THE GARDEN SUNDIAL:
MORE THAN AN ORNAMENT

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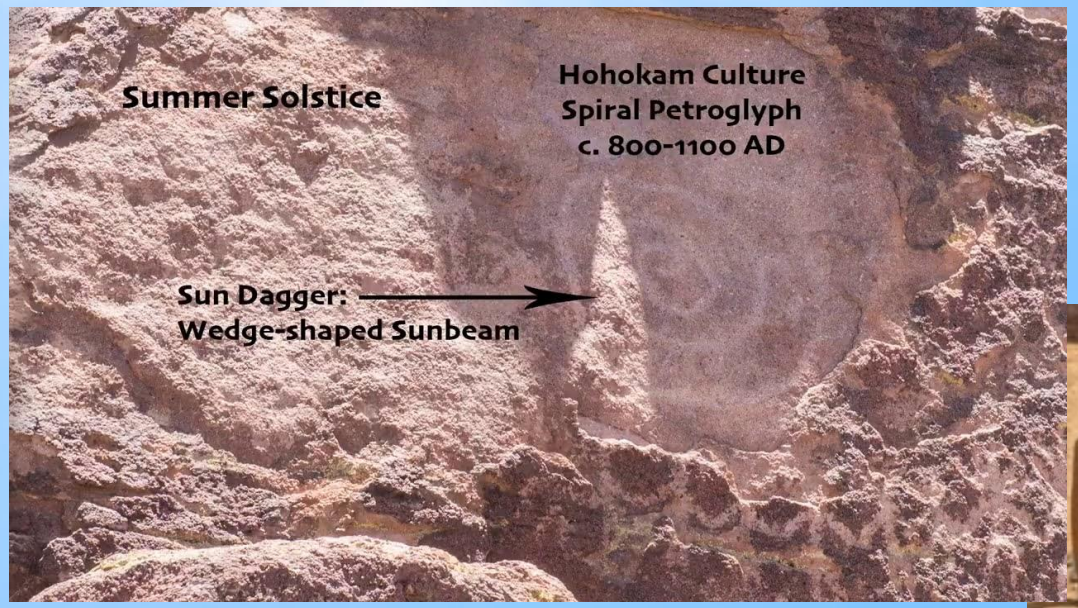
Indiana University Northwest

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

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



Native America: Hohokam sun dagger

Europe: Stonehenge

Northern Africa: Nabta Playa

A BRIEF HISTORY OF SUNDIALS

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

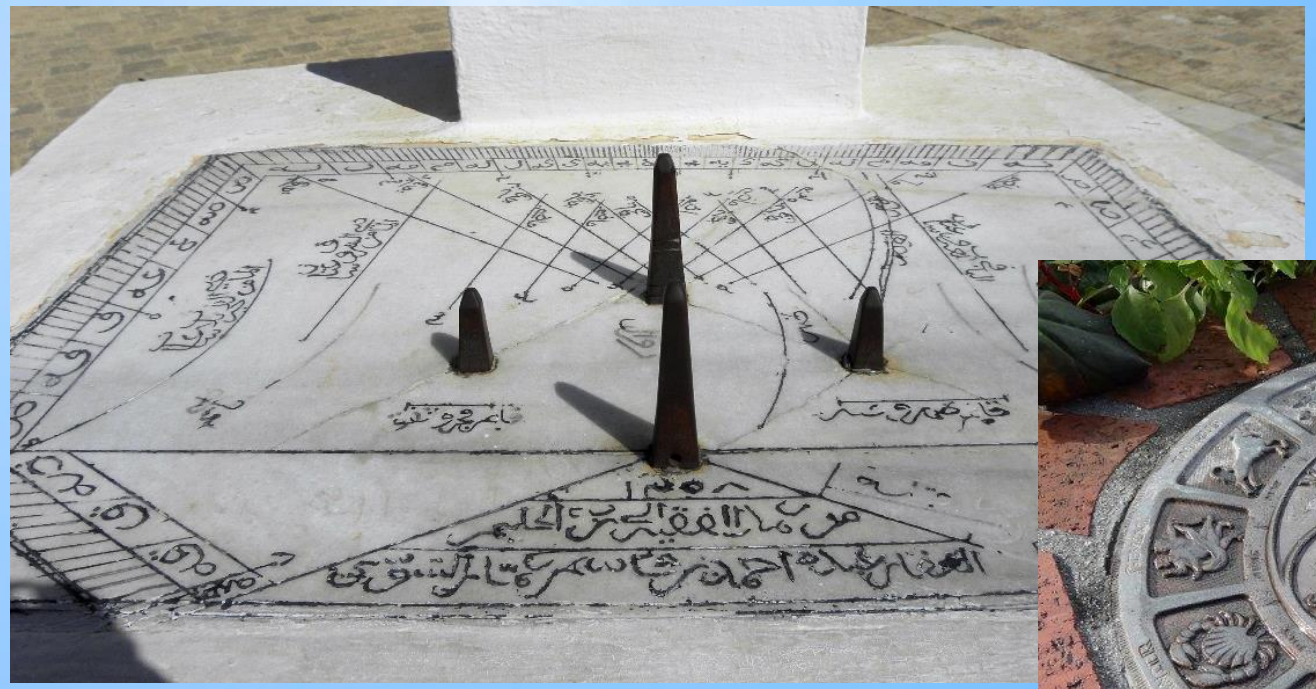
Hemicyclium sundial from Turkey, ~2000 yrs old

Roman empire (Pompeii, circa 1st century BCE)

A BRIEF HISTORY OF SUNDIALS

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

Islamic cultures (Grand Mosque of Kairouan, Tunisia)



Diptych sundials

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

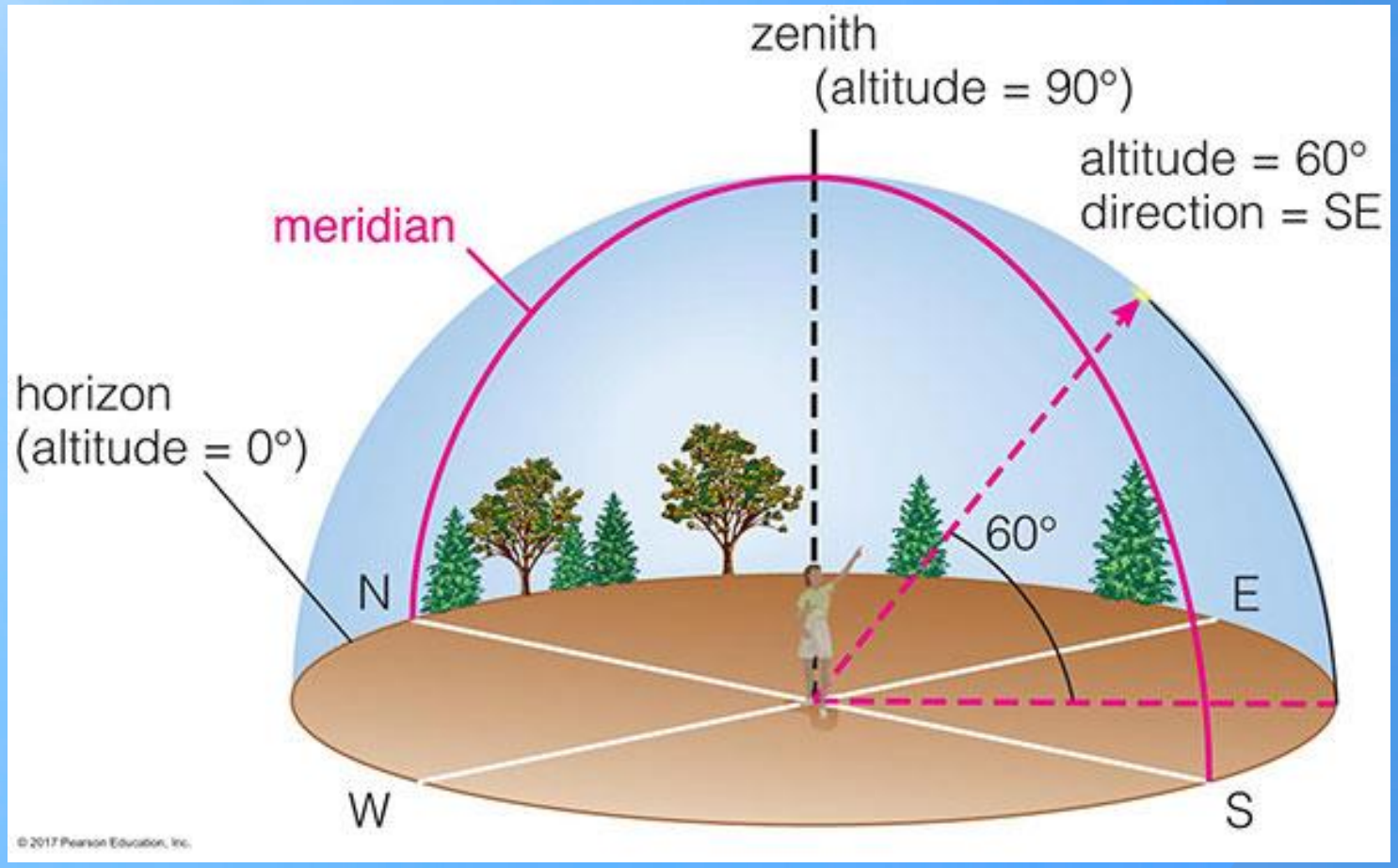
Solar time does not usually match clock time.

What is time?

Why?

