

THE GARDEN SUNDIAL: MORE THAN AN ORNAMENT

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THE GARDEN SUNDIAL - OUTLINE

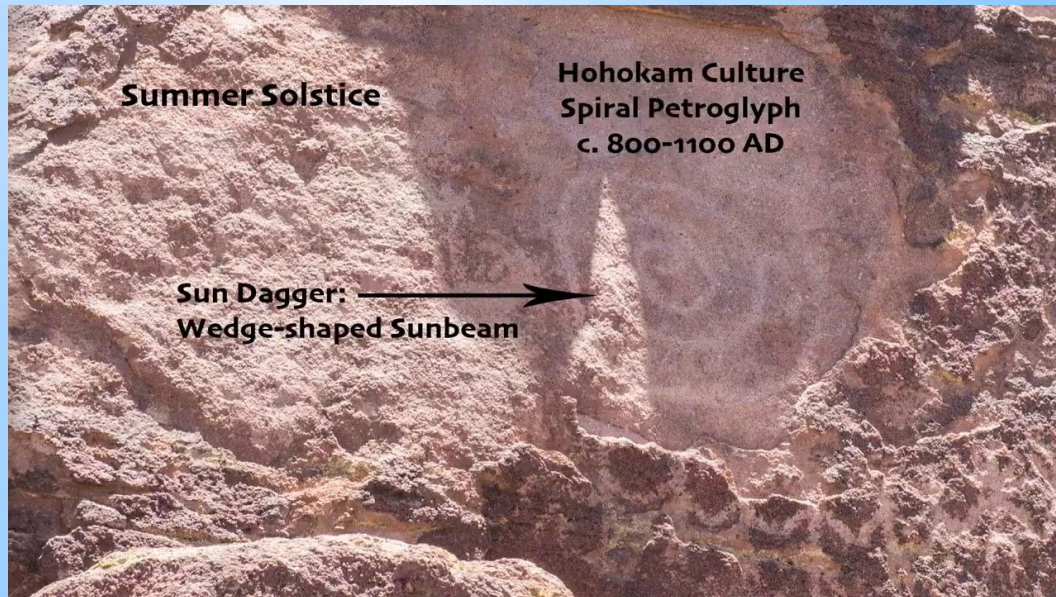
- Brief history of sundials
- Solar time vs. clock time
- How to read a sundial
- Other types of sundials
- Planting a sundial?
- Resources



A BRIEF HISTORY OF SUNDIALS

Europe: Stonehenge

Cultures all over the world used the Sun to mark the passage of time.



Native America: Hohokam sun dagger



Northern Africa: Nabta Playa

A BRIEF HISTORY OF SUNDIALS

Cultures all over the world used the Sun to mark the passage of time.



Hemicyclium sundial from Turkey, ~2000 yrs old



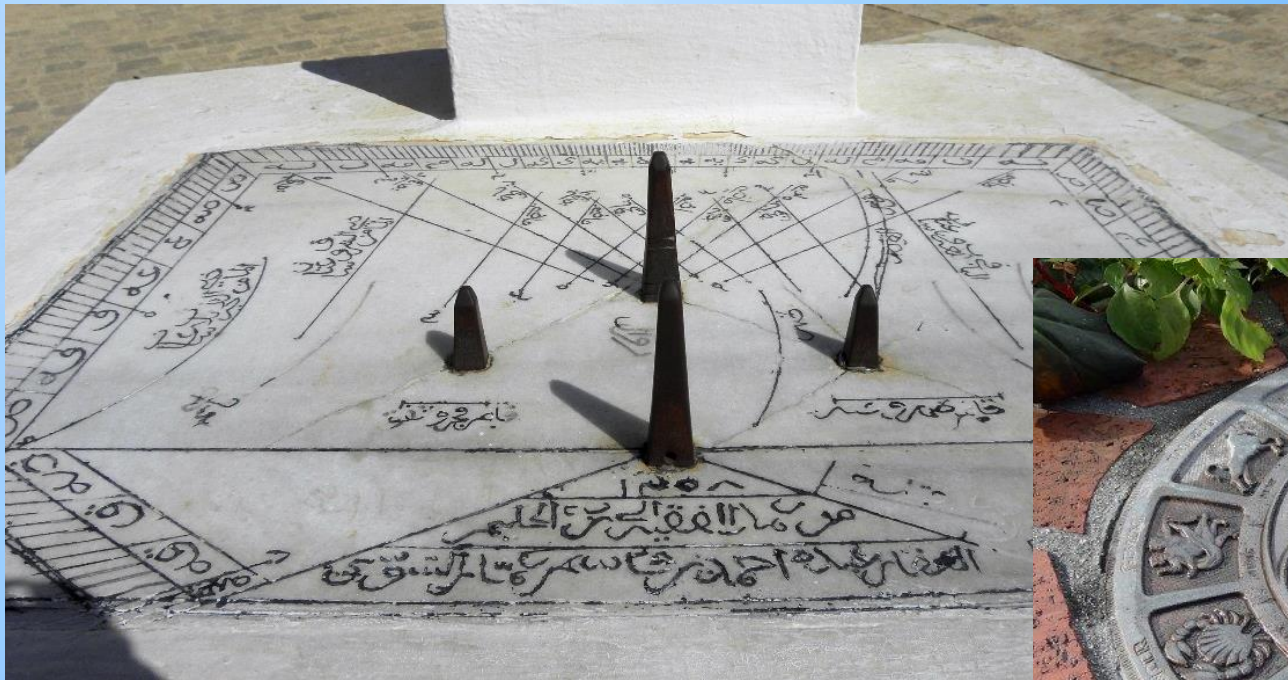
Roman empire (Pompeii, circa 1st century BCE)

A BRIEF HISTORY OF SUNDIALS

Diptych sundials

Cultures all over the world used the Sun to mark the passage of time.

Islamic cultures (Grand Mosque of Kairouan, Tunisia)



Gifts from Harvard University's Scientific Instruments



Horizontal sundial from CA, circa 1700s

SOLAR TIME VS. CLOCK TIME

What is time?



Solar noon: Sun crosses your local meridian

Sundial's shadow marks time away from solar noon: **solar time**



SOLAR TIME VS. CLOCK TIME

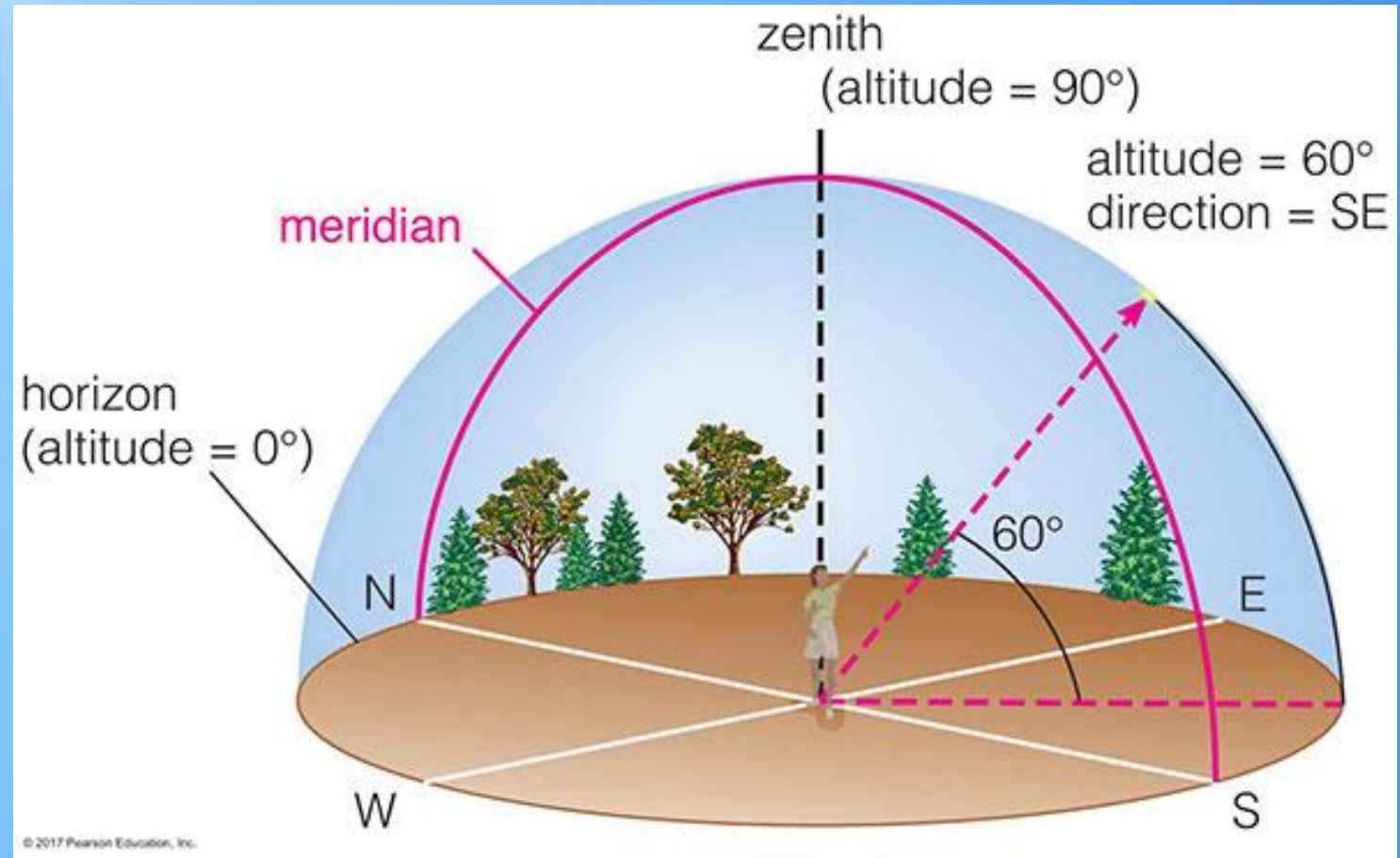
Solar time does not usually match clock time.
Why?

