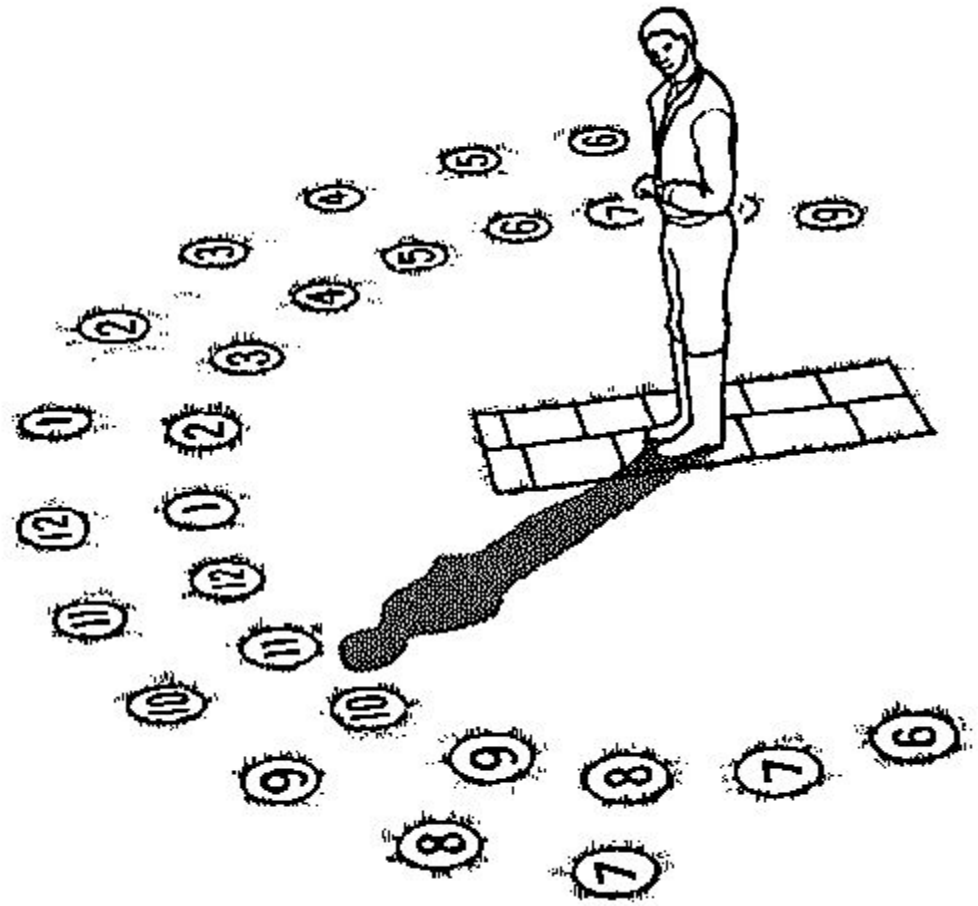
Human Sundials

Create a uniquely interactive “sun clock” that uses a person’s shadow to tell correct time



True School Project

Ecological

Educational

Fun

Practical

Unique

Permanent or Temporary

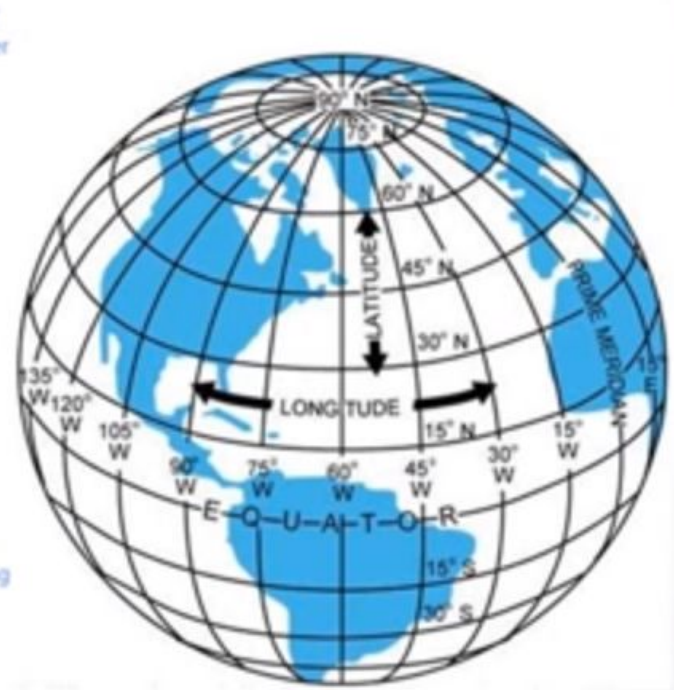
Accurate

CONTENT

1. About the project
2. How Sunclock „works”?
3. What’s „analemma”?
4. Layout making process?
5. How to make sunclock using our layout plan?
6. How to determine „true north”?
7. Measurements „on the ground”
8. Finalize your project
9. Info

How Sunclock works?

