| | |
|---|---|
| **Title:** Astronomy 101: Why in 2020 would using the stars be beneficial to determine time and location? Grade 9-12 | **Grade:** 9th-12th Grades |
| **Content:** Literacy, English Language Arts (ELA) / Speaking and Listening, Social Studies (HGSS), Science/Astronomy, Mathematics | **Duration:** Five days—this multidisciplinary unit is designed for a week. It is estimated a total of 10-15 student work hours per week would be needed to complete this unit. |

**Standards**:

- **SL.9-10.4 / SL.11-12.4:** Present information, findings, and supporting evidence clearly, concisely, and logically such that listeners can follow.
- **SL.9-10.6 / SL. 11-12.6:** Adapt a speech to a variety of contexts and tasks, demonstrating command of English language.
- **RI.9-10.2 / Ri.11-12.2:** Determine a central idea of a text; provide a summary of the text.
- **HGSS Standard 3**: Societies are shaped by the identities, beliefs, and practices of individuals and groups.
- **HS-ESS1-4:** Earth's Place in the Universe

**Objective**:
Student(s) will evaluate earth's place in the universe and determine how societies are or may have been shaped by the practices of groups. Student(s) will demonstrate speaking and listening skills to logically support a central idea(s).

**Resources Needed:**

Attached (see below) 3 articles by Peter Christoforou:

- *Mapping The Night Sky Using Ursa Major* (2012)
- *Using The Stars To Tell Time* (2012)
- *Using The Stars For Direction, Latitude, And Time* (2012)

*The articles are not meant to be the activity. The activities are used within the steps below. The articles go above and beyond what is expected for this unit. They are meant to drive critical thinking and provide scaffolding. Our focus is on awareness of the benefits of astronomy.