What is time?



Solar noon: Sun crosses your local meridian

Sundial's shadow marks time away from solar noon: **solar time**



SOLAR TIME VS. CLOCK TIME

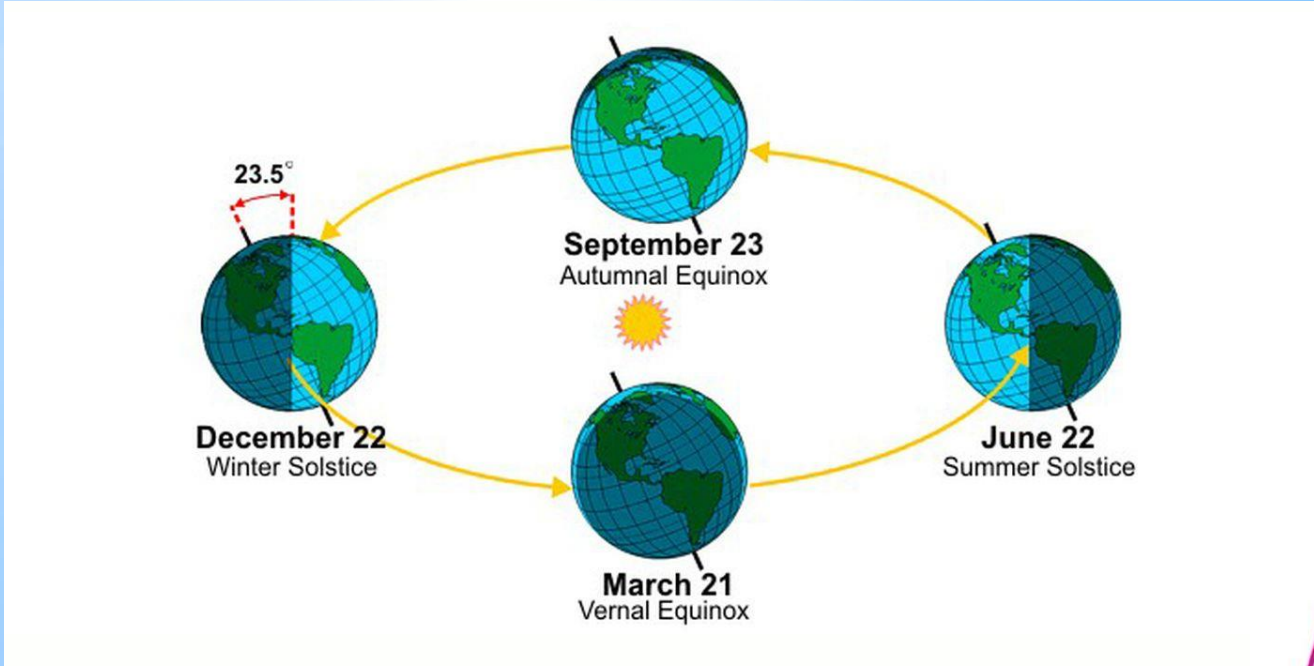


Winter vs. summer –

shifting shadows and sunlight

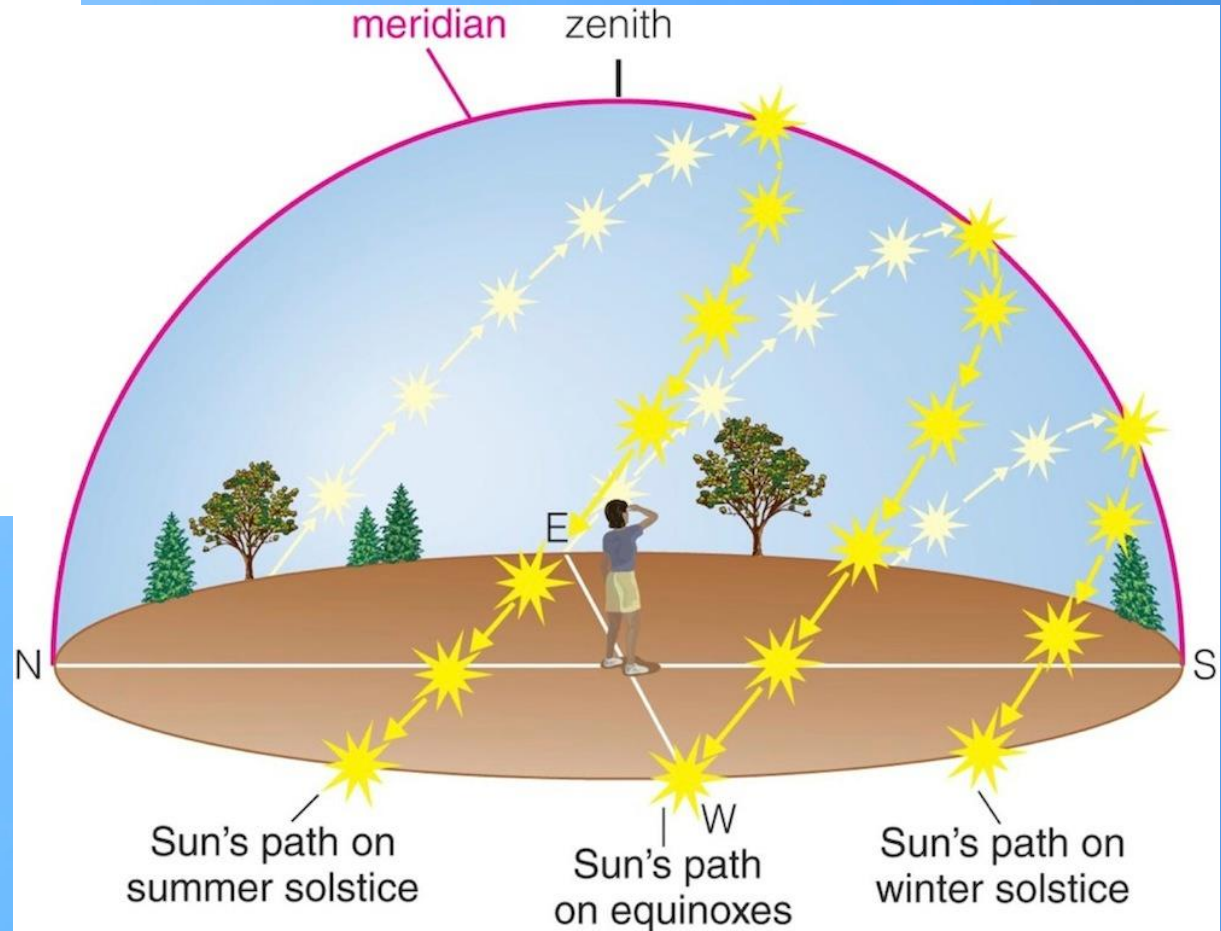


SOLAR TIME VS. CLOCK TIME



Earth is **tilted** in its orbit around the Sun

– gives us the **seasons**



SOLAR TIME VS. CLOCK TIME

Earth moves in an elliptical orbit around the Sun

– speeds up and slows down

Sun's position at noon each day will change during the course of a year due to:

- (1) axial tilt
- (2) elliptical orbit.



SOLAR TIME VS. CLOCK TIME

This produces a characteristic “squashed figure-eight” shape called an **analemma**.