Solar noon: Sun crosses your local meridian

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

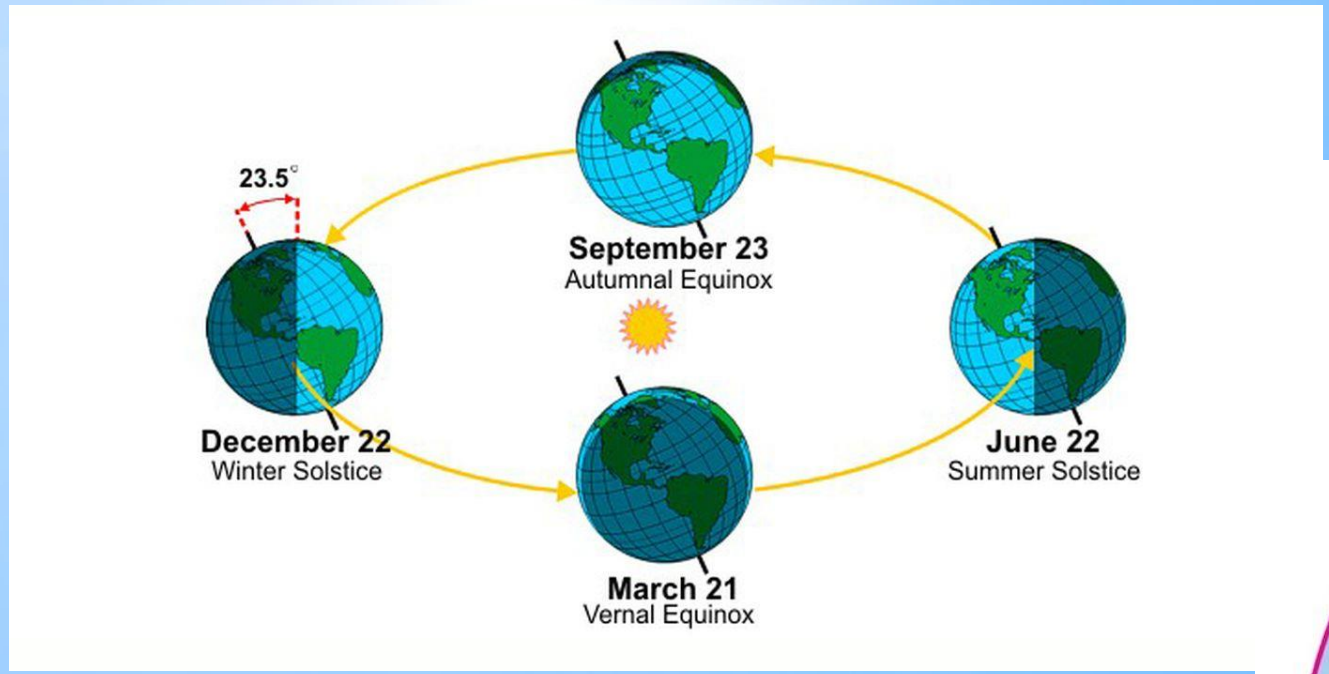


SOLAR TIME VS. CLOCK TIME

Winter vs. summer –

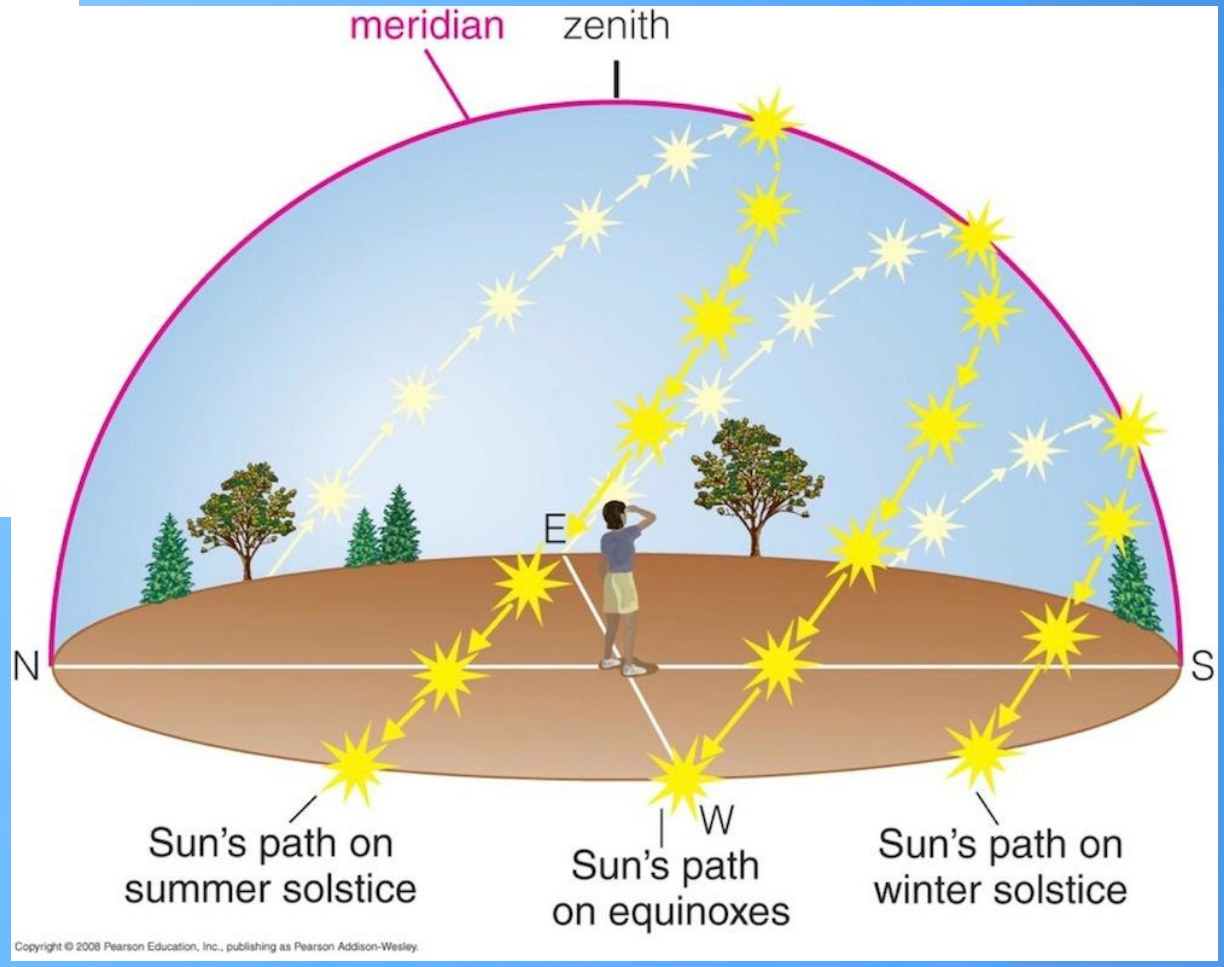
shifting **shadows** and sunlight

SOLAR TIME VS. CLOCK TIME



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

– gives us the seasons



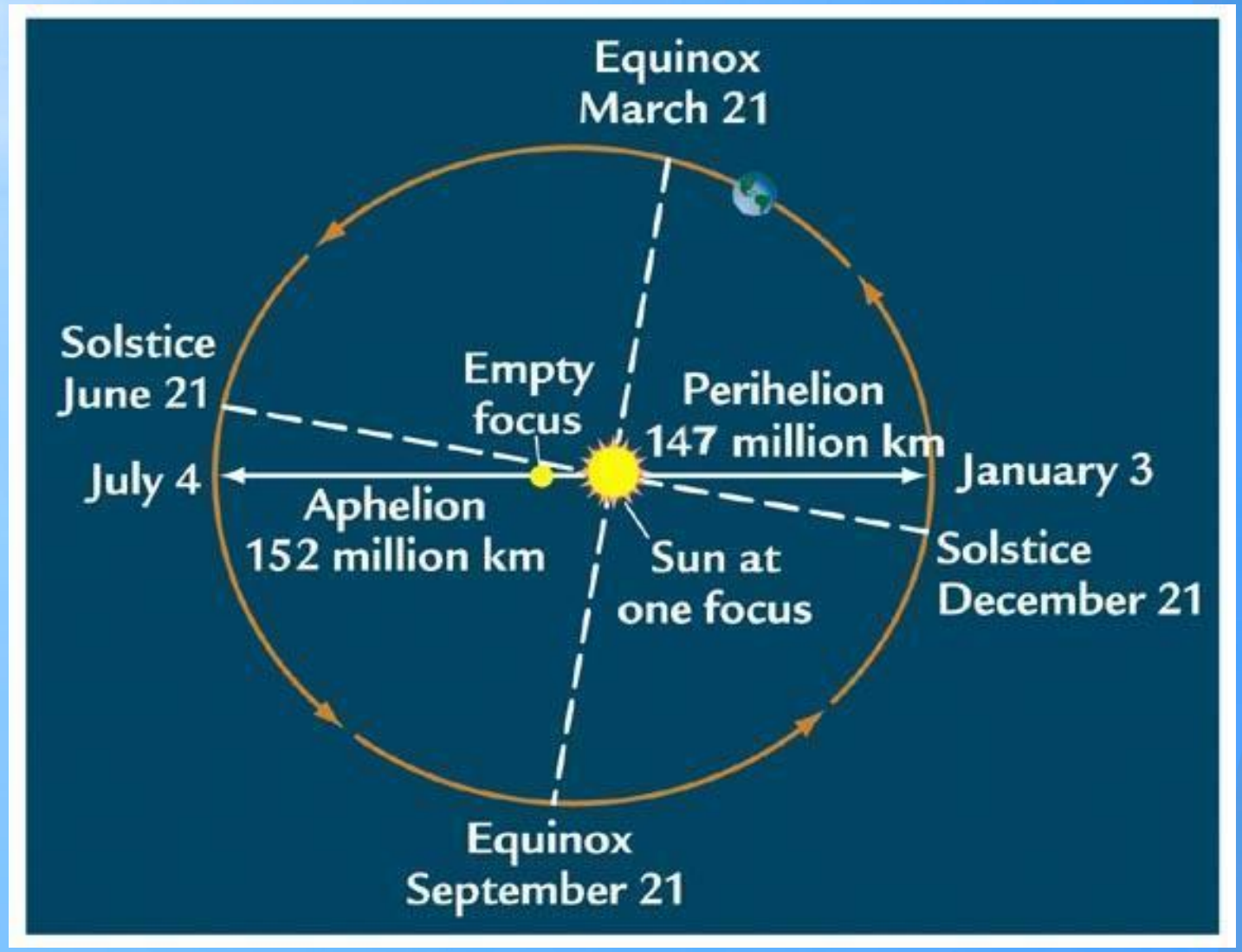
SOLAR TIME VS. CLOCK TIME

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**.