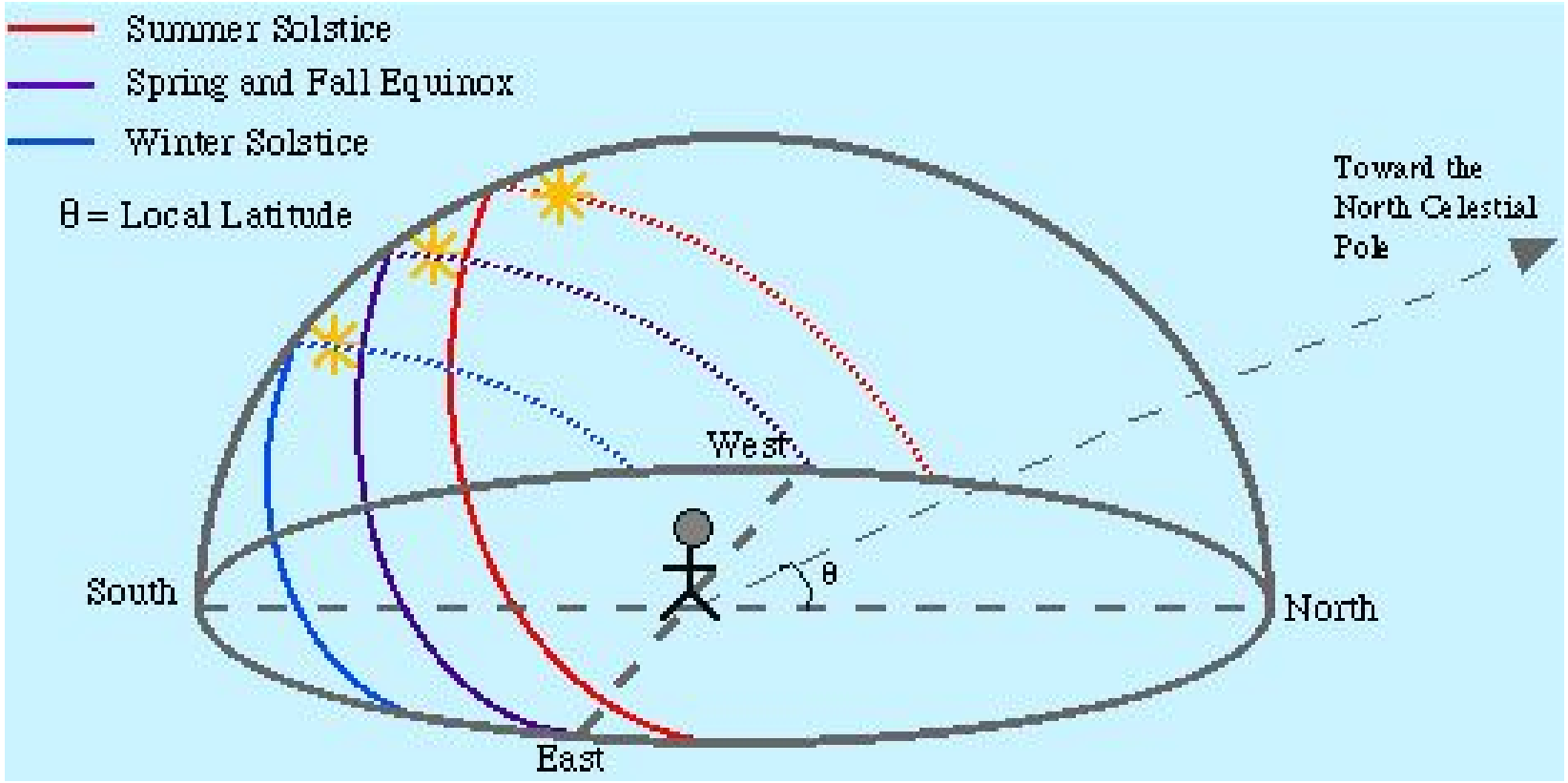
- Earth around the Sun – changeable movement
- „Sun” time = local time on the belonging meridian
- „Zone” time = agreement made by man

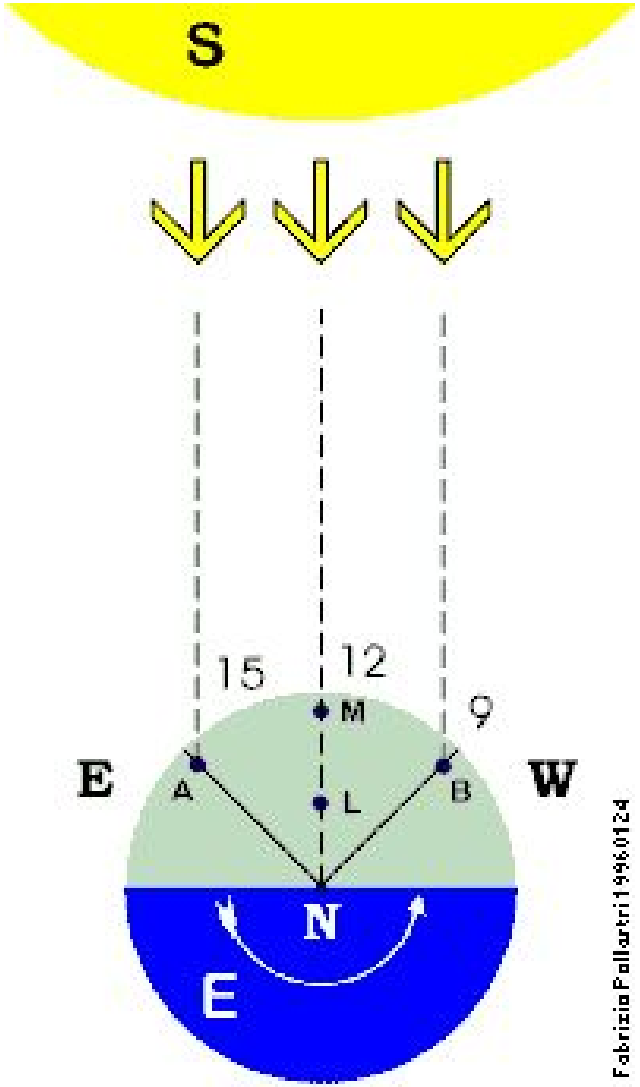


Our Preconceived Notions

- The Sun rises exactly in the East and sets exactly in the West each day. T/F
- The Sun is directly overhead once a day. T/F
- The Moon is sometimes visible in the daytime. T/F
- The shadow of a vertical stick at Solar Noon is aligned N-S. T/F