Clock time is an **average** of solar time

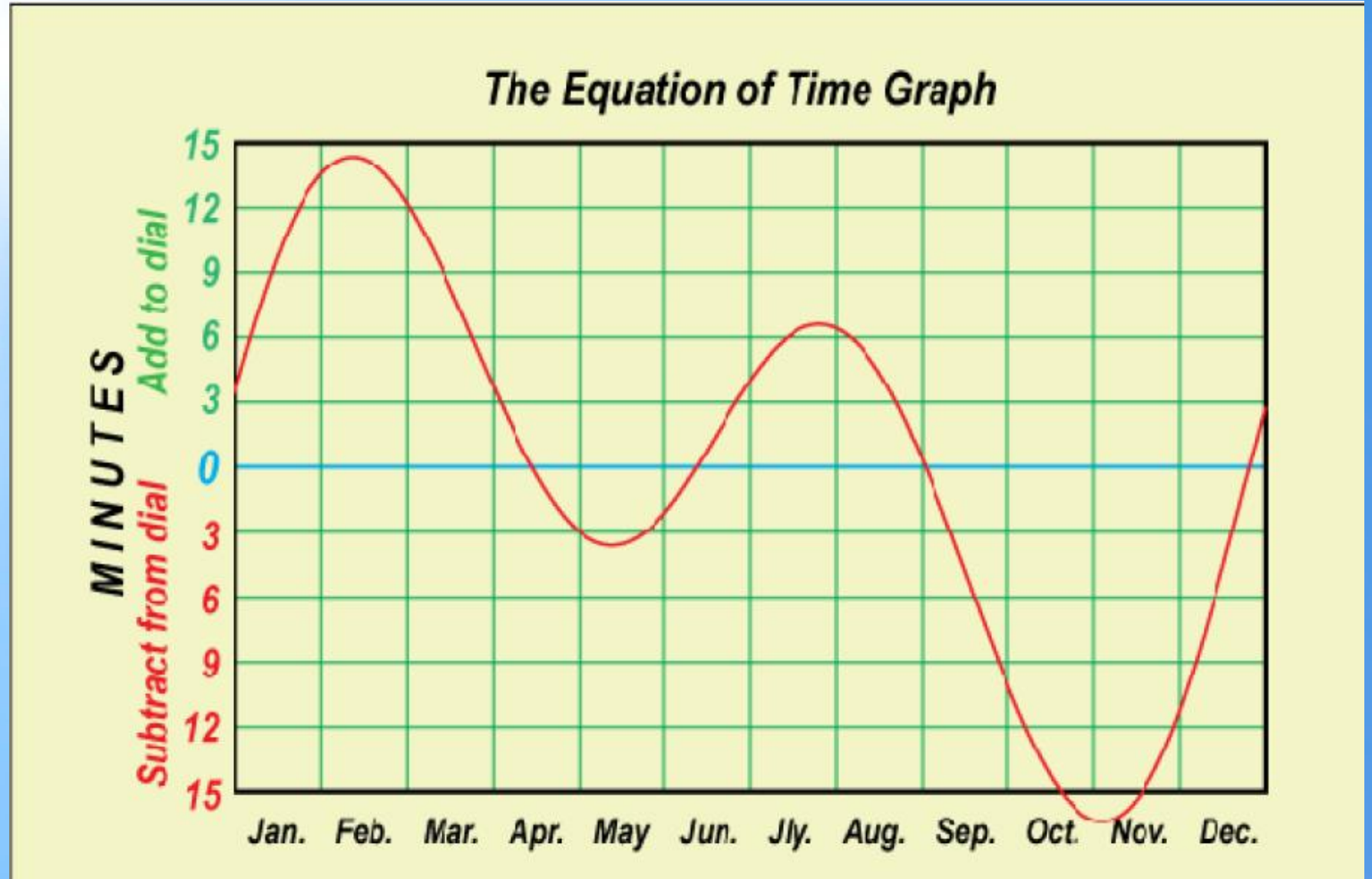
– giving us same length of day (time between successive noons).



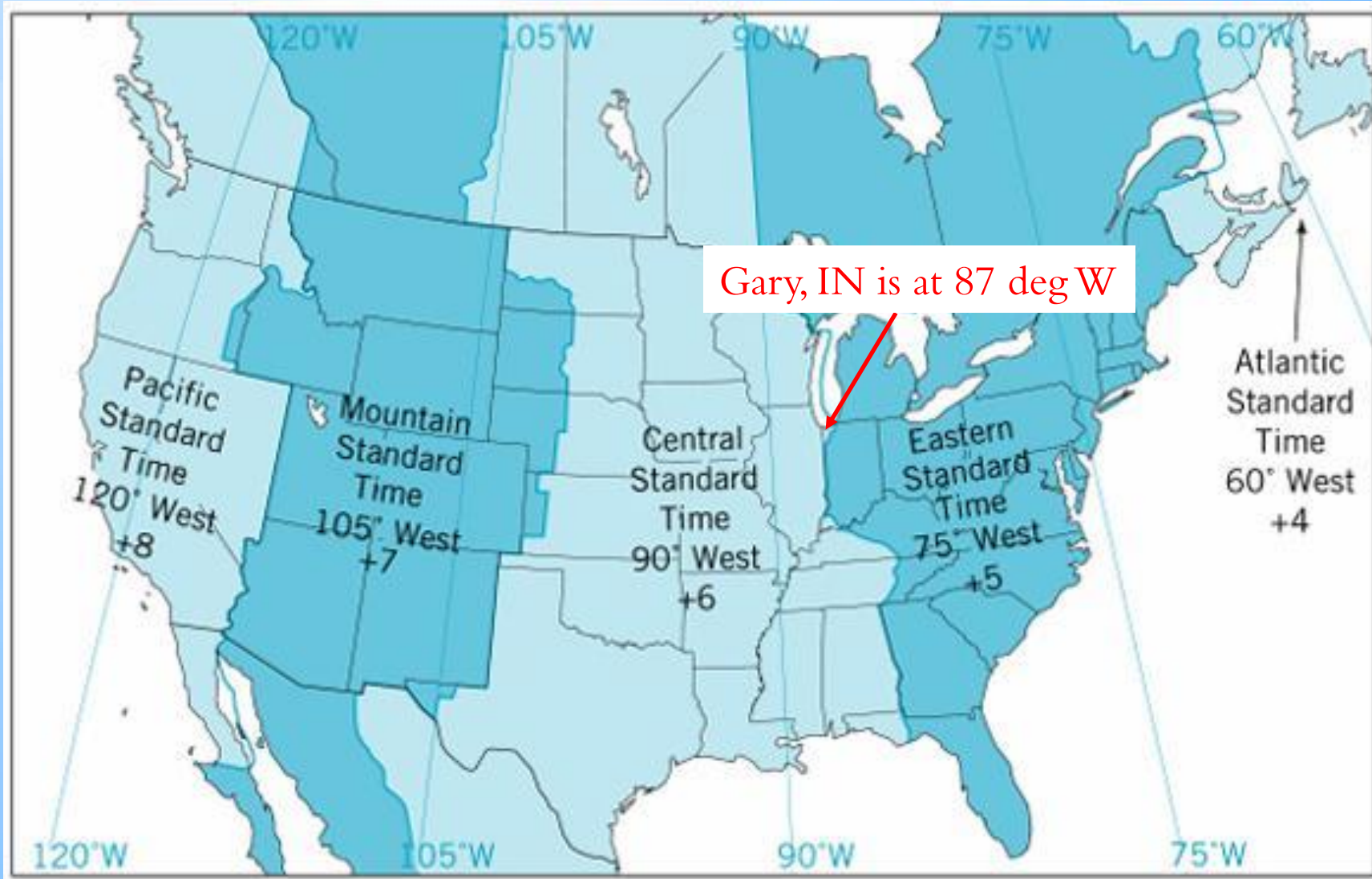
SOLAR TIME VS. CLOCK TIME

Equation of time is the difference between solar time and **mean time**

- almost clock time!



