

It sure is dark outside

Have you noticed that it has been getting dark out really early? Take a minute and think about how long the sun is up.

1. For how many hours would you estimate that the Sun is up during the day during this time of year?
2. How does this compare to summer day length? Record your comparisons.

At 11:28 AM **EST** on December 21 (16:28 UT on December 21st), the northern hemisphere will be tilted as far from the sun's rays as it ever is in a year. That means that

- During that day, the shadows that we see will be the longest shadows that we will be seeing all year.
- We will have the longest nighttime hours of the year.
- We will have the shortest daylight hours of the year.
- And some people will say that winter has begun.

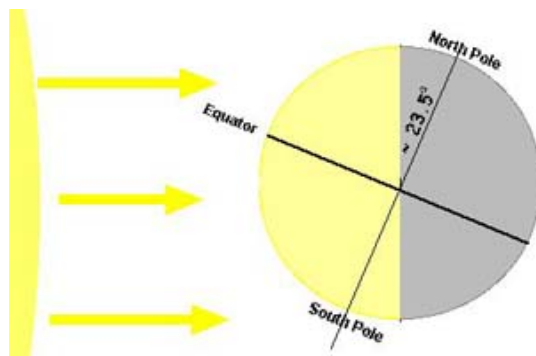
This date in the year is called the **winter solstice**.

From your science class you have learned that the earth's axis is tilted and not perpendicular to the rays of the sun. The tilt of the earth from vertical is about 23.5 degrees. The Earth spins around that imaginary line running from the South Pole to the North Pole called its axis. Try to imagine the Earth spinning around that line that goes from pole to pole. You should notice that this line does not match up with the line that divides day and night on Earth.

You can see a great, short demonstration on the Earth's spin and tilt at

<http://www.youtube.com/watch?v=n3rkUjrdo3A>

3. As you imagine the Earth spinning, do you see any places not getting into the lit up half of the Earth?



Do you notice places not getting into the dark or nighttime half of Earth? Record your observations below.

Earth at daylight on December 21st

4. In my diagram, what is the angle measure of the lighted (yellow) part of the Earth that is north of the equator?
5. Remember, the U.S. is north of the equator and south of the North Pole. Think about where your home would be located on the above picture of the Earth. As the Earth spins on its axis on December 21st, is your home more often in the dark side of the Earth or in the lit side of the Earth? Explain.

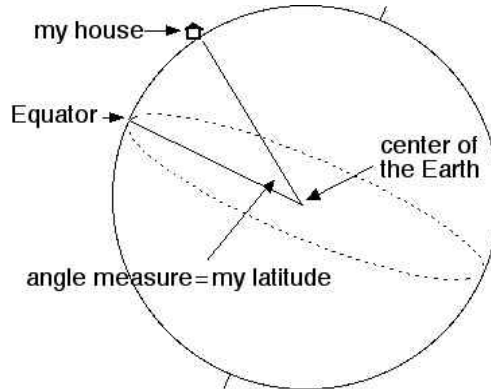
6. What do you think the day will be like on December 21st in the upper gray section, north of the equator, side of the Earth (for example, imagine the Earth spinning, what will the day be like for people living near the “N” of the word “North Pole” in my picture)?
7. South of the Equator there is a region that is on the night side of the Earth (right side in the image above) that is colored yellow. What do you think December 21st will be like in this region?

Our variations of daylight hours are directly related to the latitude of where we live.

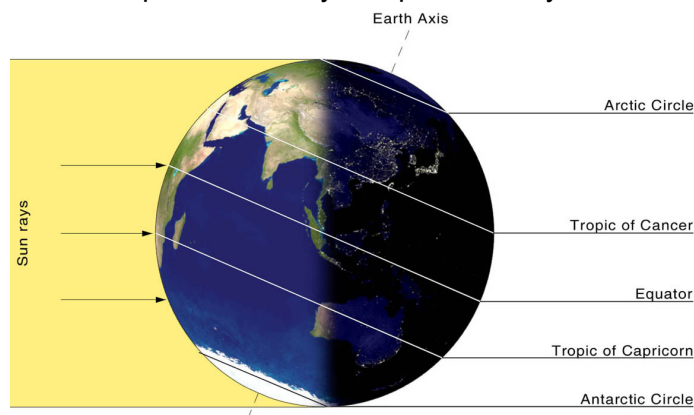
8. Are latitude lines, the east-west imaginary lines around the Earth or the north-south lines?
9. Do you know the latitude of where you live? If not, find your latitude. Write it here.
10. What is the latitude of the North Pole?
11. What is the latitude of the equator?

Hmmm. Does this sound like a geometry lesson?

I have one more interesting observation. Latitude is actually the angle measure of the central angle formed by a place on the equator, the center of the earth, and another place on the earth.



Below is another picture of the lighted Earth on December 21st. This picture includes the names of several latitudinal regions. Use this picture and my first picture to try to answer the following questions.



12. What do you guess is the latitude for the Arctic Circle? Explain why you think this latitude has a special name.

13. What do you suppose is the latitude for the Tropic of Cancer? Explain why you think this latitude has a special name.

14. What do you suppose is the latitude for the Tropic of Capricorn? Explain why you think this latitude has a special name.

15. What do you suppose is the latitude for the Antarctic Circle? Explain why you think this latitude has a special name?

16. So, why is it so dark at 4pm around here?

17. Is there any hope for brighter days in the near future even though winter seems to have only just begun?

Happy dark days!

Credits:

<http://scijinks.nasa.gov/solstice>

<http://geography.about.com/library/misc/blequator.htm>

<http://www.timeanddate.com/calendar/december-solstice.html>

http://en.wikipedia.org/wiki/Great-circle_distance

<http://www.usno.navy.mil/USNO/astronomical-applications/data-services/rs-one-day-us>

<http://www.sunrisesunset.com/>

www.yummymath.com