What's Happening with the Sun





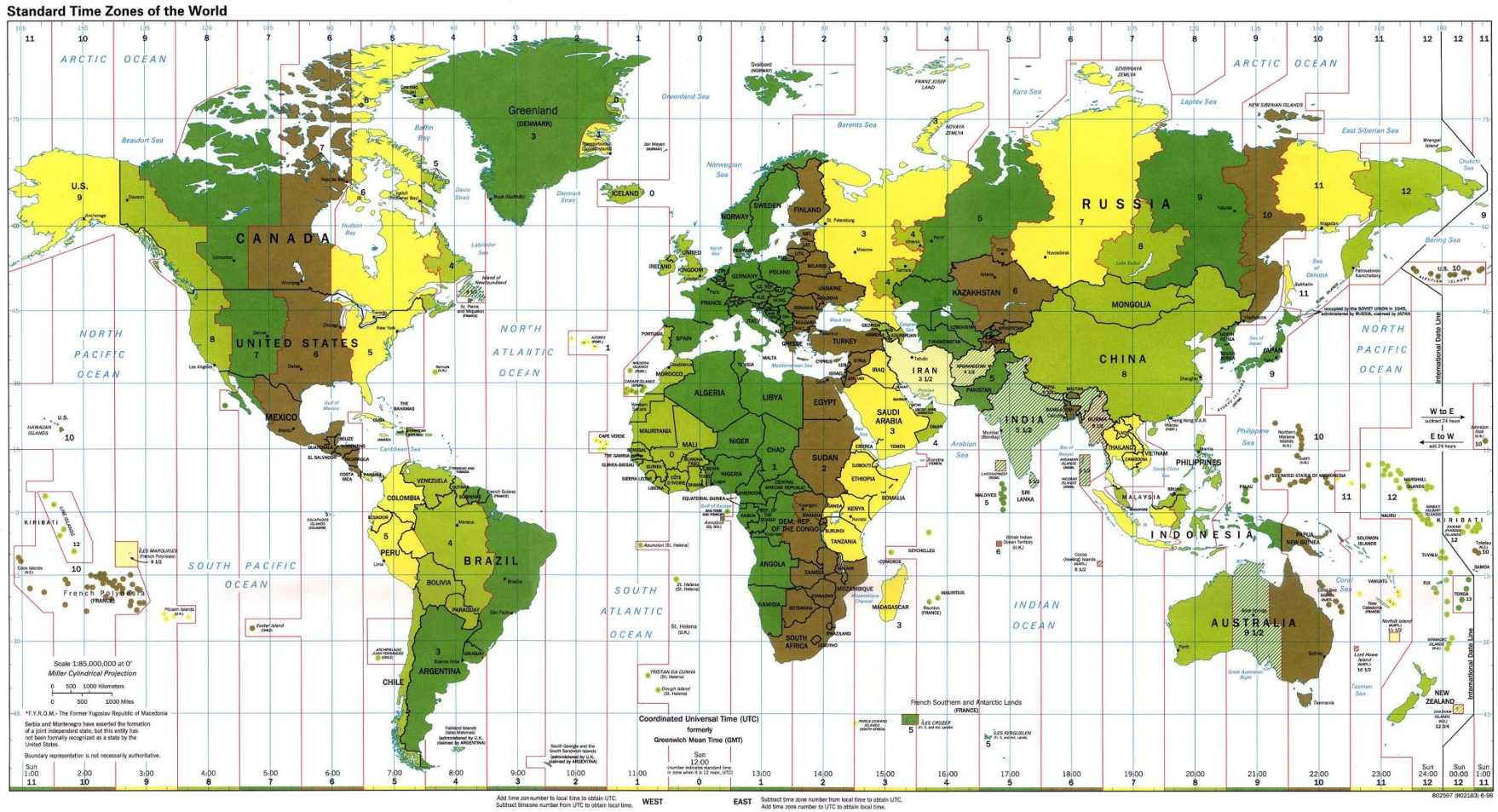
Set the Scene

- Earth rotates counterclockwise itself and around the Sun
- Sun's rays arrive on Earth as parallel beams

The Relationship Between Time and Longitude

Equivalence of Arc and Time	
Time to Arc	Arc to Time
24h = 360° 1h = 15° 1m = 15′ 1s = 15″	360° = 24h 1° = 4m 1′ = 4s

World Time Zones



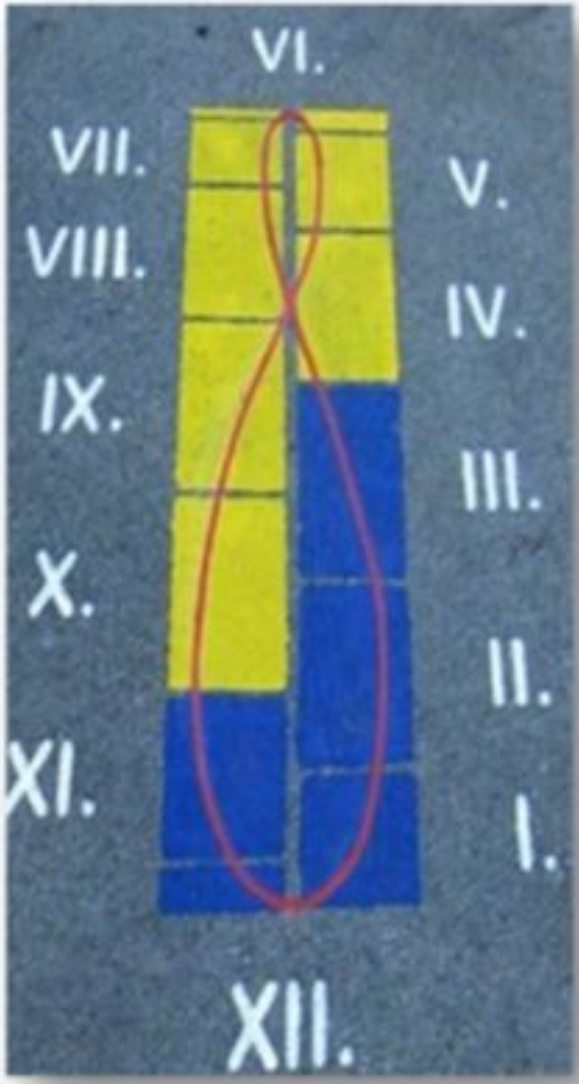
Origins of the Analemma

It is the summation of two effects:

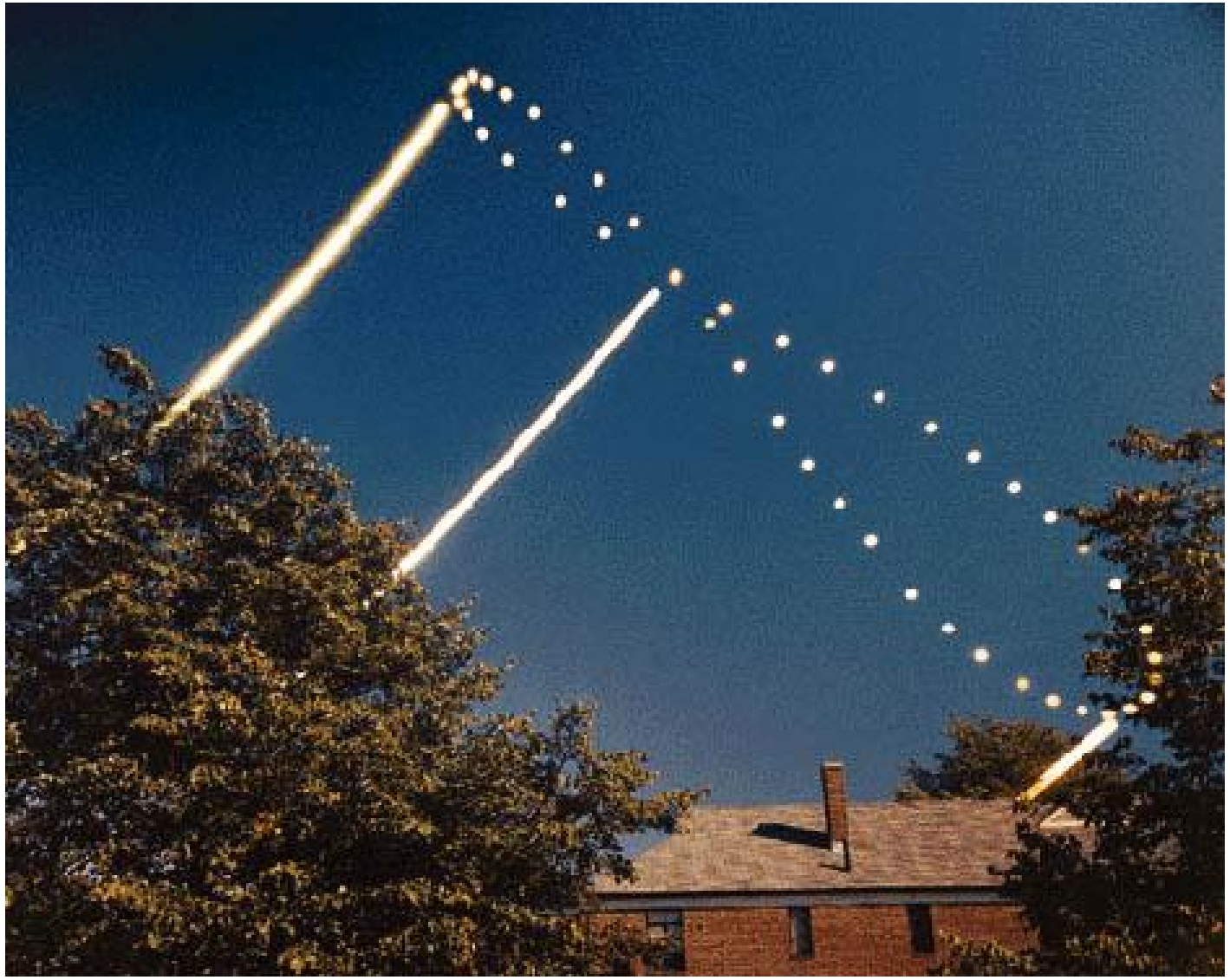
- The Earth's orbit around the sun is not a circle, but is an ellipse (elliptical orbit effect).
- The Earth's axis is tilted 23.5° relative to its plane of orbit around the sun (tilted axis effect).

Analemma – Sun „eight”