SOLAR TIME VS. CLOCK TIME

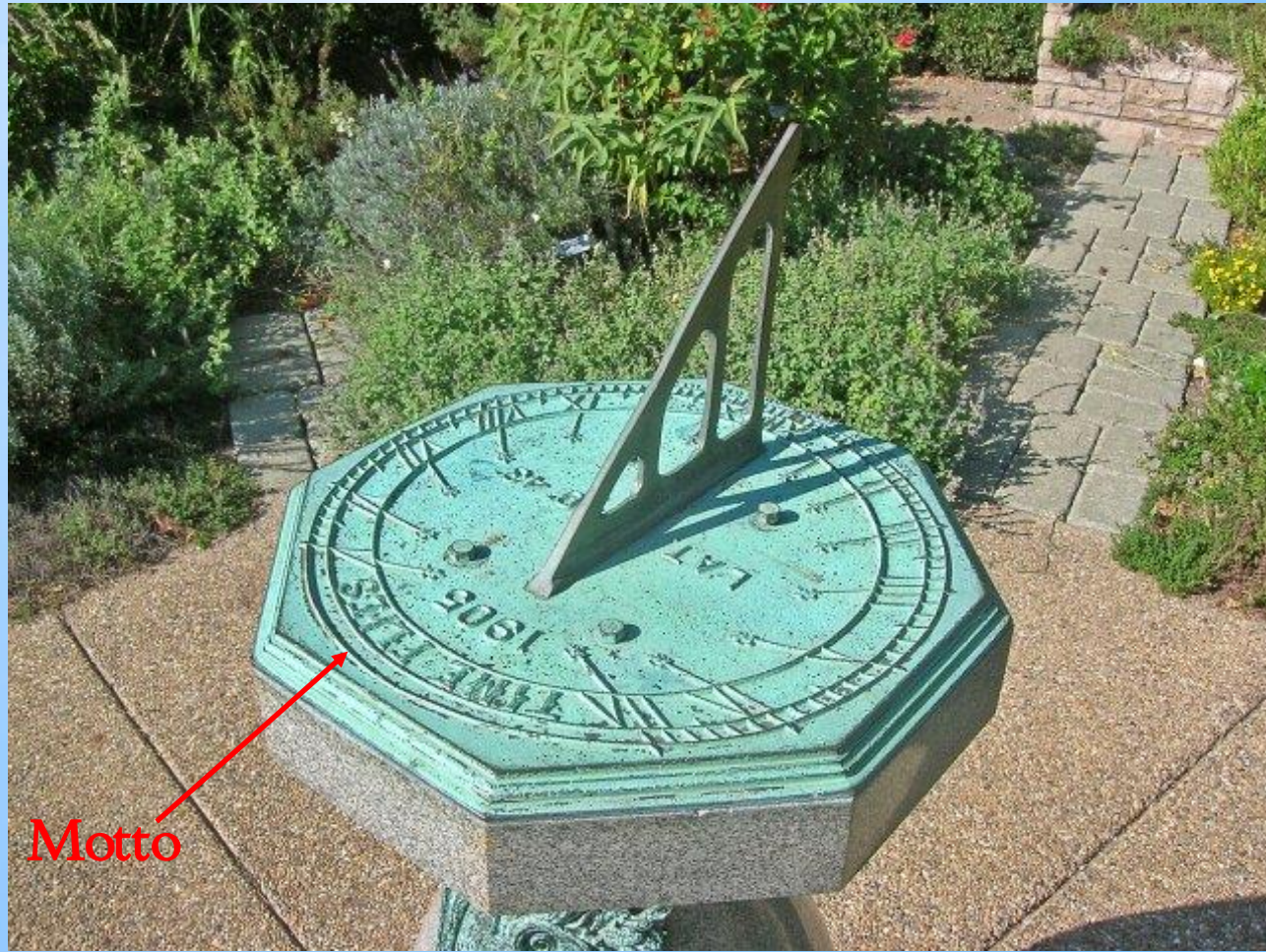


Clock time will differ from mean time because it is defined by reference to a time zone's meridian.

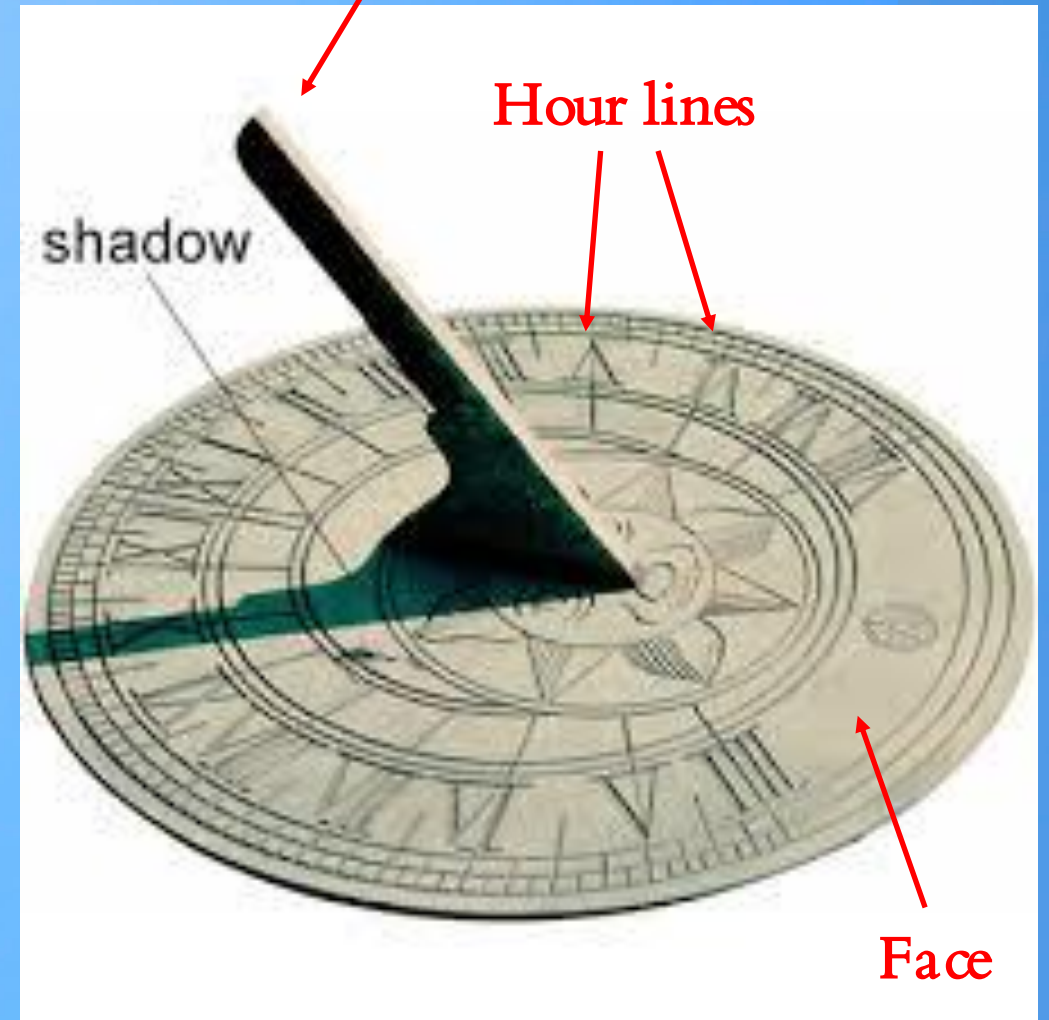
Need a correction for **longitude**:

4 min per degree different from time zone meridian

HOW TO READ A SUNDIAL



Motto



Gnomon (or style)

Hour lines

shadow

Face

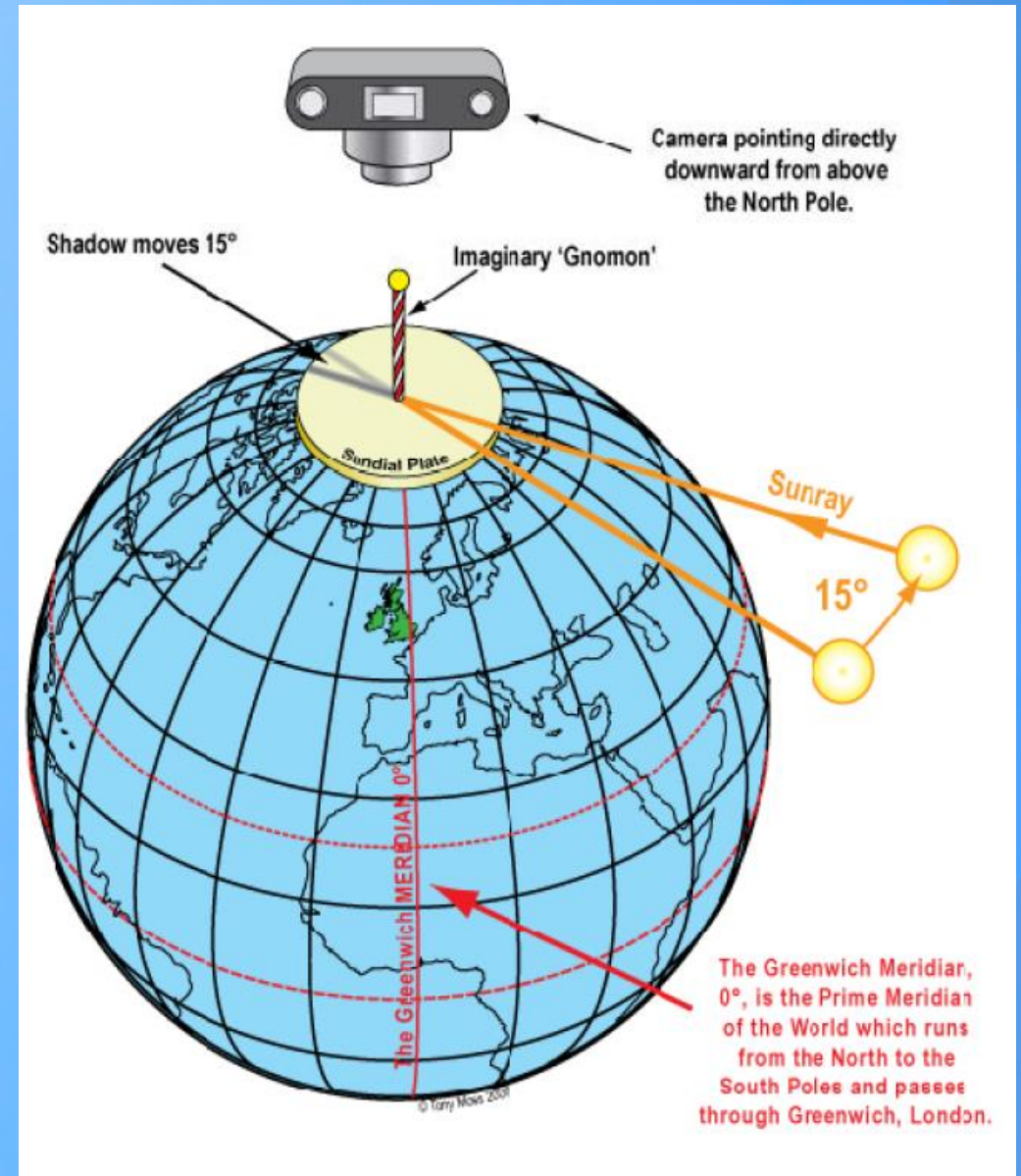
Sundial in Peoria, IL (Glen Oak Park Conservatory)

HOW TO READ A SUNDIAL

The Sun appears to move around the Earth (15 degrees each hour).