Optional website:
https://planetary-science.org/astronomy/star-charts/

**Introduction/Description:** By examining the night sky, students will think about how astronomy still has relevance or not in 2020.

**Steps:**
*Parent/guardian / teacher says:* "We have been stuck inside for days. Tonight let's go out and stargaze and see if we can find any constellations. What do you know about astronomy? It is often a subject that people first learn about in college or on their own."

*Key vocabulary:* Ursa Major, Ursa Minor Polaris, astronomy

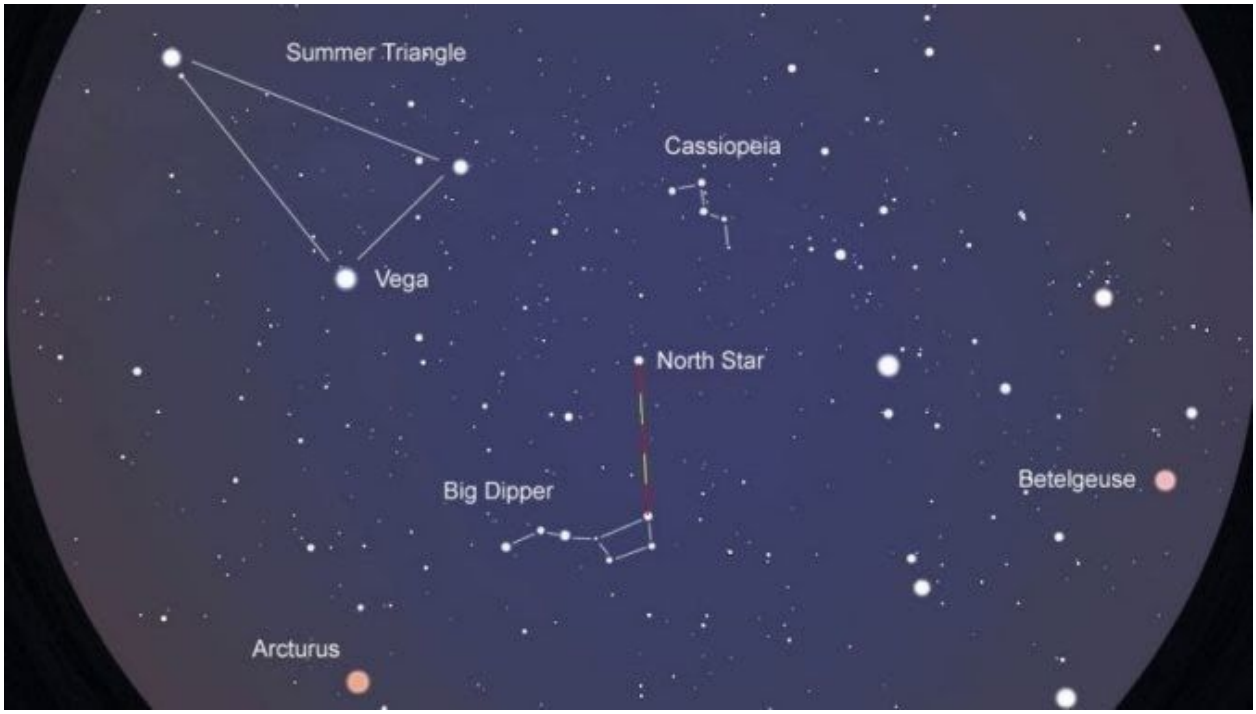
- **Day 1:** Read *Mapping The Night Sky Using Ursa Major* and examine the Star Chart (blue) by Sky and Telescope. Compare the chart to the night sky to see what you can find.
- **Day 2:** Read *Using The Stars To Tell Time.* Standing in a fixed location and referencing a landmark, you will determine hourly movement of the star you have identified. (The article says to use Polaris; however, you can use another star, such as the Big Dipper, aka Ursa Major, if you'd like!)
- **Day 3:** Read *Using The Stars For Direction, Latitude, And Time.* Identifying and using Polaris, determine North, South, West, and East.
- **Day 4:** Teach someone how to tell time and determine location based on the stars either by creating a step-by-step document, by creating an instructional video, OR by taking a person outside and demonstrating what to do.
- **Day 5:** Reflect on the unit by answering the essential question: Why in 2020 would using the stars be beneficial to determine time and location especially when I have a smartphone?