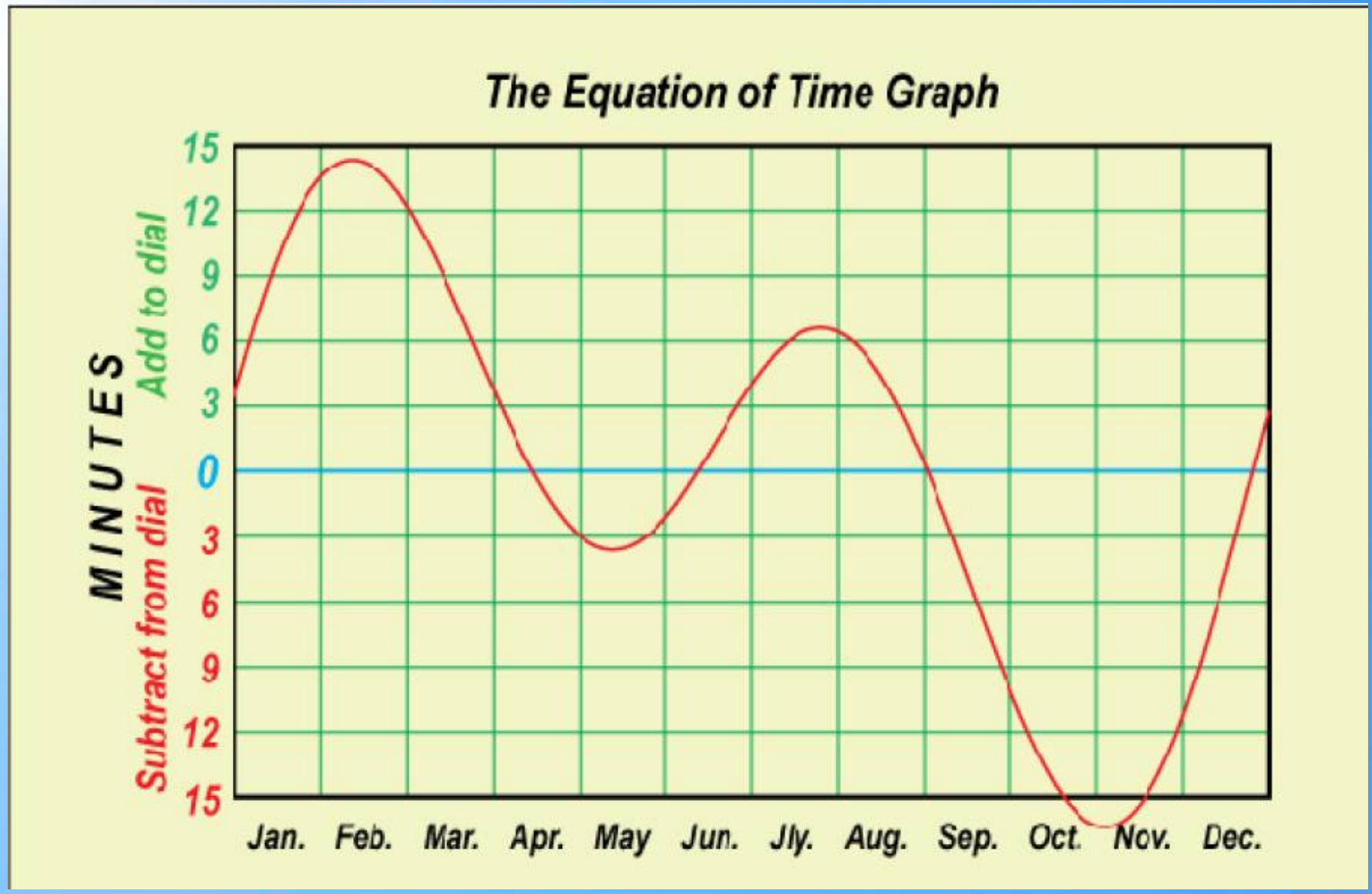
Clock time is an **average** of solar time

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

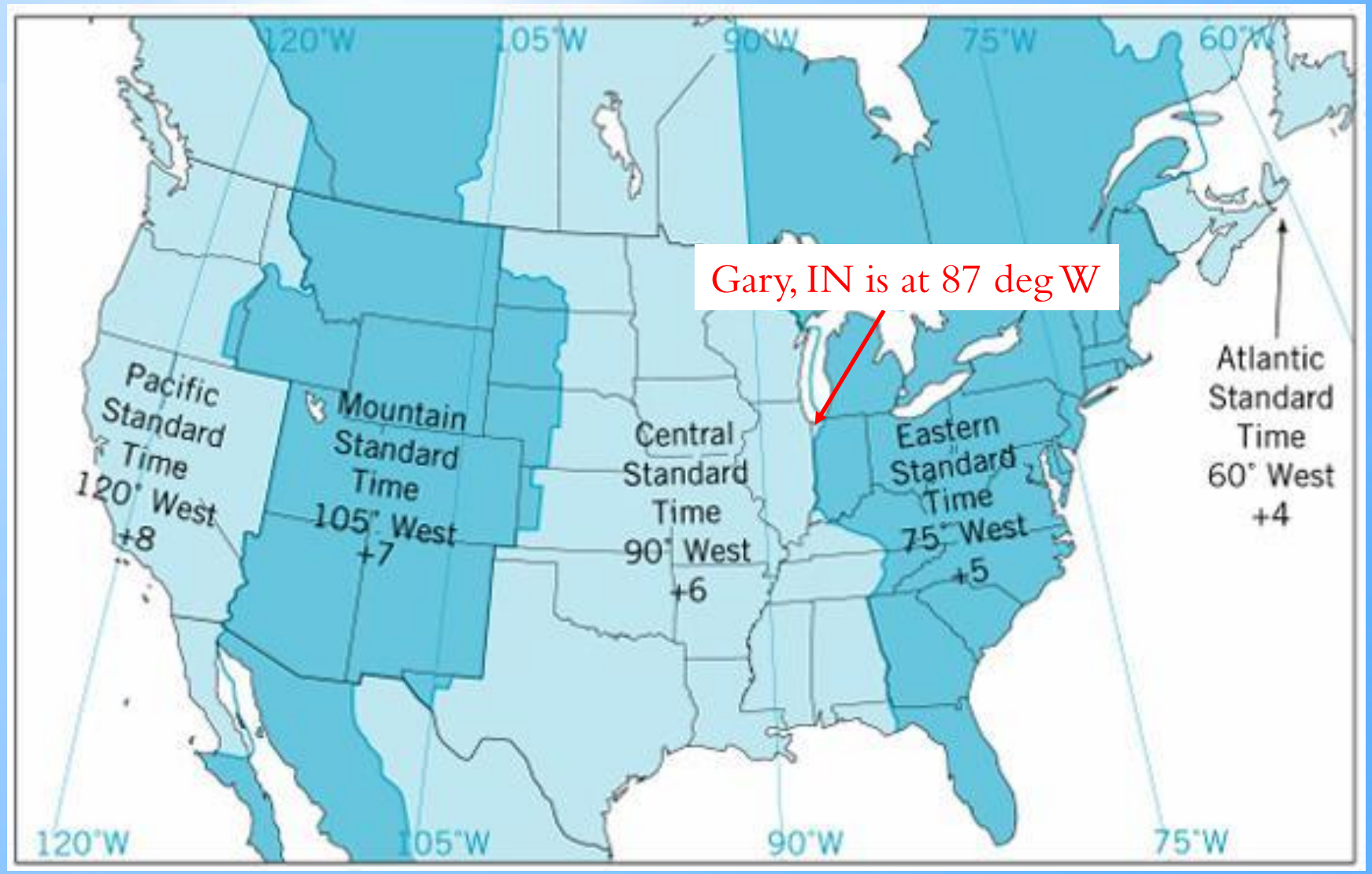
SOLAR TIME VS. CLOCK TIME

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

- almost clock time!



SOLAR TIME VS. CLOCK TIME

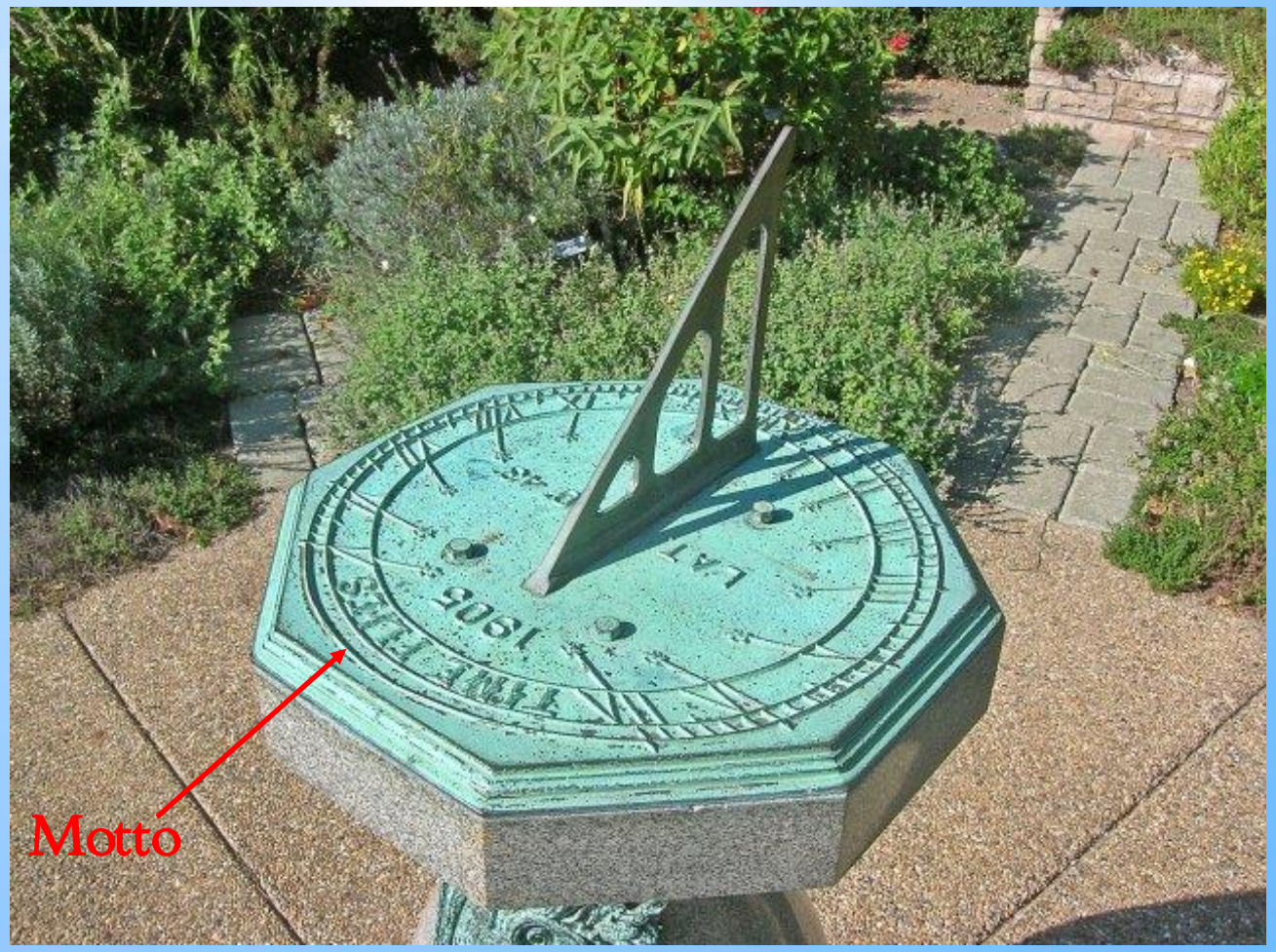


Clock time will differ from mean time because it is defined by reference to a time zone's meridian.