Use a **gnomon** to create a shadow which will be projected onto the **face** of the dial.

The shadow will appear then to change its angle by 15 degrees each hour.



HOW TO READ A SUND

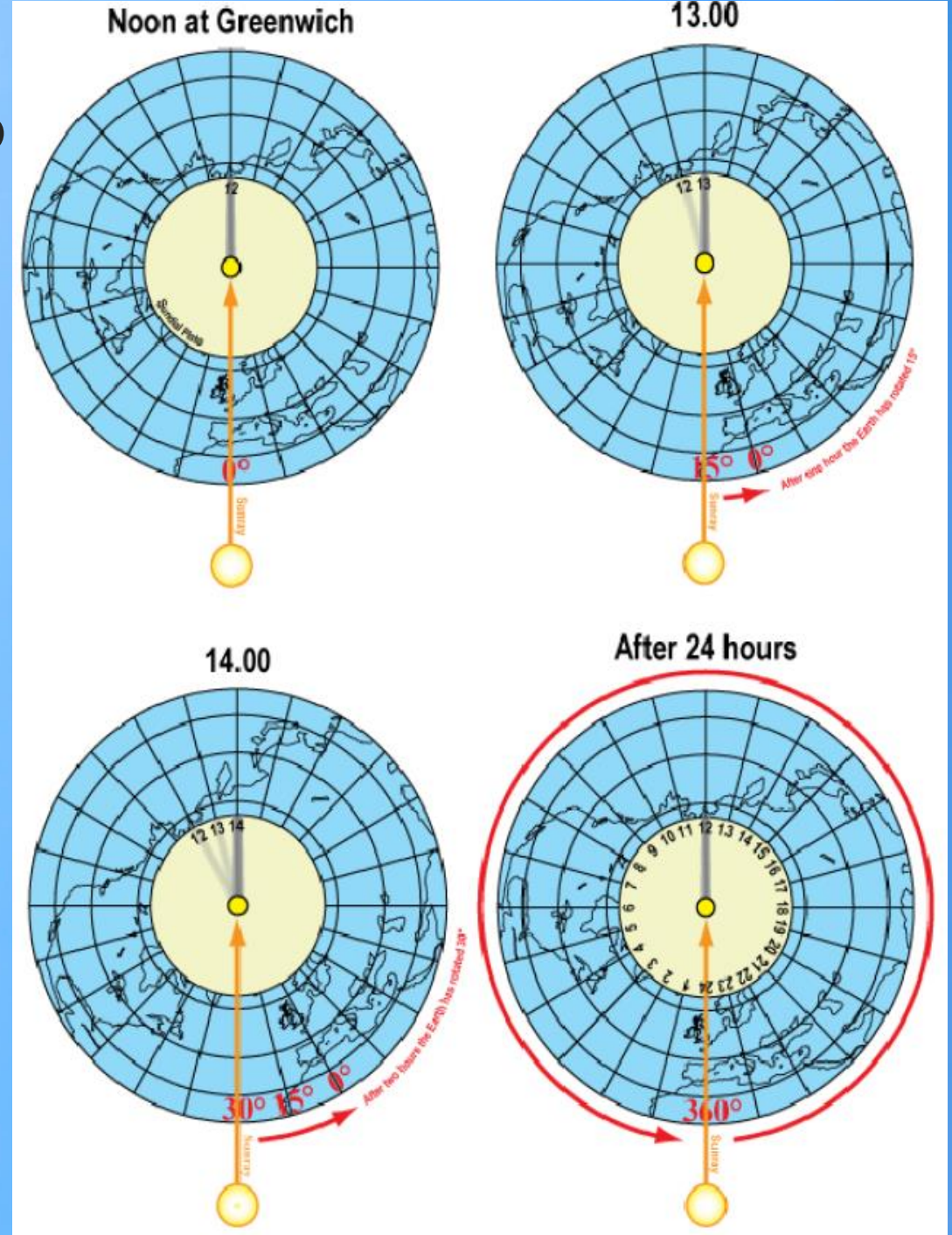
The Sun appears to move around the Earth (15 degrees each hour).

Use a **gnomon** to create a shadow which will be projected onto the **face** of the dial.

The shadow will appear then to change its angle by 15 degrees each hour.

Graphics thanks to Tony Moss

At the North Pole:



HOW TO READ A SUNDIAL

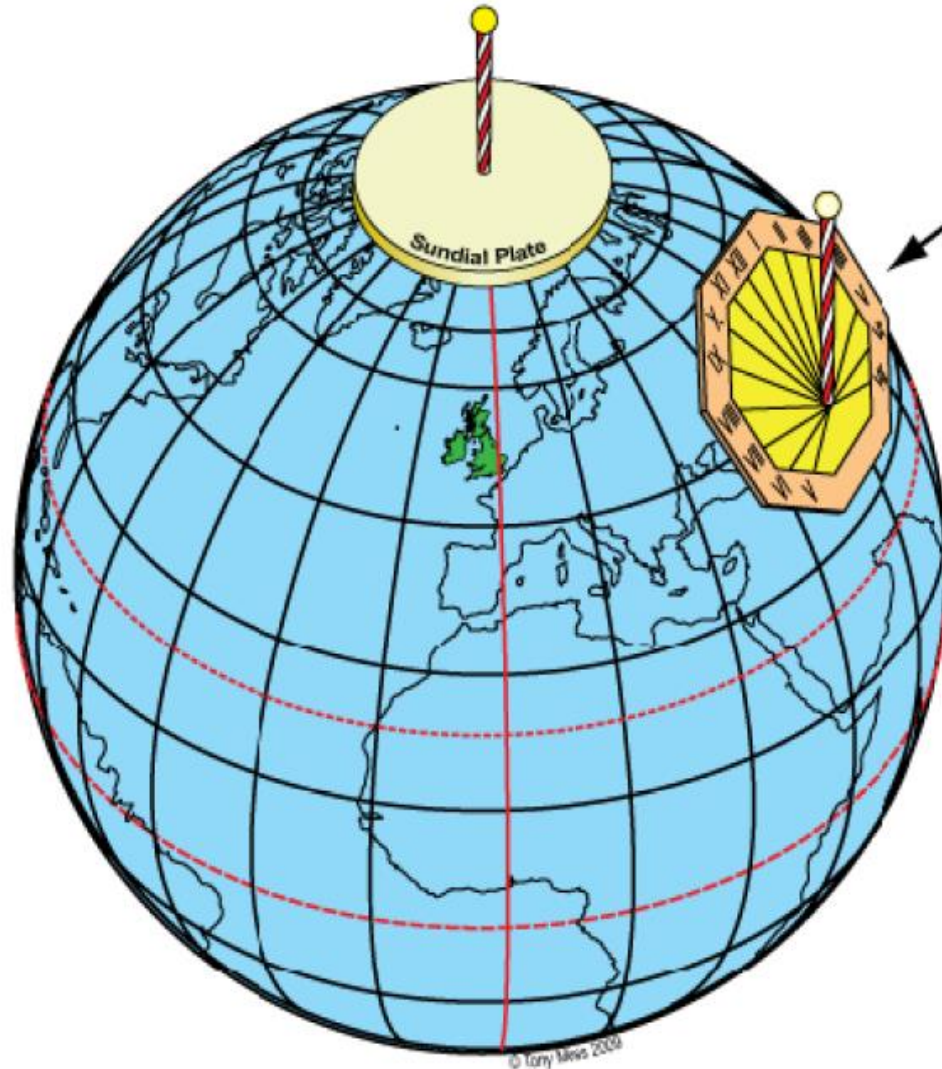
Angle between gnomon and face equals your **latitude**

Horizontal Dial

The **face** is oriented to be horizontal; the **gnomon** remains parallel to Earth's rotation axis.

(The face is *tangent* to the Earth's idealized surface).