**Finished Product**:
A "How-To" will be performed to a person, and a project summary/overview will be provided.

**Adaptations**:
- This project could be extended or shortened for project length limitations. For example, this project could be extended to be 10 days or shortened to 2.5 days depending on the needs of the student(s).
- Student(s) could implement the project / reading suggestions to extend learning.
- Student(s) could create a nightly or hourly journal mapping the night sky.
- Project can be altered to fit additional grade levels.
- Project could be conducted with a partner(s) or as a family.

**Mapping The Night Sky Using Ursa Major**

November 29, 2012 Peter Christoforou



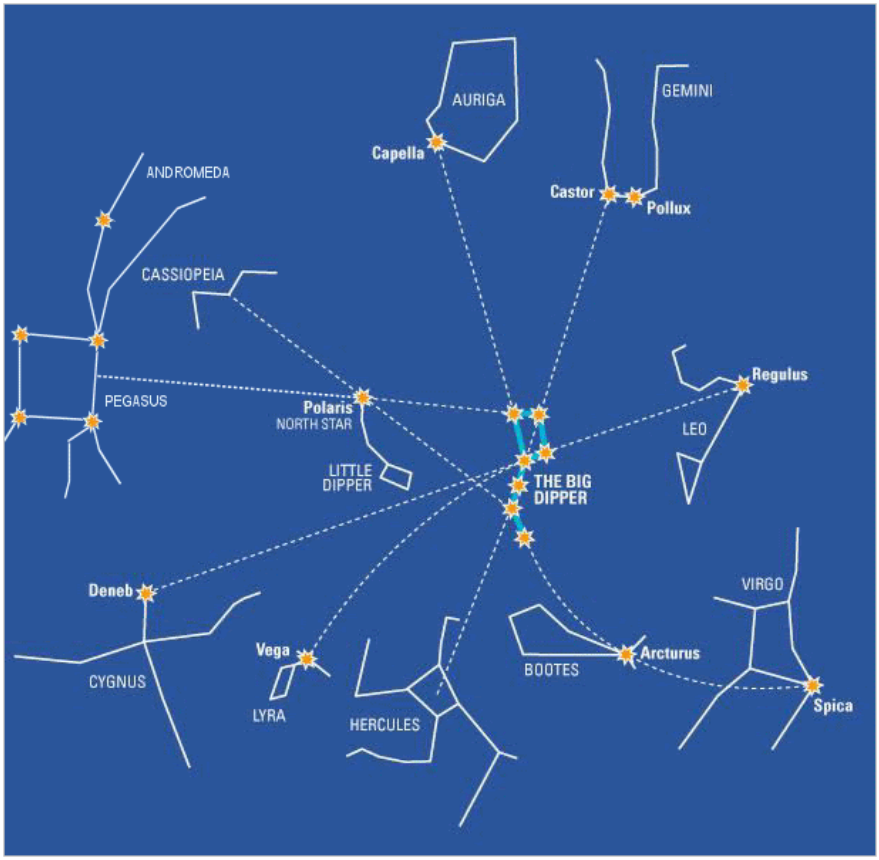

Ursa Major ("Big Bear") is the third largest constellation, and being so recognizable makes it a natural reference point for locating several important constellations of the night sky.

Ursa Major: The 7 brightest stars in this constellation form a distinctive shape, known separately as the Plough or Big Dipper, although the entire constellation is spread over a greater area of the sky. It is the most famous of all Northern constellations and is circumpolar in England and the Northern United States.

Ursa Minor: The 7 main stars of this constellation form a shape similar to Ursa Major, but with the tail of the bear pointing in the opposite direction. Ursa Minor ("Little Bear") has been more universally observed than any other constellation on account of the close proximity to the north celestial pole of its brightest star Polaris (North Star). A line through Ursa Major's last two stars, Merak and Dubhe, also known as 'the pointers', leads to Polaris, with the bright star having been used to tell direction and time for thousands of years.

Cassiopeia: A line through the last star at the handle end of the Big Dipper and through Polaris will lead onto a conspicuous W shaped group of stars called Cassiopeia. This constellation depicts a mythological Greek queen by the same name who was punished for her boastfulness by being condemned to eternally circle the sky on her throne, which sometimes hangs upside

down as the constellation revolves in the night sky. The Milky Way runs through Cassiopeia, making it particularly rich in deep-sky objects, including star clusters and galaxies.