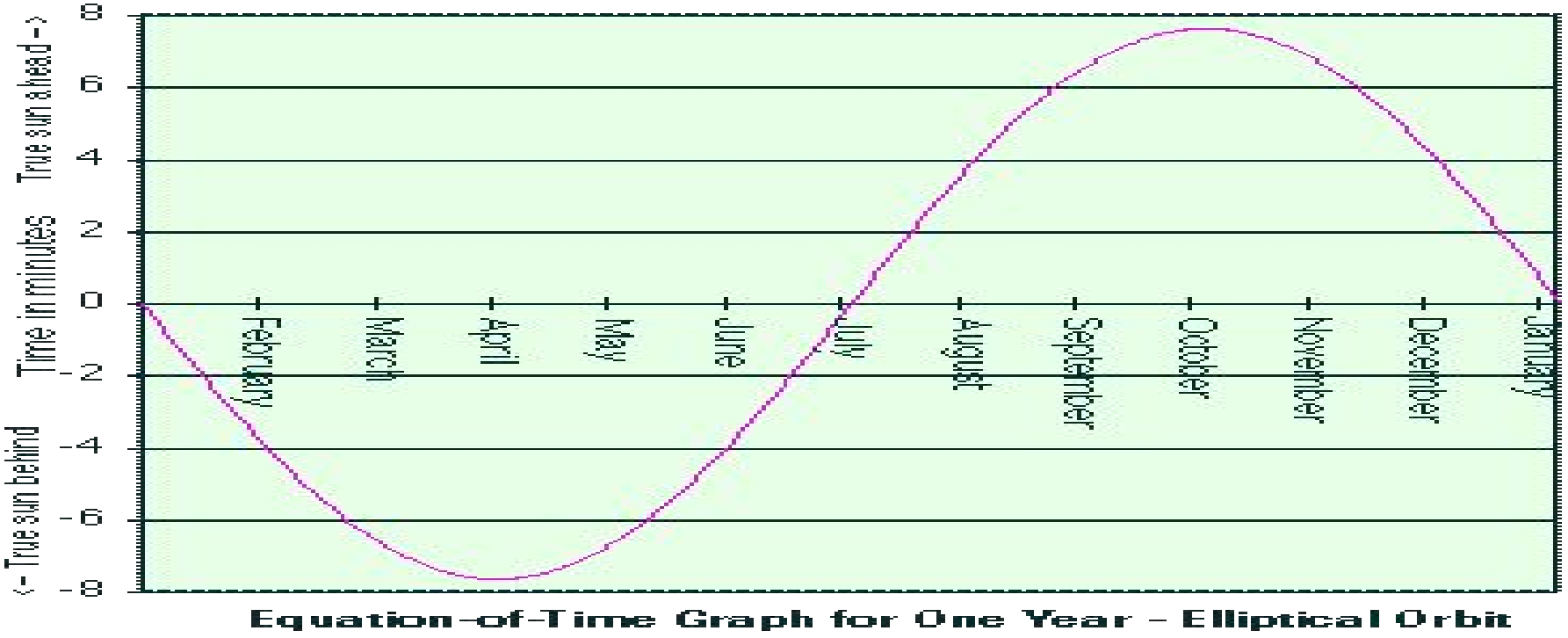
„Sun movement” on
the sky throughout the year