Graphics thanks to Tony Moss



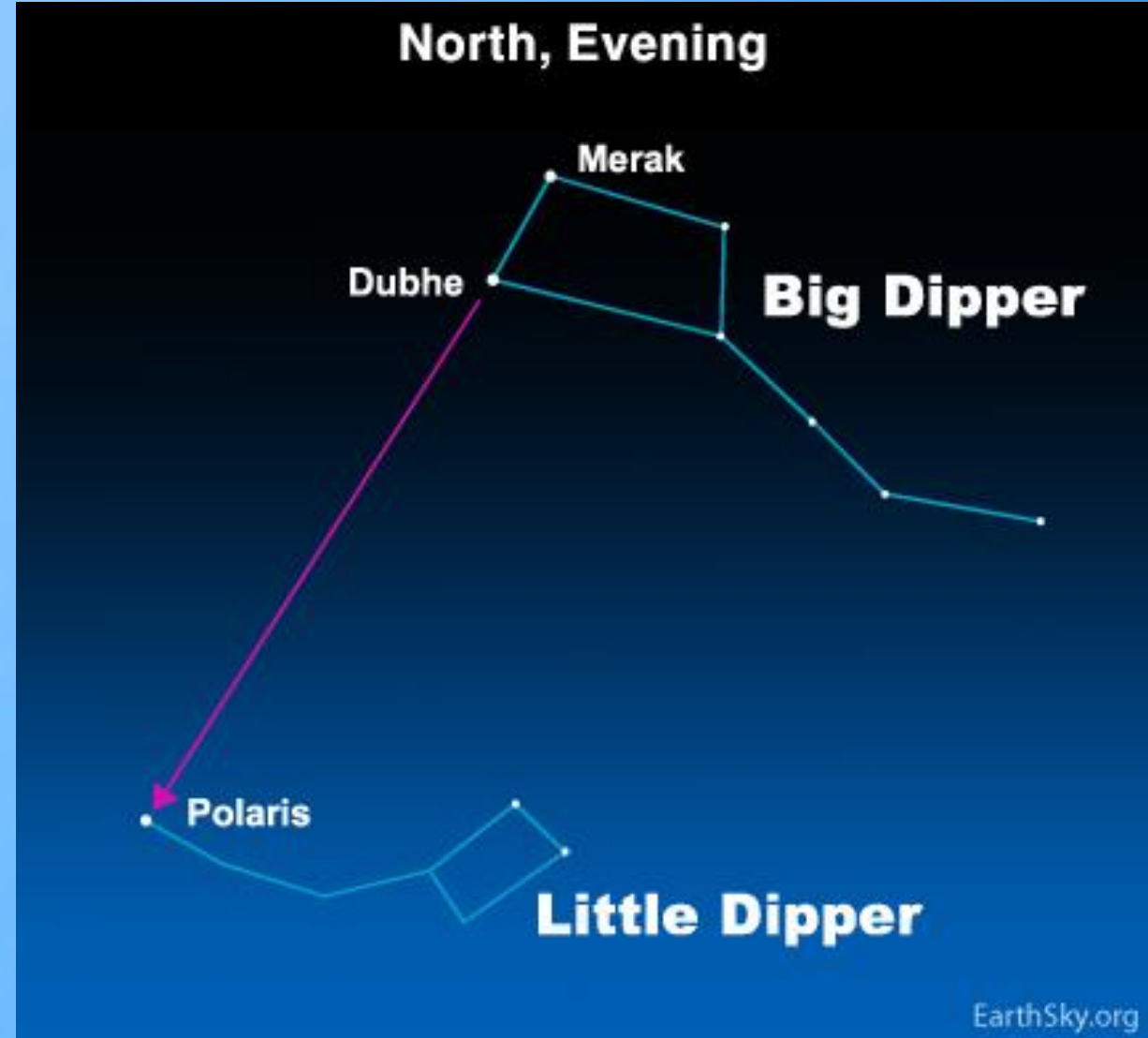
When the 'shadow-catching' surface is laid flat on the ground (a 'Horizontal Dial') the gnomon remains parallel to the Earth's axis so is set at an angle to the plate which is equal to the local latitude. The example shown is at approximately 45° north.



This is what it looks like to the local people.

HOW TO READ A SUNDIAL

Finding north – look for the North Star, Polaris



HOW TO READ A SUNDIAL

Finding north – look for the North Star, Polaris

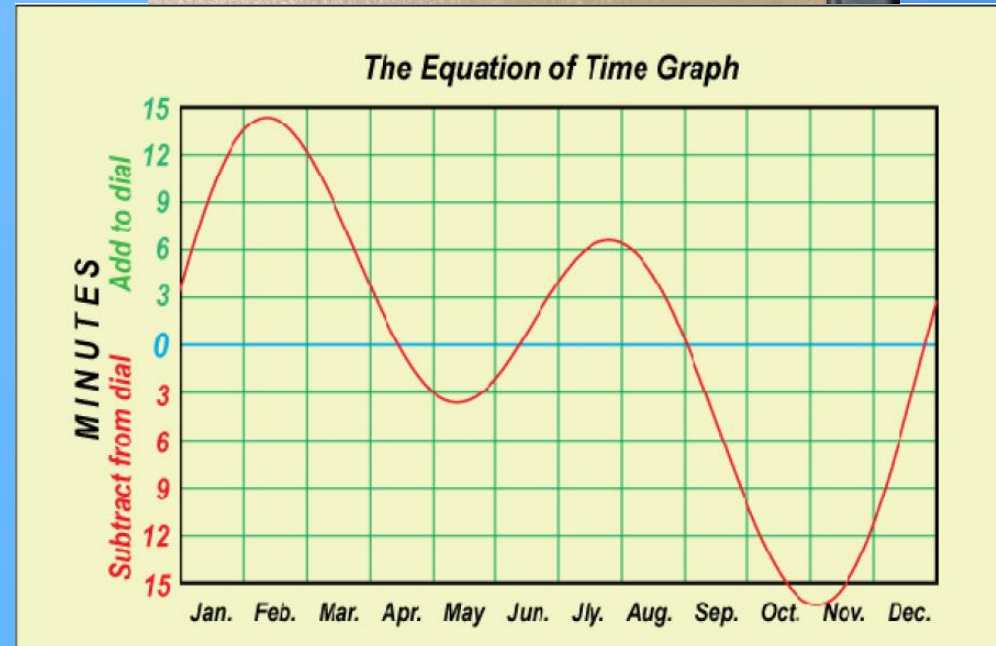
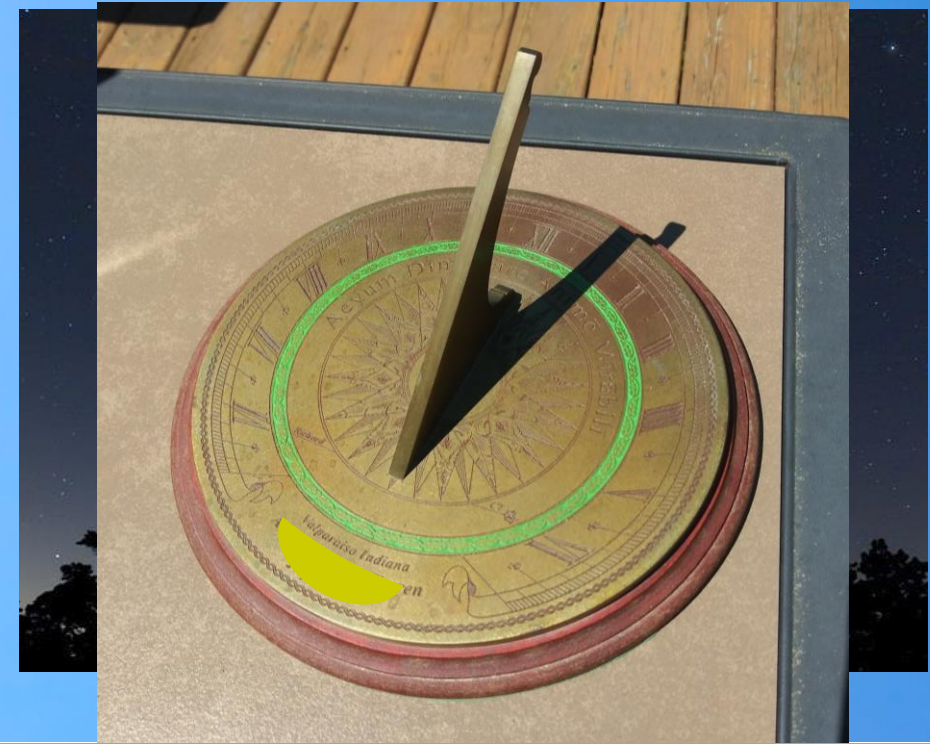


The north pole of Earth points directly toward Polaris, or the North Celestial Pole.