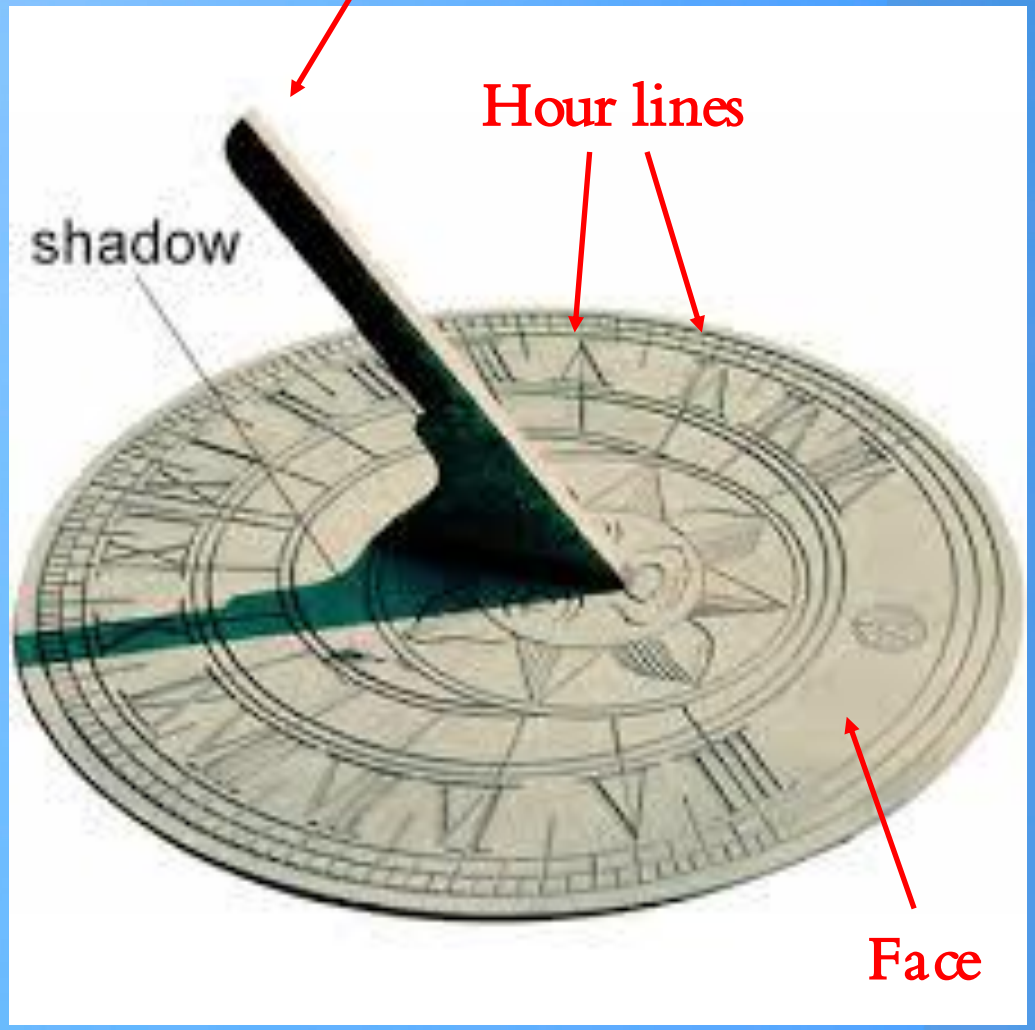
Need a correction for **longitude**:

4 min per degree different from time zone meridian

HOW TO READ A SUNDIAL



Sundial in Peoria, IL (Glen Oak Park Conservatory)

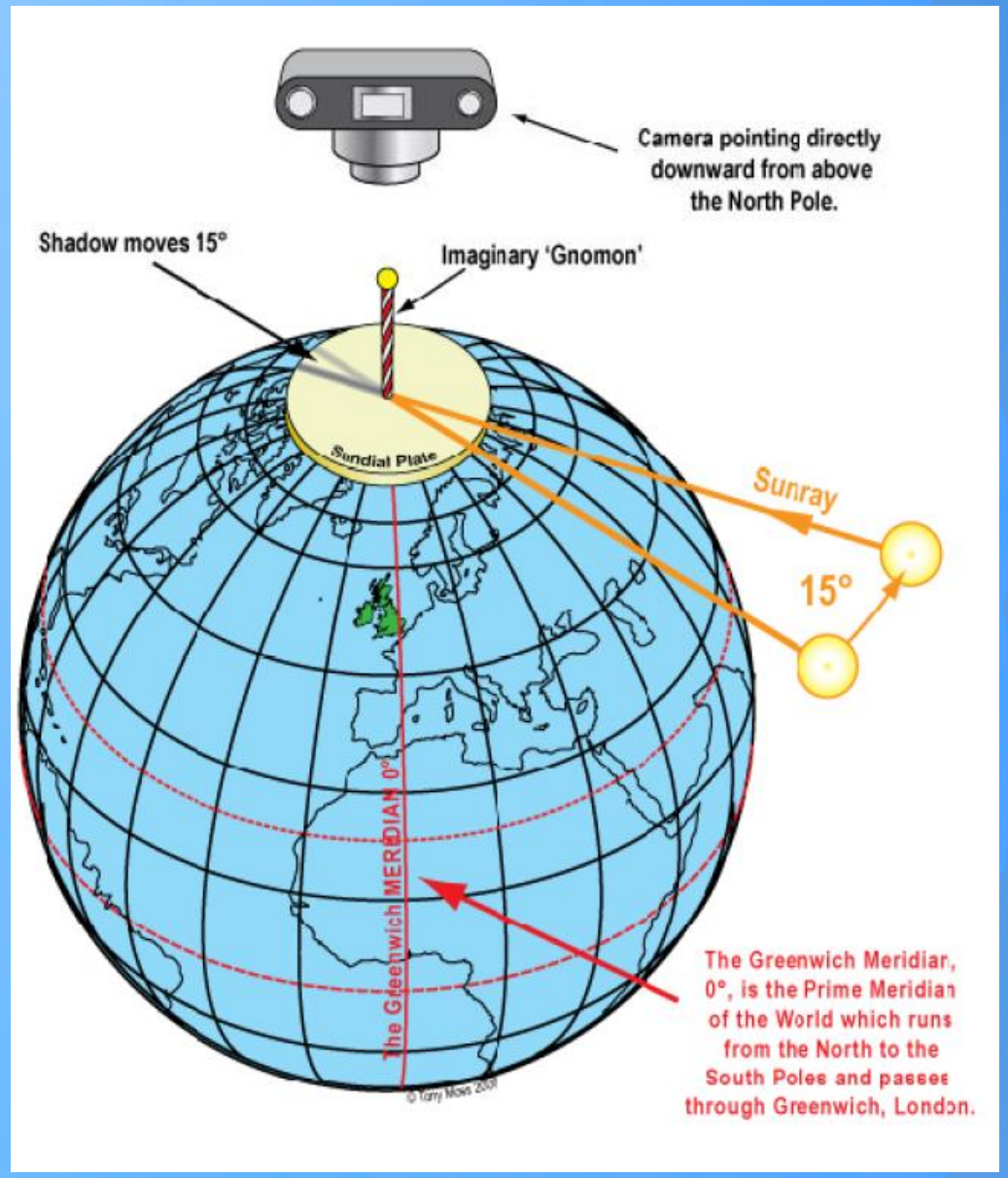


HOW TO READ A SUNDIAL

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.



Graphics thanks to Tony Moss

At the North Pole:

HOW TO READ A SUND

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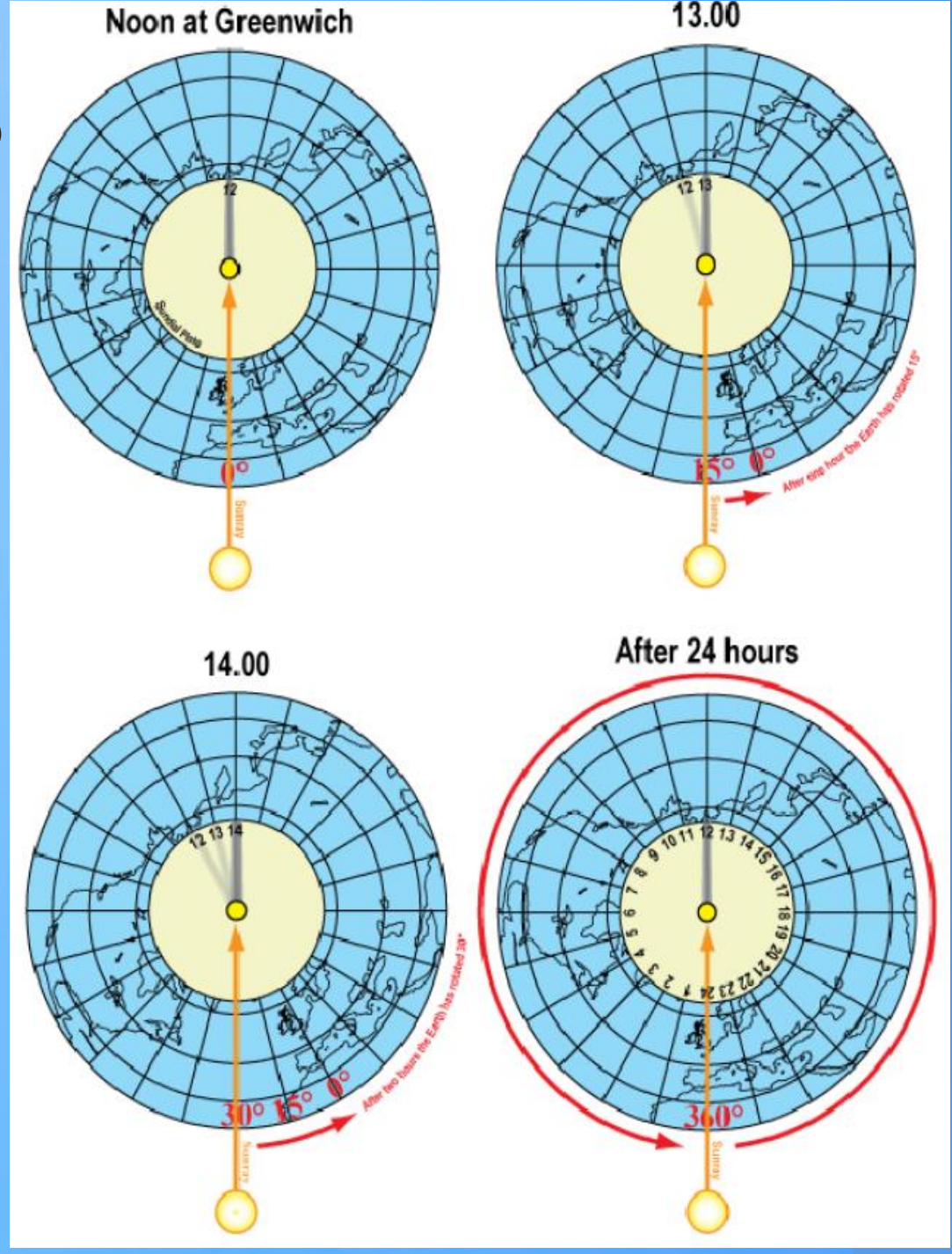