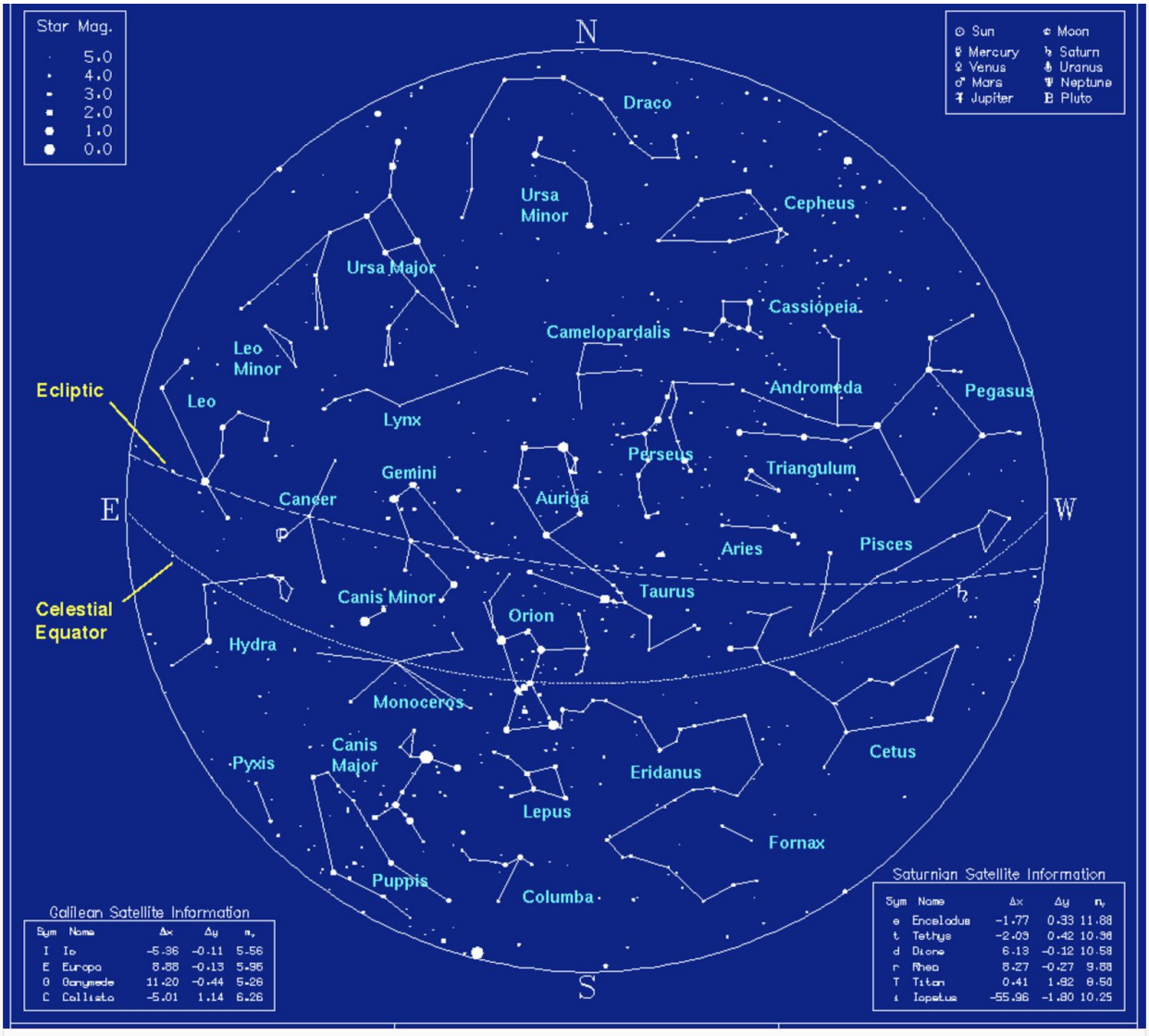

Bootes: An imaginary line that follows the arc of the Big Dipper's handle leads onto Bootes, which is ancient Greek for 'plowman' of 'herdsman'. The constellation contains the beautiful orange-red giant star Arcturus ("Bear Watcher"), whose visual magnitude of −0.04 makes it the 3rd brightest star in the night sky, after Sirius and Canopus, but the brightest in the northern celestial heavens.

Virgo: Extending the imaginary curved line further south from Bootes leads to the blue-white star called Spica. This is the 15th brightest star, and lies in the constellation Virgo, which is the night sky's second largest constellation, after Hydra.

Leo: This constellation can be found by following the pointer stars Merak and Dubhe in the opposite direction to Polaris. Leo lies south of Ursa Major, and is so beautiful and striking in its resemblance to the animal it depicts as to make it unmistakable. Its brightest stellar object, Regulus, is a blue-white star from which longitude is reckoned.

Gemini: An imaginary line drawn diagonally through the stars Megrez and Merak in the ‘bowl’ of the Big Dipper, in the opposite direction of the ‘handle’, leads to the constellation of Gemini. The constellation is characterized by two nearly parallel rows of stars; the northern row, headed by Castor, if extended, would reach Taurus, while the southern row, headed by Pollux, would reach Orion.