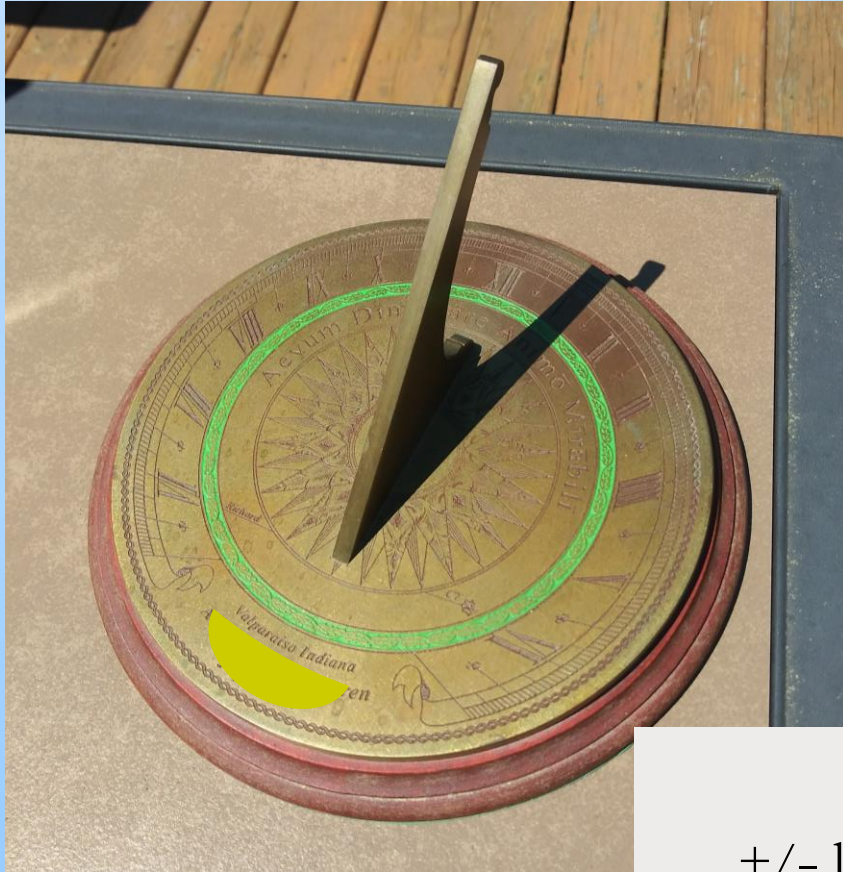


HOW TO READ A SUNDIAL

1. Choose a sundial for **your latitude**
 - Find on Google maps
2. Align sundial so gnomon points to **true north**
 - Find Polaris
 - Use compass
3. Note the **hour line** that the shadow's edge hits
4. Add or subtract according to the **equation of time** for today's date
5. Add or subtract for the **longitude correction**
 - -4 min for each degree **east** of time zone meridian
 - +4 min for each degree **west** of time zone meridian
6. Adjust if we're in **Daylight Saving** time
 - Add 1 hour