At the North Pole:

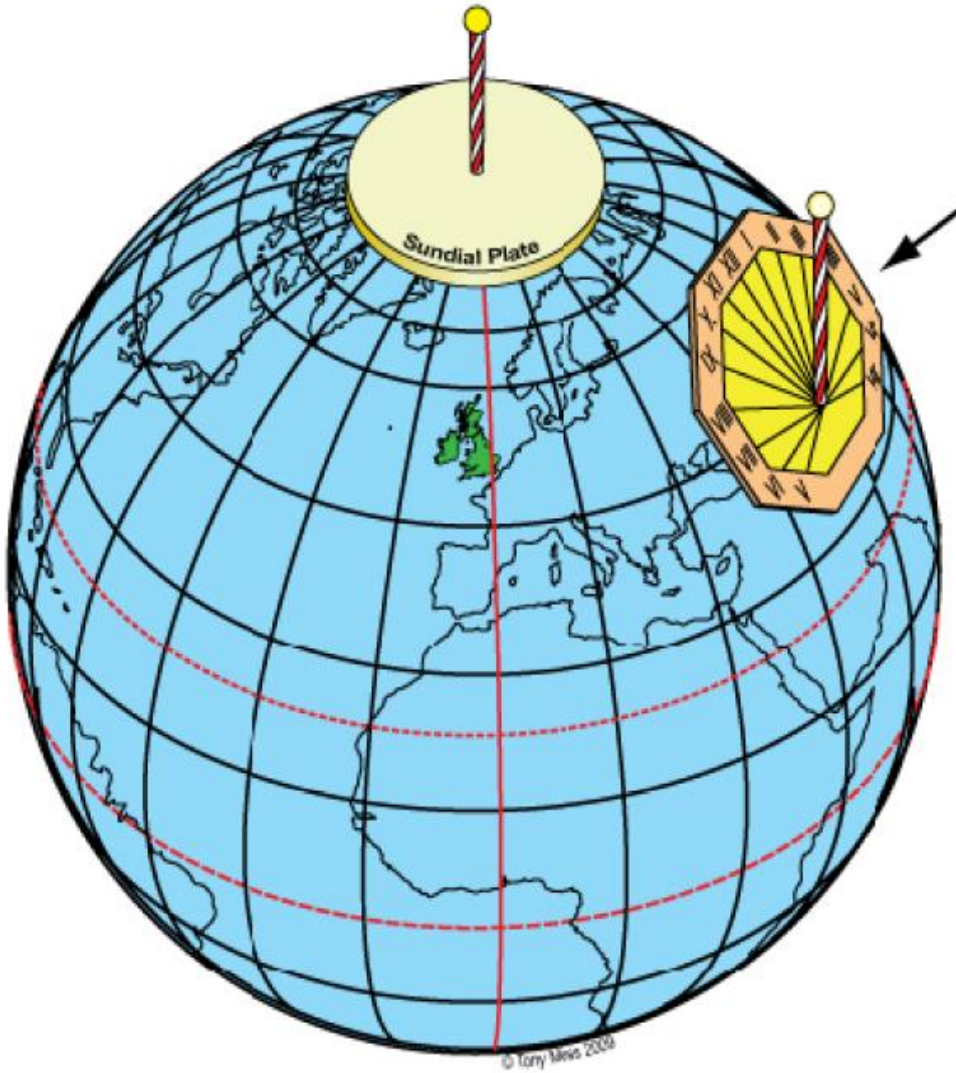
HOW TO READ A SUNDIAL

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).



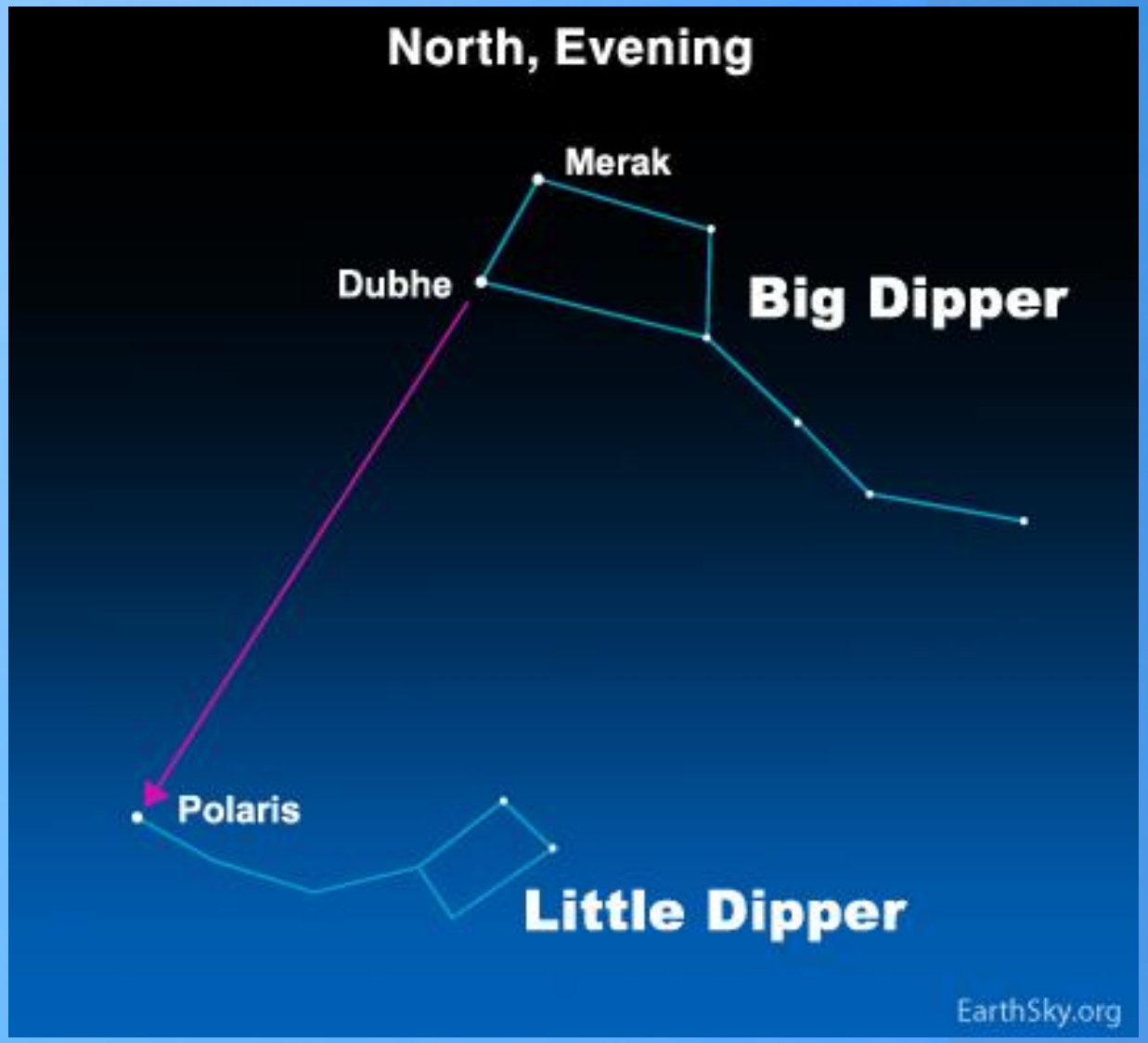
When the 'shadow-catching' surface is laid flat on the ground (a 'Horizontal Dial') the gnomon remains parallel to the Earth's axis so is set at an angle to the plate which is equal to the local latitude. The example shown is at approximately 45° north.

This is what it looks like to the local people.

Graphics thanks to Tony Moss

HOW TO READ A SUNDIAL

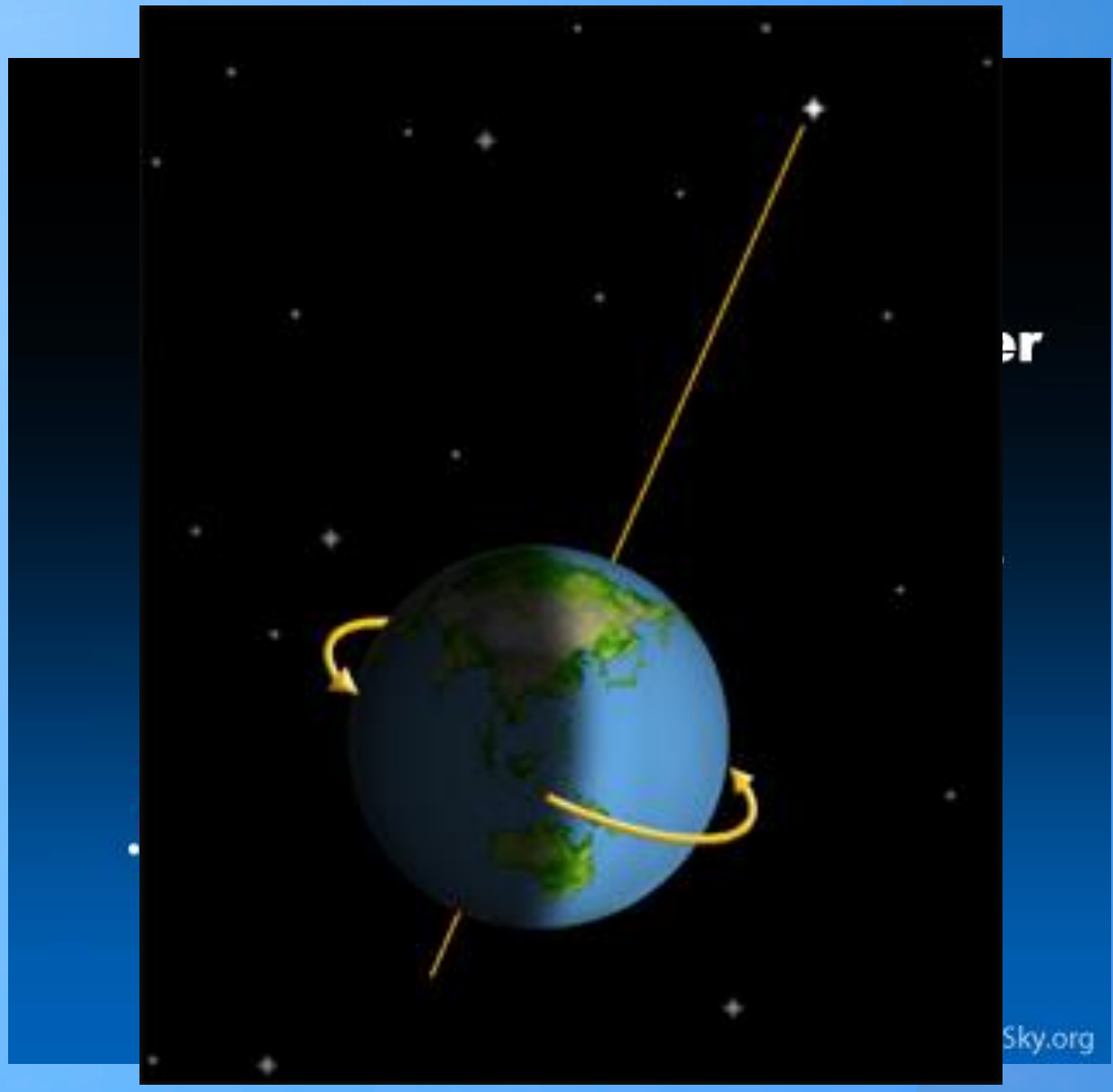
Finding north – look for the North Star, Polaris