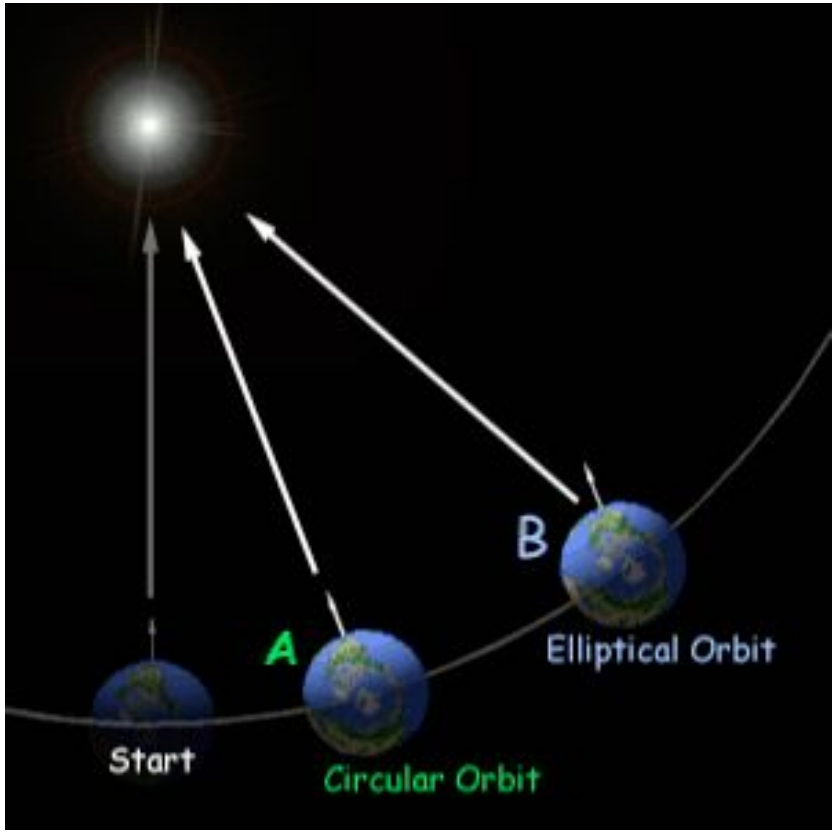
„Copied” analemma on
the date scale

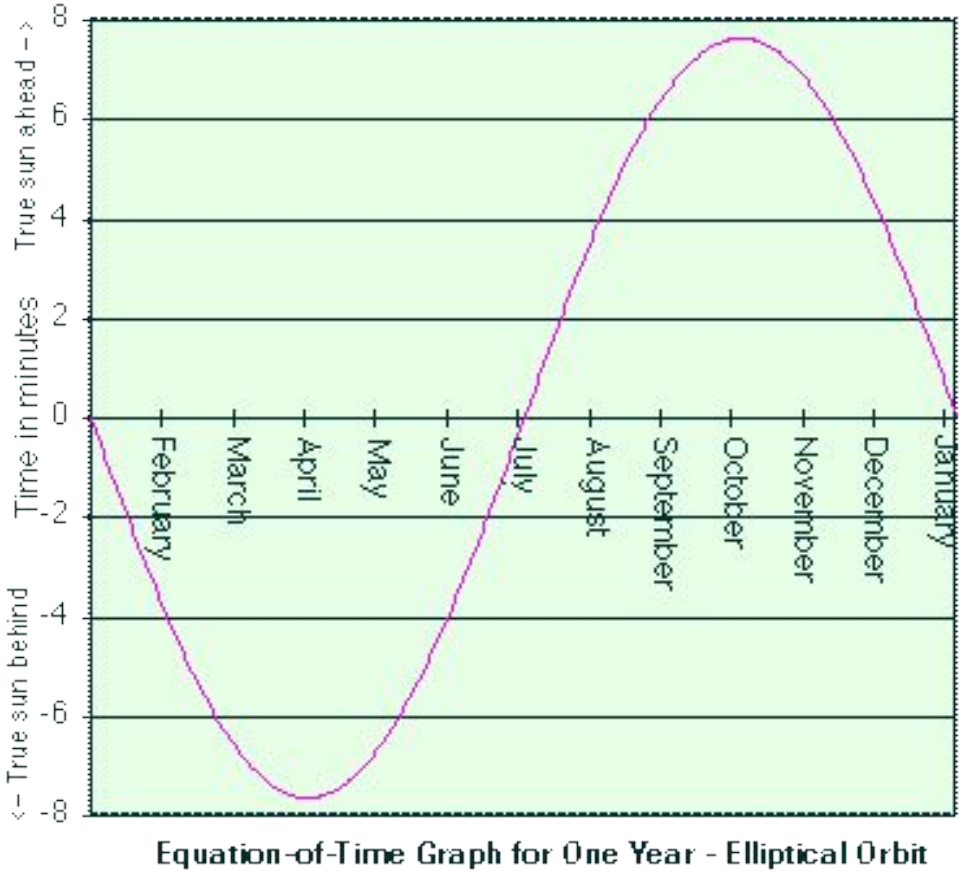


Elliptical Orbit Effect

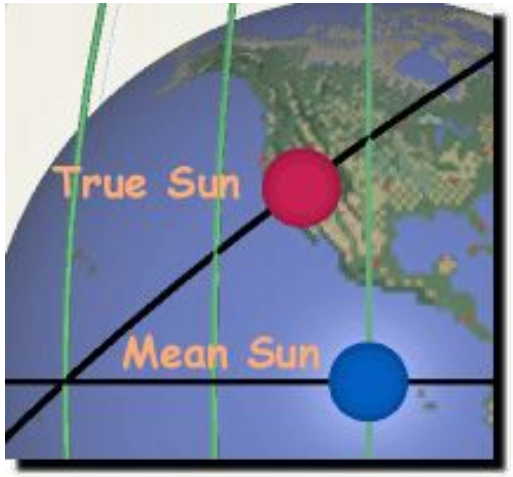


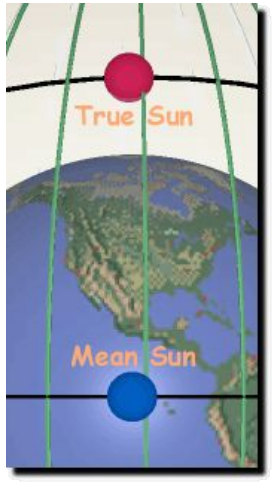
Detail of Effects of Orbit and Changing Speed