HOW TO READ A SUNDIAL



Sundial time

+/- longitude correction

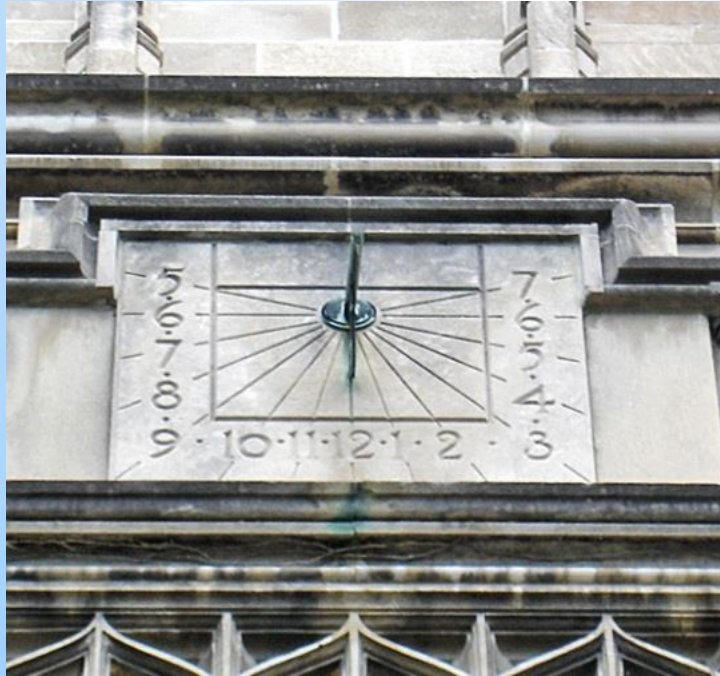
+/- equation of time correction

+ 1 hr if Daylight Saving

Clock time



OTHER TYPES OF SUNDIALS



Vertical sundial –
Indiana University
Bloomington, IN



Horizontal dial – Vietnam
Veterans Memorial,
Frankfort, KY



Armillary sphere –
Purdue Fort Wayne, IN

OTHER TYPES OF SUNDIALS



Equatorial dial – Adler Planetarium, Chicago, IL

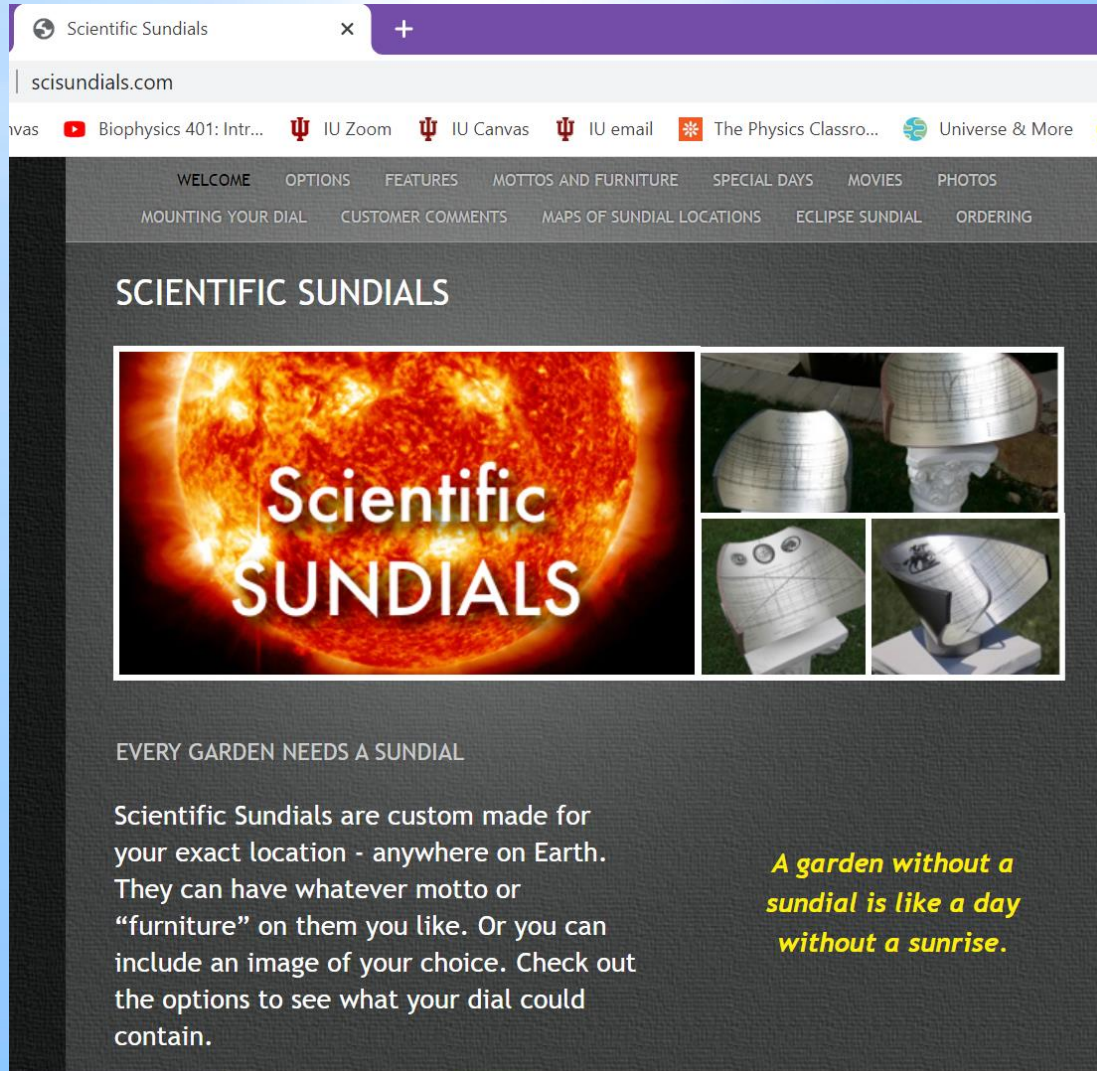


Analemmatic sundial –
Kokomo, IN

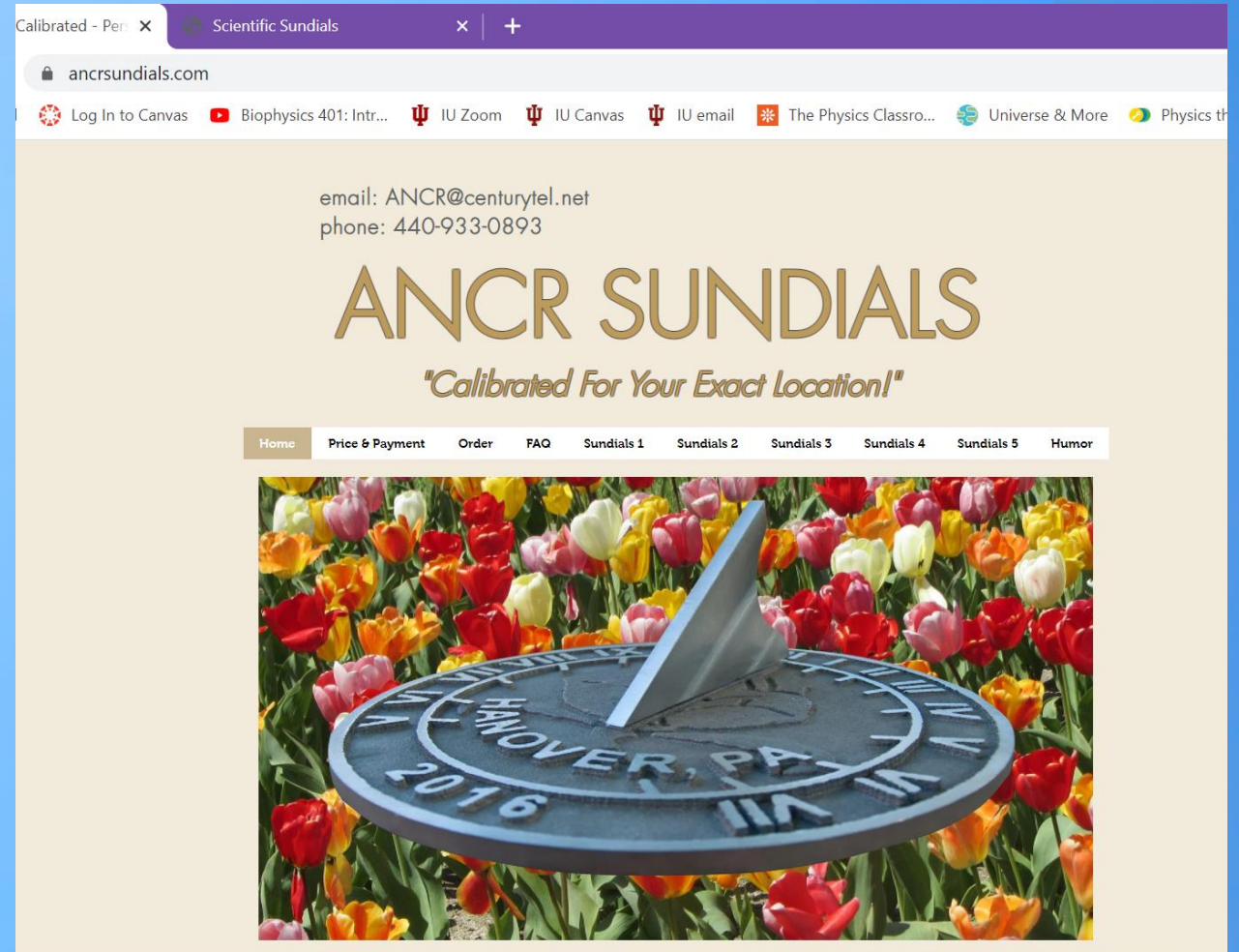
Check out the sundial registry:
<https://sundials.org/sundial-registry.html>

SUNDIALS FOR GARDENS

Check resources at <https://sundials.org/dial-links/sundial-artisans.html>



The screenshot shows the homepage of Scientific Sundials. The browser address bar displays 'scisundials.com'. The navigation menu includes: WELCOME, OPTIONS, FEATURES, MOTTOS AND FURNITURE, SPECIAL DAYS, MOVIES, PHOTOS, MOUNTING YOUR DIAL, CUSTOMER COMMENTS, MAPS OF SUNDIAL LOCATIONS, ECLIPSE SUNDIAL, and ORDERING. The main heading is 'SCIENTIFIC SUNDIALS'. Below it is a large image of the sun with the text 'Scientific SUNDIALS' overlaid. To the right are four smaller images of different sundial designs. Below the main image, the text reads: 'EVERY GARDEN NEEDS A SUNDIAL. Scientific Sundials are custom made for your exact location - anywhere on Earth. They can have whatever motto or "furniture" on them you like. Or you can include an image of your choice. Check out the options to see what your dial could contain.'



The screenshot shows the homepage of ANCR Sundials. The browser address bar displays 'ancrsundials.com'. The contact information is: email: ANCR@centurytel.net, phone: 440-933-0893. The main heading is 'ANCR SUNDIALS' with the tagline '"Calibrated For Your Exact Location!"'. The navigation menu includes: Home, Price & Payment, Order, FAQ, Sundials 1, Sundials 2, Sundials 3, Sundials 4, Sundials 5, and Humor. Below the menu is a large image of a sundial in a field of colorful tulips. The sundial's gnomon is a metal rod, and the dial face is circular with the text 'ANCR SUNDIALS' and '2016' visible.

SUNDIALS FOR GARDENS

The screenshot shows the website's header with the logo and the text "North American Sundial Society" and "Sundials - World's Oldest Clocks". Below the header is a navigation menu with items like "NASS", "Join or Renew", "Publications", "All Things Sundial", "Dial Links", "Videos", "Features", "Teachers Corner", and "Sundials". The "Teachers Corner" menu is open, showing options like "STEM Outreach", "Sundial Construction", "Draw a Sundial", "Cut-Out Sundials", "Sundial Mathematics", and "Art and Literature". The main content area is titled "Draw A Sundial" and includes a date "Published: Saturday, 15 November 2014 20:59 | Print | Hits: 14806". It contains instructions for drawing a sundial, such as "To draw your sundial, convert your latitude into a decimal number for entry. For example: 38°45' N would be entered as 38.75". At the bottom of the page, there is a form with the text "Enter Your Latitude:" followed by an input field containing "41.55" and "Draw" and "Clear" buttons.

The screenshot shows the interactive tool interface. At the top, there is a browser tab titled "Draw a Sundial" and a URL bar showing "sundials.org/teachers-corner/draw-a-sundial.html". Below the browser bar, there are navigation icons and a search bar. The main content area has the text "Enter Your Latitude:" followed by an input field containing "41.55" and "Draw" and "Clear" buttons. Below this is a large, detailed drawing of a sundial face. The sundial face is octagonal with Roman numerals for the hours. A vertical line represents the gnomon. A compass rose is located in the center of the dial face, with "N", "S", "E", and "W" labels. Below the sundial face, the text "Lat: 41.55" and "North American Sundial Society" are visible. To the left of the sundial face, there is a smaller drawing of the sundial's base, which is a trapezoidal shape with a curved bottom edge.

Make your own from a template!

PLANTING A SUNDIAL?

Carl Linnaeus – Swedish botanist, 1750

Horologium florum (Flower Clock):
Flowers that open or close at certain times throughout the day



PLANTING A SUNDIAL?



Morning:

Ipomoea spp. (morning glory)



Late morning/midday:

Hibiscus grandifloras (swamp rose mallow)

Early afternoon:

Phemeranthus teretifolius (quill fameflower)



Late afternoon:

Mirabilis jalapa (four o'clock)

Evening:

Oenothera fruiticosa (evening primrose)

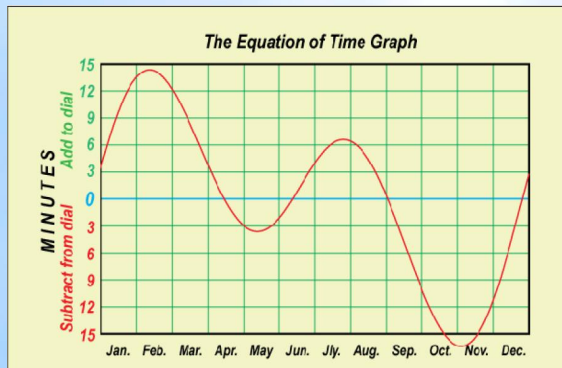
Night:

Ipomoea alba (moonflower)



SUNDIALS CONNECT US

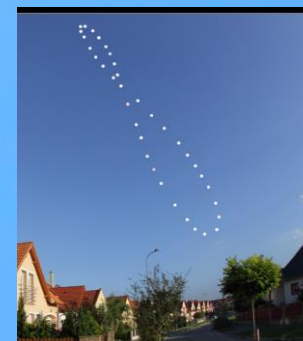
Math



History



Astronomy



Nature



Art



RESOURCES

Special thanks for suggestions and resources to
Fred Sawyer, NASS President (and my dad!)

- All things sundial: North American Sundial Society <https://sundials.org/>
- Buying sundials:
 - ANCR Sundials <https://www.ancrsundials.com/>
 - SciSundials <http://scisundials.com/Welcome.html>
 - Sundial artisans <https://sundials.org/dial-links/sundial-artisans.html>
- Astronomy:
 - Seasons https://www.weather.gov/dvn/Climate_Astronomical_Seasons
 - Sky & Telescope <https://skyandtelescope.org/>
 - Adler Planetarium, Chicago, IL (large collection of historic instruments) <https://www.adlerplanetarium.org/>
 - Stellarium <https://stellarium-web.org/>
- Solar time:
 - NOAA <https://www.esrl.noaa.gov/gmd/grad/solcalc/>
 - NOAA true north <https://www.ngdc.noaa.gov/geomag/calculators/mobileDeclination.shtml>
 - Equation of Time <https://sundials.org/teachers-corner/sundial-construction/60-equation-of-time.html>
- Linnaeus's Horologium Florae
 - A Garden to Set Your Clock By (Joel Lerner, October 19, 2002)
<https://www.washingtonpost.com/archive/realestate/2002/10/19/a-garden-to-set-your-clock-by/3a662448-42b2-4cca-b77e-41627bce098f/>
 - Five Minutes to Moonflower (Michael Tortorello, January 28, 2015)
<https://www.nytimes.com/2015/01/29/garden/planting-a-clock-that-tracks-hours-by-flowers.html>



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THANK YOU!