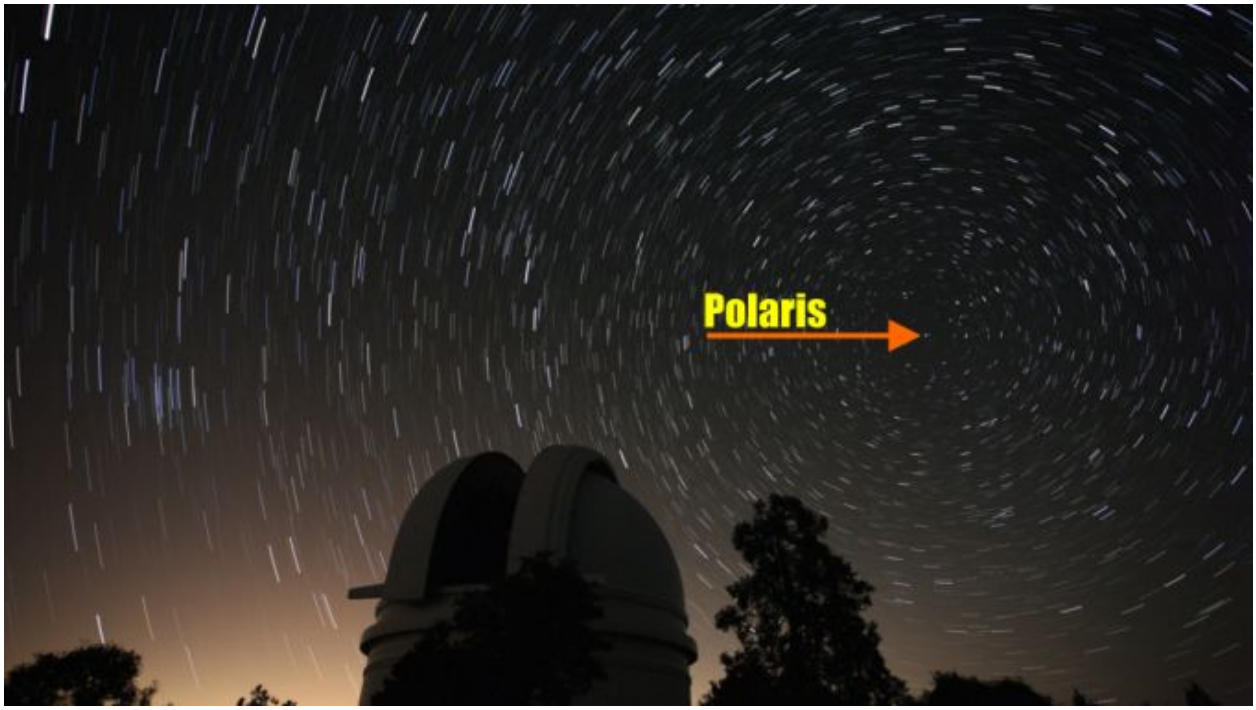
Auriga: A line running through the two top stars in the ‘bowl’ of Ursa Major in the opposite direction of the handle leads to Auriga. This constellation means “the charioteer” in Latin, and contains the night sky’s 6th brightest star, Capella, which is a rich yellow color.




A typical star chart found on many astronomy magazine, newspapers, and almanacs. Credit: Sky and Telescope

## Using The Stars To Tell Time

November 29, 2012 Peter Christoforou FAQs, Star Constellations, Star FAQs, Stars 0




Polaris (The North Star) is located in the constellation of Ursa Minor and can be used to either measure time, or tell the time within 30 minutes of accuracy.

**Locating Polaris**

Polaris lies just opposite The Plough (Big Dipper) in the constellation of Ursa Major with a line drawn from the pointer stars (Dubhe and Merak) in the Big Dipper and five times their distance from each other then leading to Polaris. It is located 434 light-years from Earth and is a yellow supergiant 2,500 times brighter than the Sun.