HOW TO READ A SUNDIAL

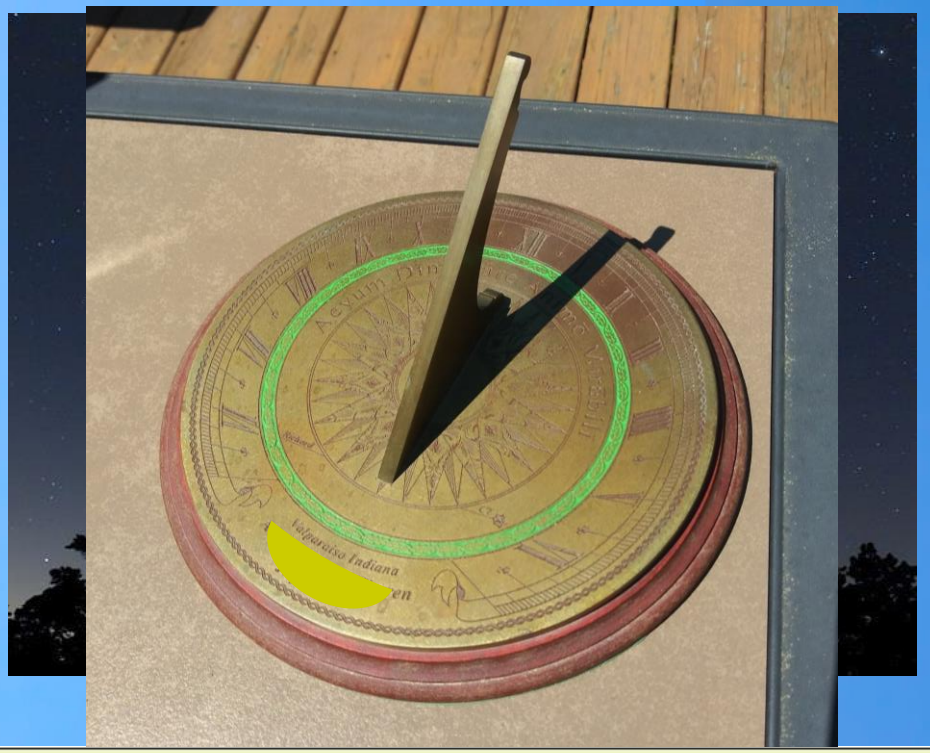
Finding north – look for the North Star, Polaris

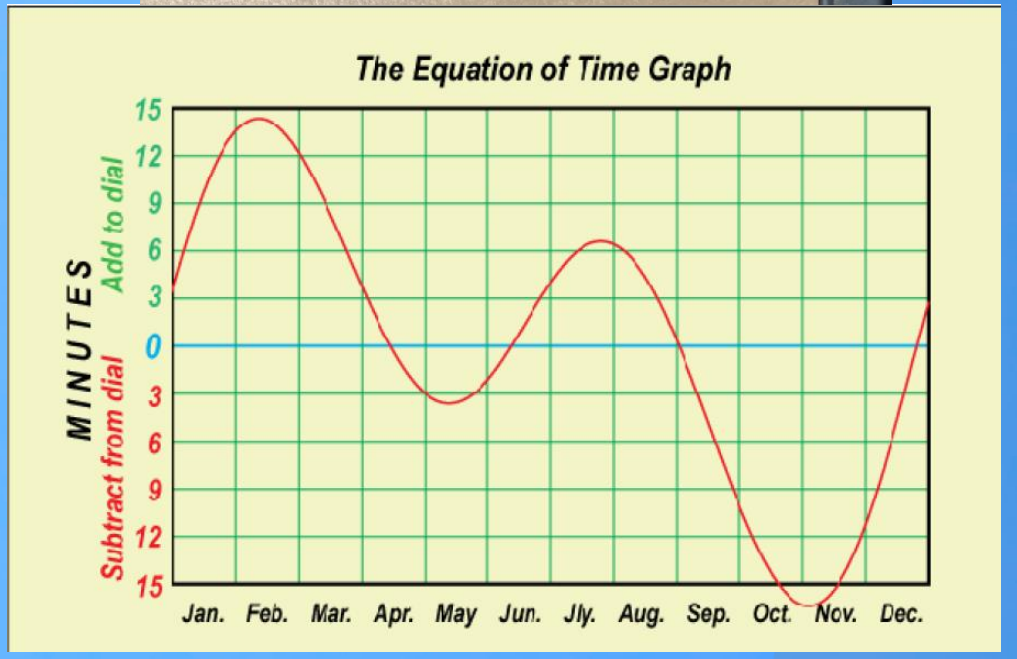
The north pole of Earth points directly toward Polaris, or the North Celestial Pole.



