she would not have to do it when they go to each child to put prongs in their paper. The exercise meets the SOL 1.6 learning goals of the student understanding Earth’s relative position in the morning is east and in the late afternoon is west as well as the Earth’s relationship to the Sun.

IV. Conclusion

The strategies we used while teaching our lesson we would use them only in a first grade level class. If using this lesson in a higher grade level we would have to make the lesson more challenging for them. For a first grade setting it was a great level of difficulty for them to understand the material without them being confused. Using the strategies we used were beneficial to the instructor because it gave him/her an understanding of how well their students know the information.

V. Appendix: Photographs

See attached photos.