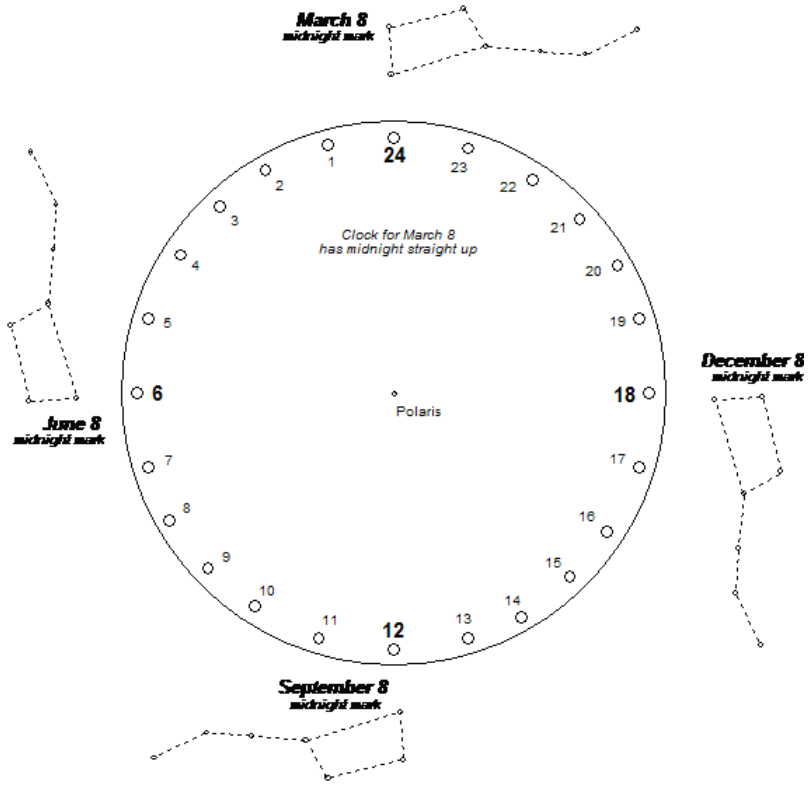
**Measuring Time**

Ursa Major along with neighboring Cassiopeia never set below the horizon and completes a whole counter-clockwise (east to west) rotation around Polaris every 24 hours. Therefore, pointer star Merak for example, would revolve all the way around Polaris and return to its original place within a 24 hour period.

Now imagine Polaris as the center of a celestial 24 hour clock (24 separate hours) and a line drawn from Polaris to Merak as an hour hand with each 15 degree rotation by Merak equaling 1 hour of time passing (360 degrees/24hrs).

To tell when four hours have elapsed draw a new hour line running 60 degrees counter-clockwise from your original hour hand and note where it would intercept the horizon. When the line eventually reaches that point four hours have elapsed.

**Telling The Time**




On March 8th the basic rule involving Polaris and The Big Dipper is as follows:

**Midnight (2400):** Big Dipper directly over Polaris.

**6AM (0600):** Big Dipper is to the left (west) of Polaris.

**Noon (1200):** Big Dipper directly below Polaris.

**6PM (1800):** Big Dipper is to the right (east) of Polaris.

Complicating matters, however, is the fact that our celestial clock runs fast by 24 hours each year because the Earth takes 365 days to travel around the Sun but a circle only has 360 degrees. In order to compensate for this, we have to thus adjust the 24-hour (midnight) mark counter-clockwise on our celestial clock by around two hours per month to give an accurate reading of the time.

To be extra accurate subtract 30 minutes for each week or four (4) minutes per remaining day to give a reading to within half an hour of accuracy. However, don't forget to add one hour to the time if DST is in effect.

## Using The Stars For Direction, Latitude, And Time

November 29, 2012 Peter Christoforou FAQs, Star Constellations, Star FAQs, Stars 0