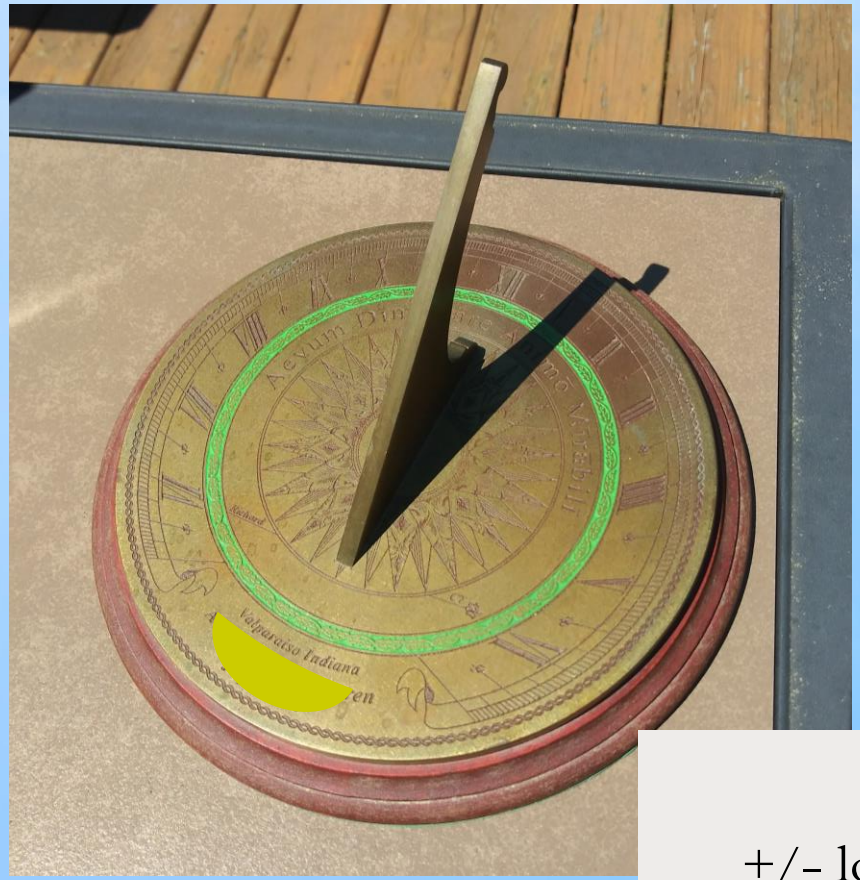
HOW TO READ A SUNDIAL

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

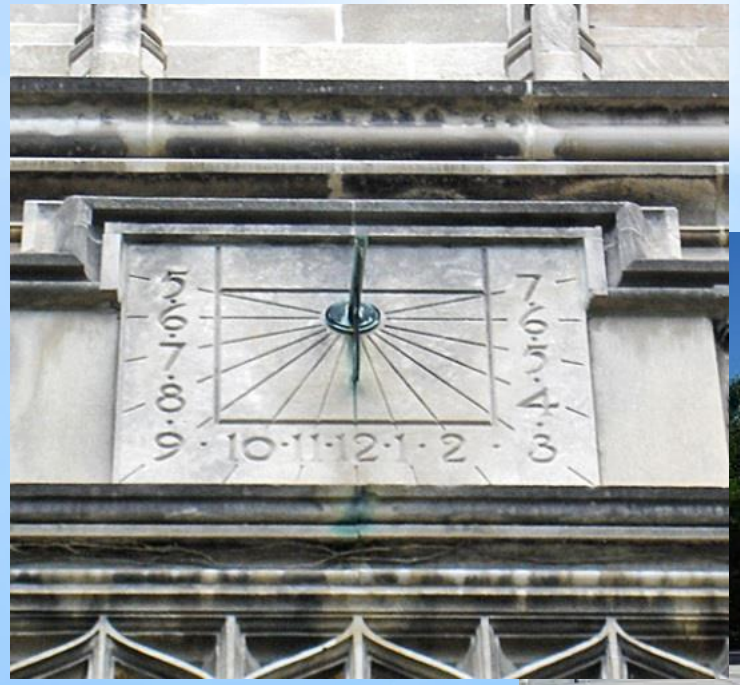
+/- longitude correction

+/- equation of time correction

+ 1 hr if Daylight Saving

Clock time

OTHER TYPES OF SUNDIALS

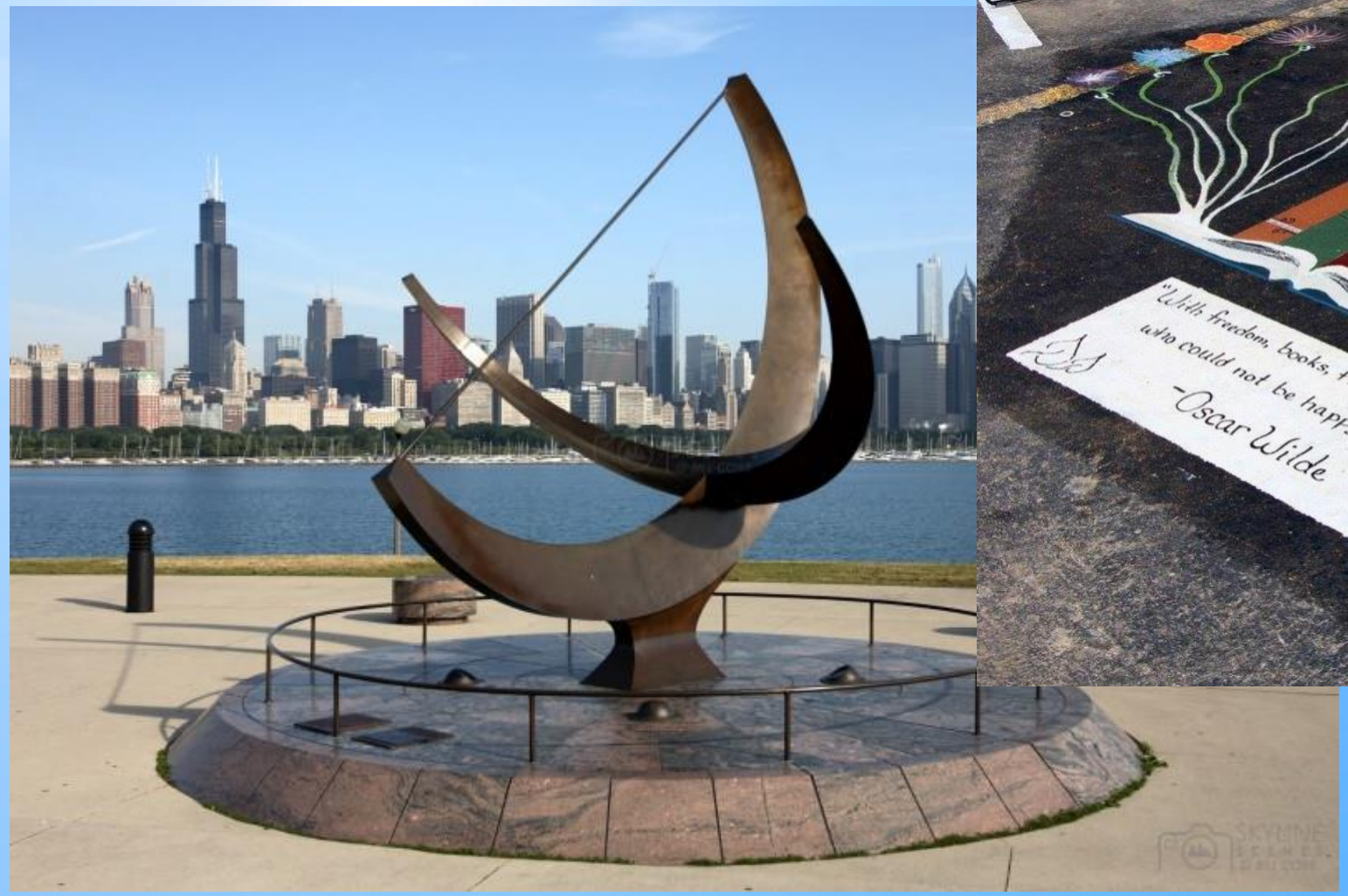


Vertical sundial – Indiana University Bloomington, IN

Armillary sphere – Purdue Fort Wayne, IN

Horizontal dial – Vietnam Veterans Memorial, Frankfort, KY

OTHER TYPES OF SUNDIALS



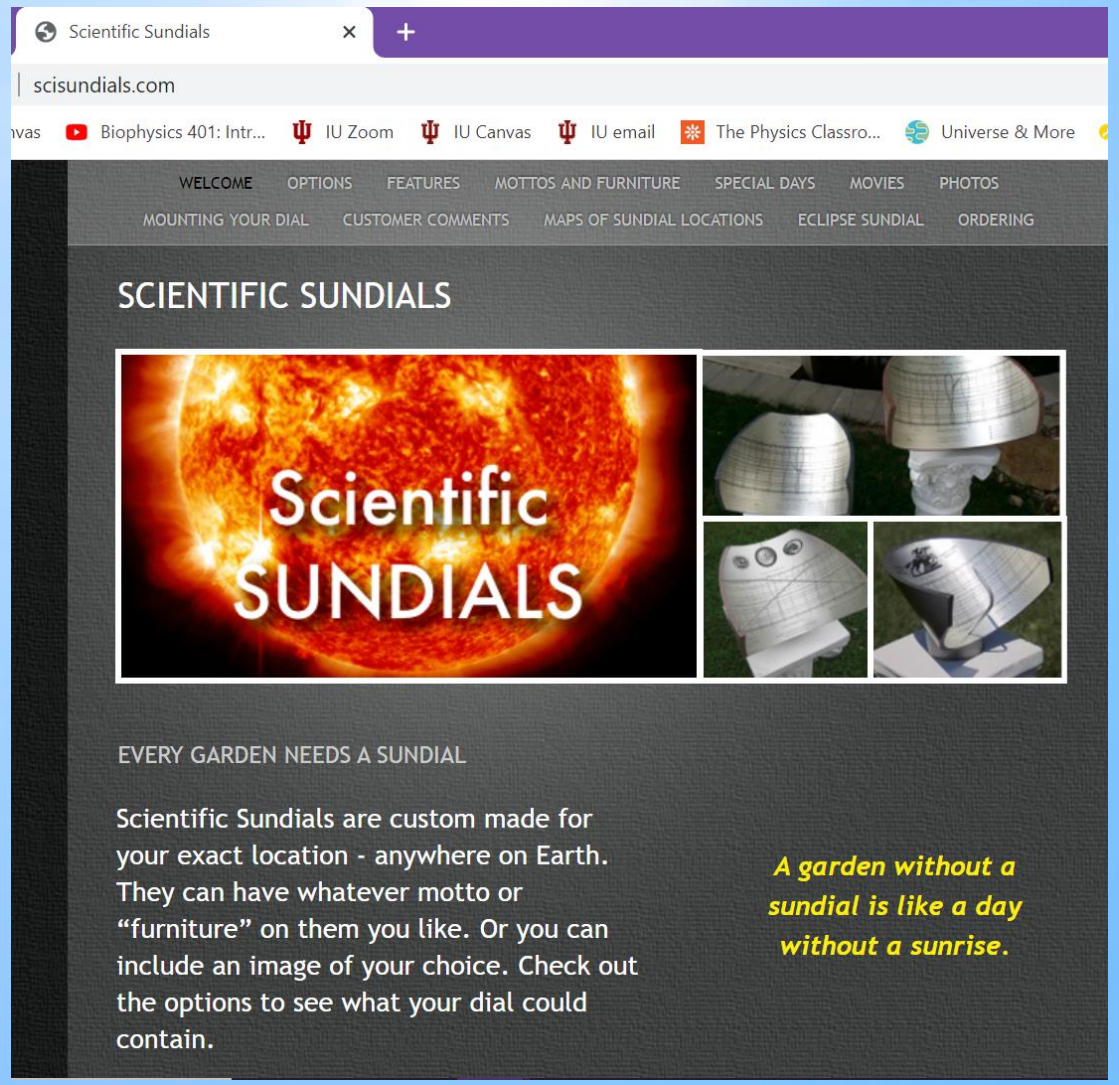
Equatorial dial – Adler Planetarium, Chicago, IL