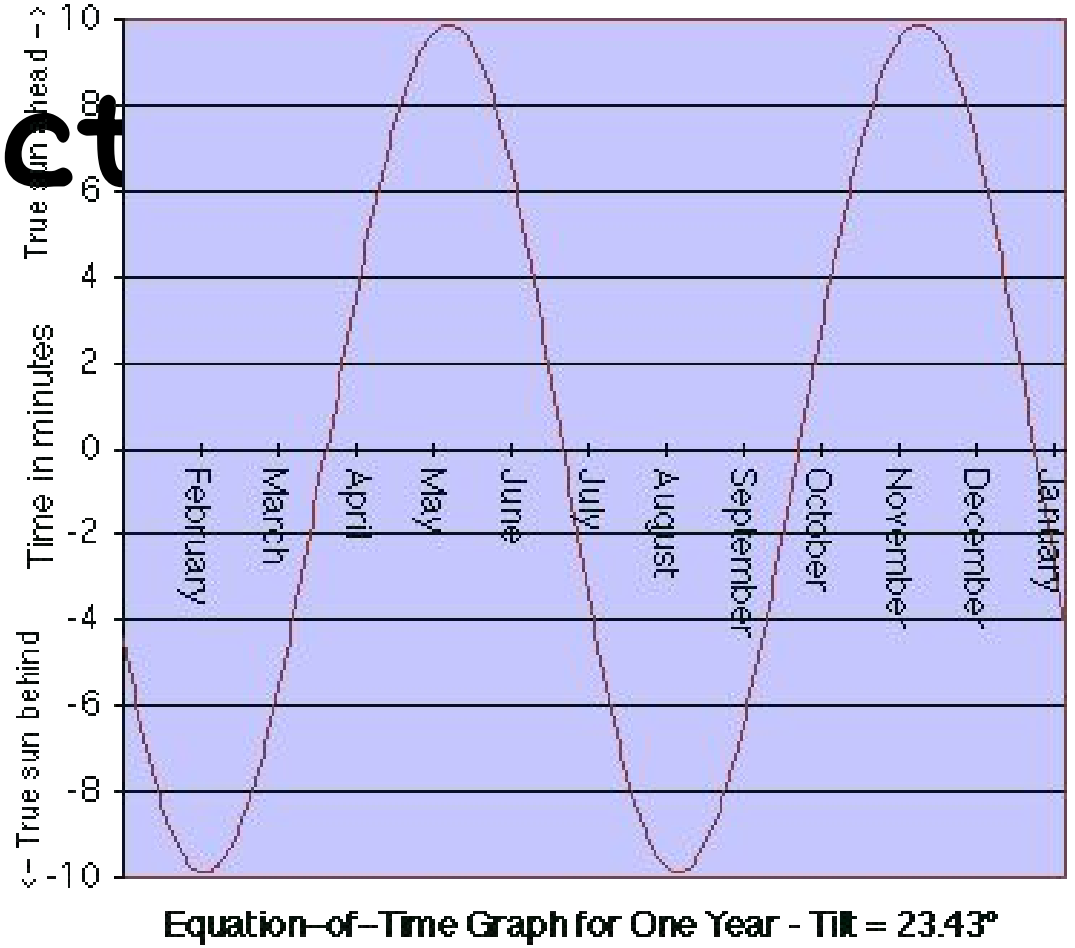




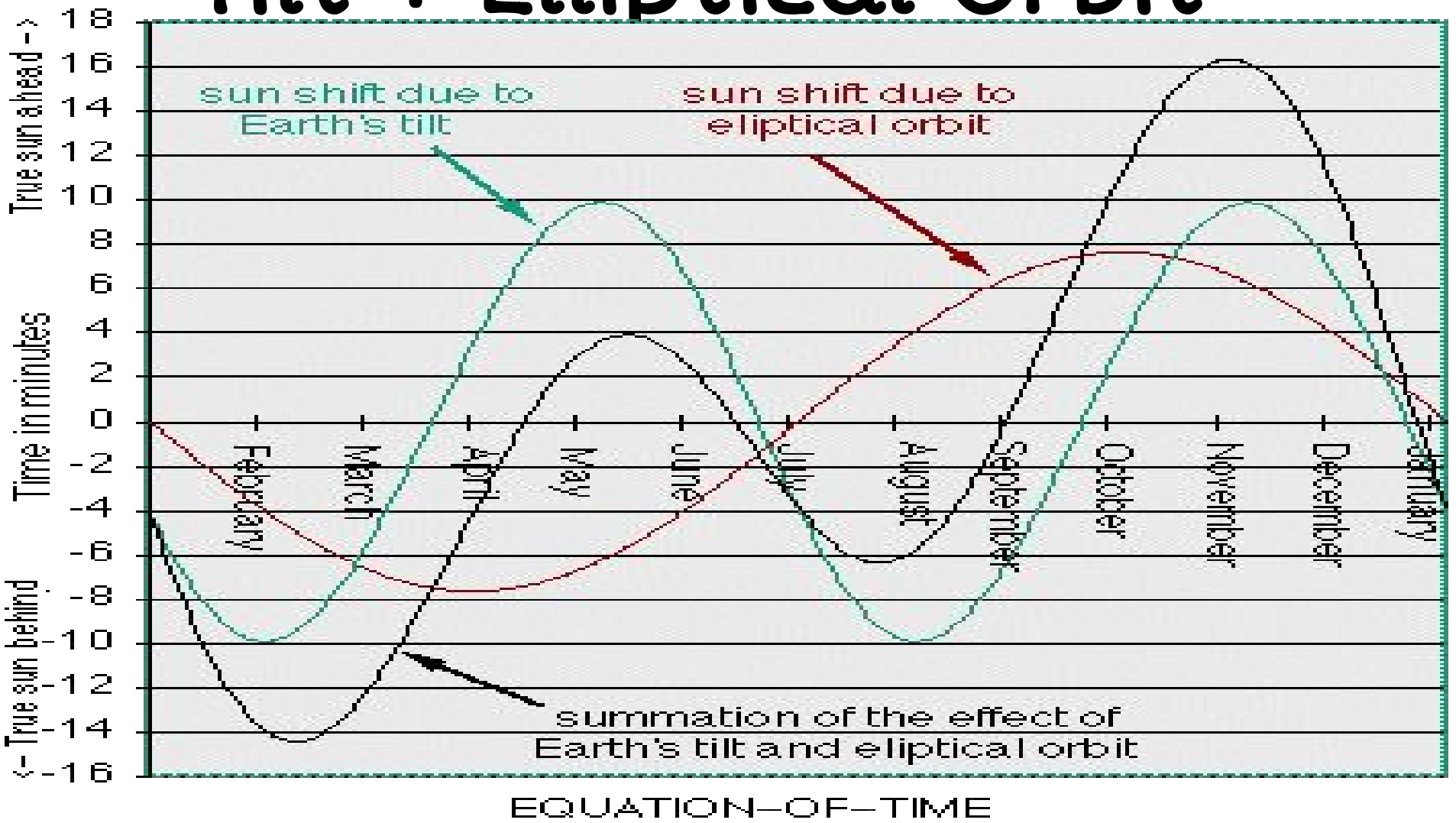
Axis Tilt Effect