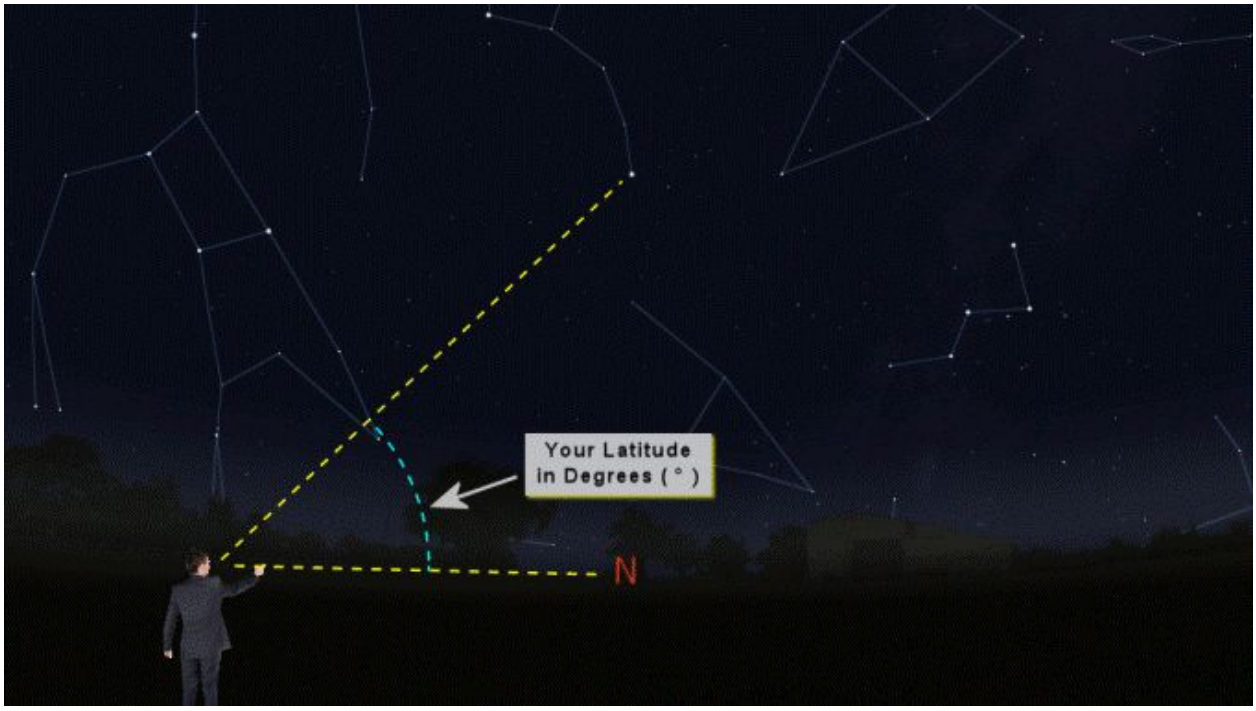



**Image Copyright: Fort Worth Astronomical Society at www.fortworthastro.com**
In the Northern Hemisphere, Polaris (The North Star) is used to determine the direction of north, as well as our position on the Earth's surface measured along a line running north to south called latitude.

### Locating Polaris

Polaris is located in the constellation of Ursa Minor which lies just opposite the The Plough (Big Dipper) in the constellation of Ursa Major. A line drawn from the pointer stars (Dubhe and Merak) in the Big Dipper and five times their distance from each other will then lead to Polaris.

### Determining North

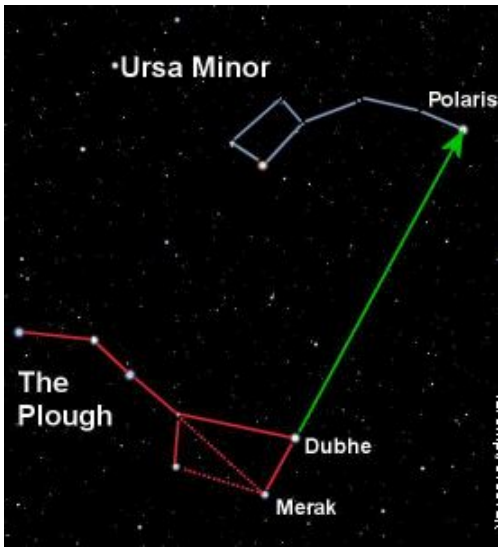
Polaris sits almost exactly over the North Pole and is readily located as unlike the other stars it does not appear to move in the night sky. Facing it will mean you are looking in a northward direction and by extending your arms to the side, your left arm will point west, your right arm east, while your back will point south.

### Latitude

Polaris appears directly overhead at the North Pole (90 degrees) but only slightly above the horizon at the equator (0 degree). Therefore by measuring Polaris' height above the horizon we are able to determine our latitude. For example, if you lived in New York, Polaris would appear due north and 40 degrees above the horizon.

**Measuring Latitude**

A rough method to measure this angle is by extending your hand and spreading your fingers which should then cover about 20 degrees of the sky between the tip of your little finger and thumb. Alternatively, you could use your outstretched fist which would cover around 10 degrees of sky.




**Time (Sky-Clock)**

Interestingly, Ursa Major along with neighboring Cassiopeia never sets below the horizon and completes a whole counterclockwise (east to west) rotation around Polaris every 24 hours. Therefore, pointer star Merak for example, would revolve all the way around Polaris and return to its original place in a 24 hour period.

Now imagine Polaris as the centre of that 24 hour clock (1hr to 24hrs) and a line drawn from Polaris to Merak as an hour hand with each 15 degree rotation by Merak equaling 1 hour of time passing (360 degrees/24hrs).

To tell when four hours have elapsed, draw a new hour line running 60 degrees counterclockwise from your original hour hand and note where it would intercept the horizon. When the line eventually reaches that point four hours have elapsed.

Note: this method is useful for simple purposes as many more complex factors would be required for long term accurate calculations. For a fuller explanation read here.