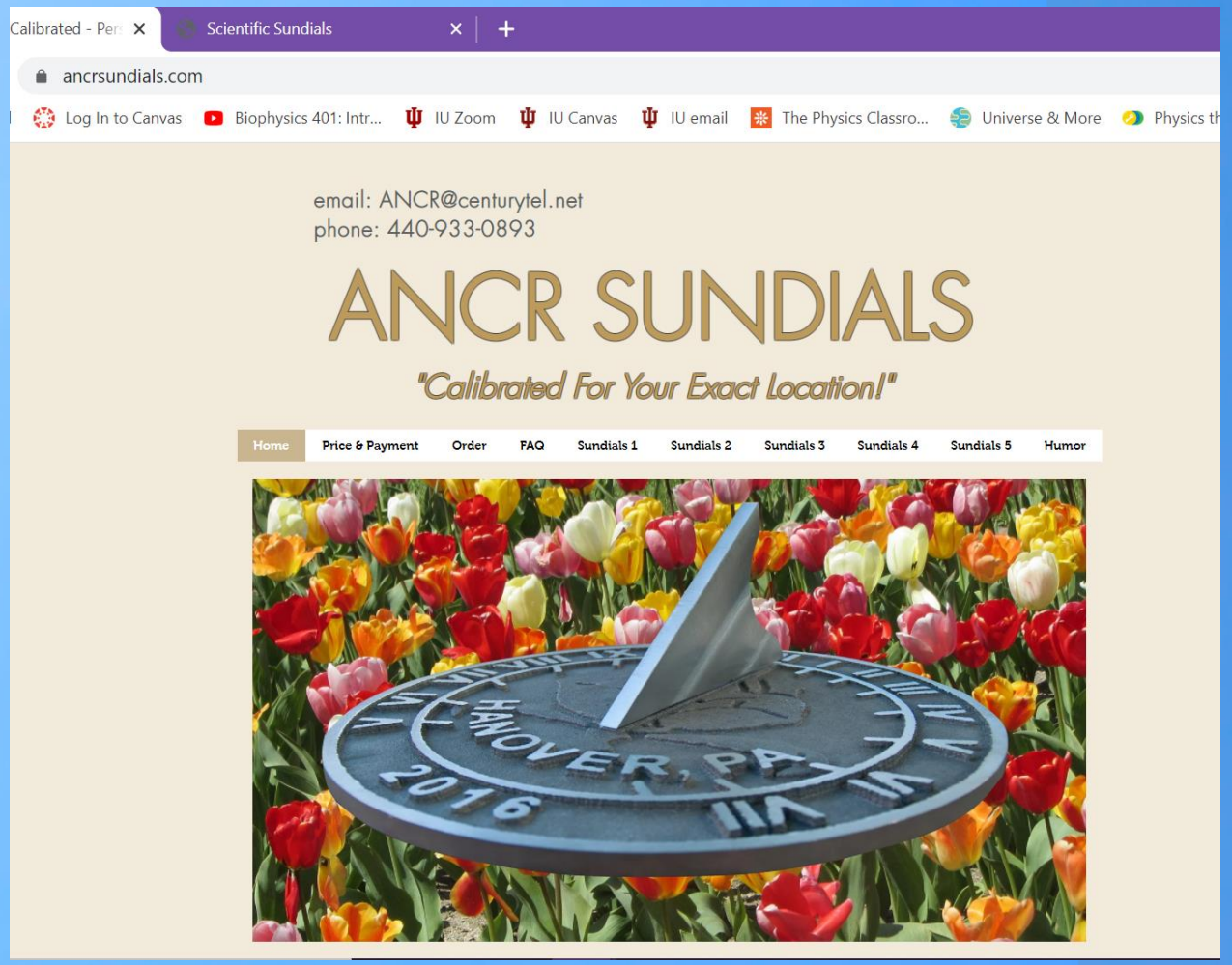
Analemmatic sundial – Kokomo, IN

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

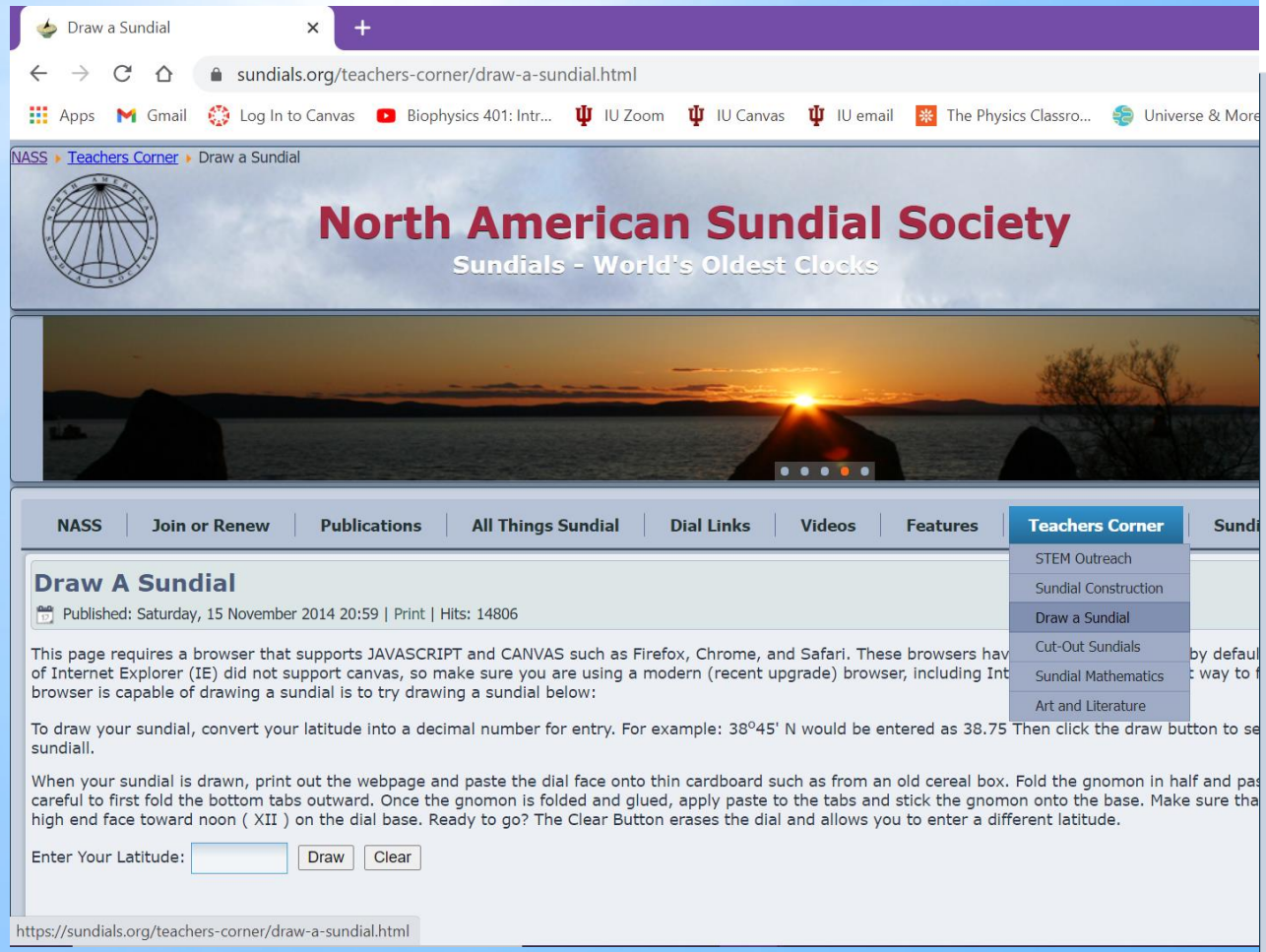
SUNDIALS FOR GARDENS

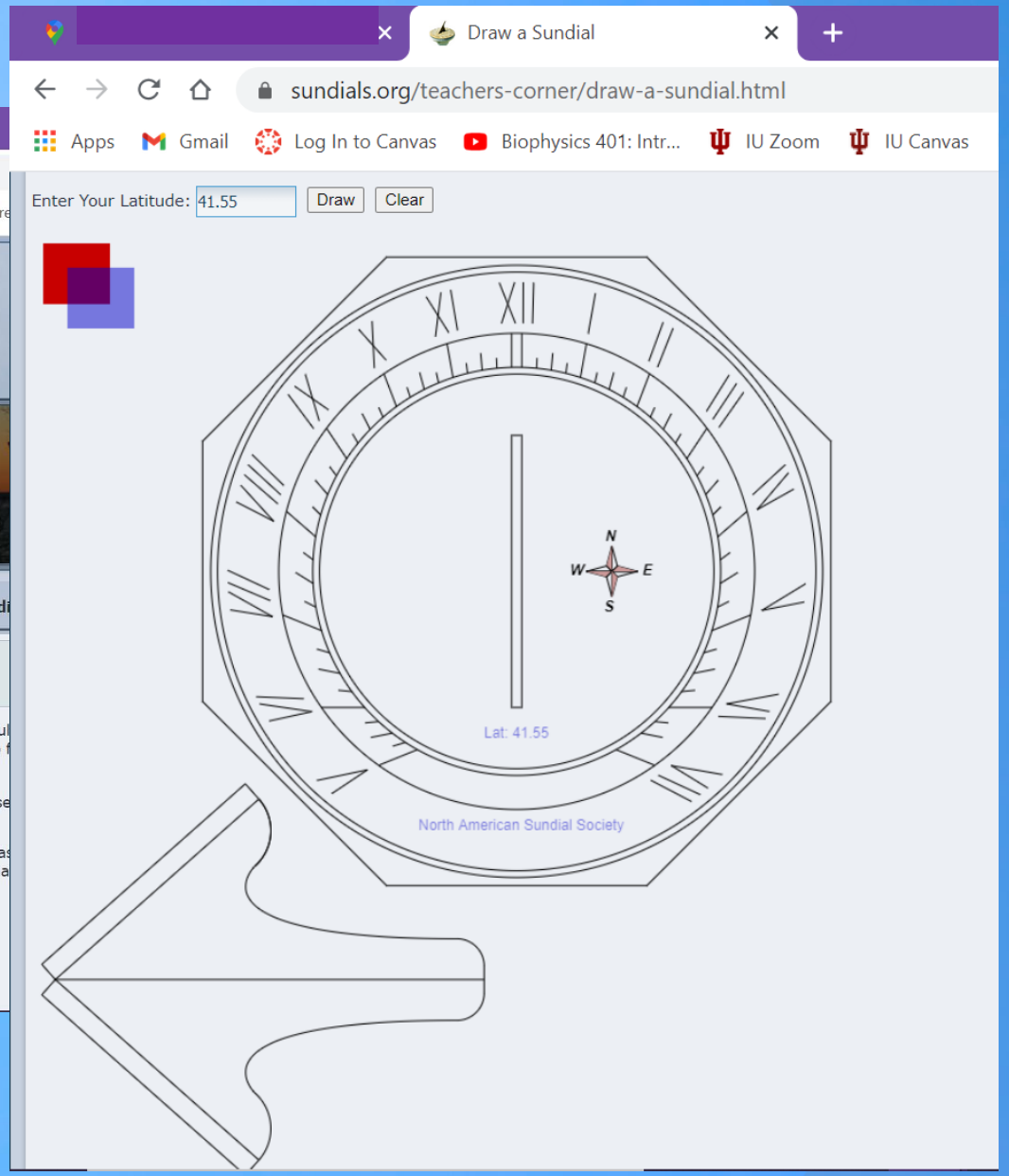
Check resources at https://sundials.org/dial-links/sundial-artisans.html





SUNDIALS FOR GARDENS





Make your own from a template!

PLANTING A SUNDIAL?

Carl Linnaeus – Swedish botanist, 1750

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

PLANTING A SUNDIAL?

Morning:

Ipomoea spp. (morning glory)

Late morning/midday:

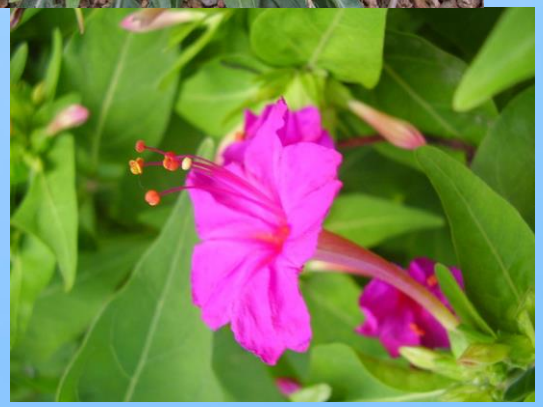
Hibiscus grandifloras (swamp rose mallow)

Early afternoon:

Phemeranthus teretifolius (quill fameflower)

Late afternoon:

Mirabilis jalapa (four o'clock)



Evening:

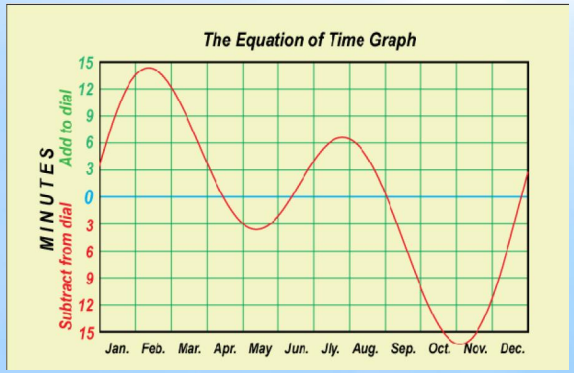
Oenthera fruiticosa (evening primrose)

Night:

Ipomoea alba (moonflower)

SUNDIALS CONNECT US

Math



Nature

Art

History

Astronomy

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!