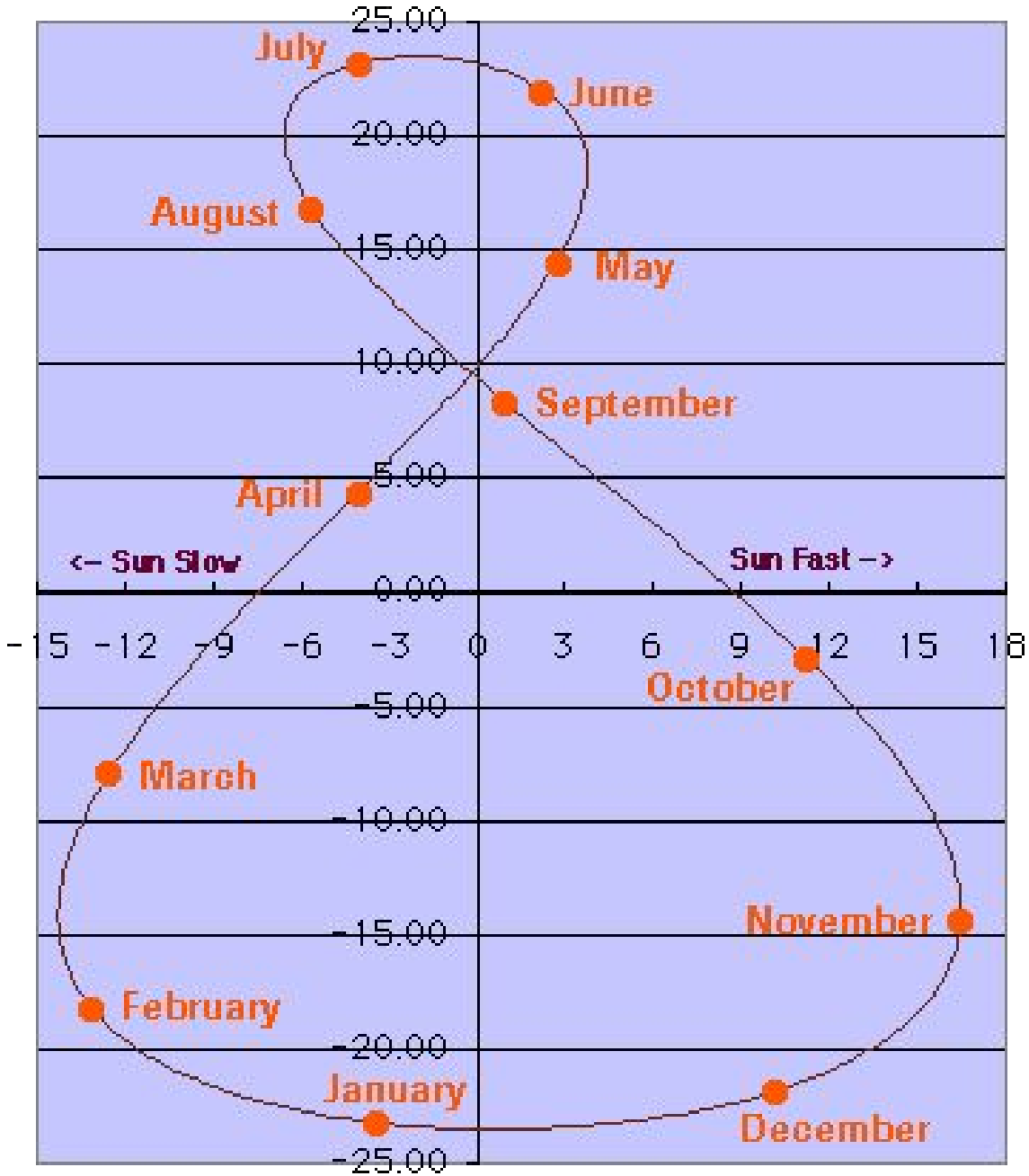






Total Effect
Tilt + Elliptical Orbit

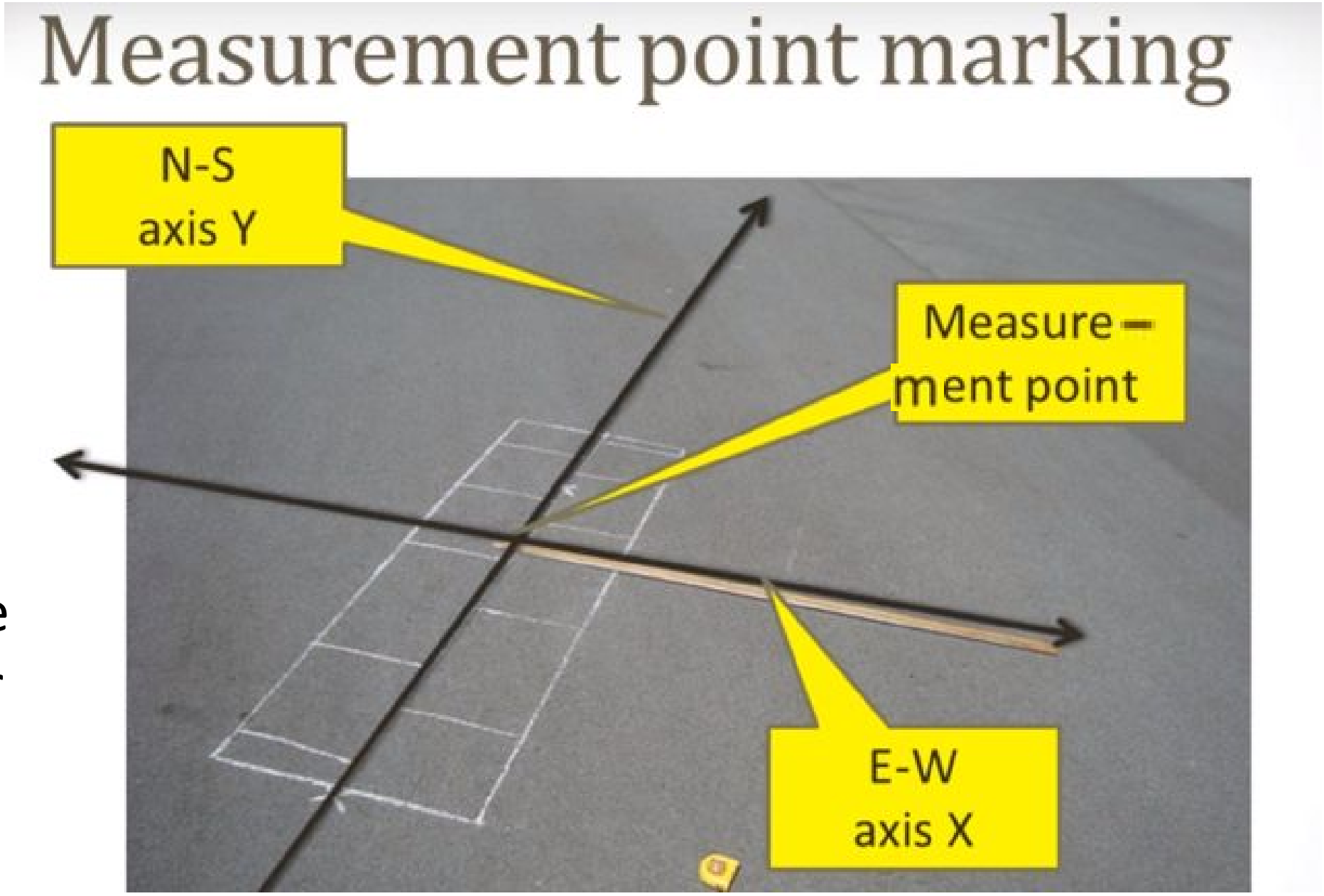




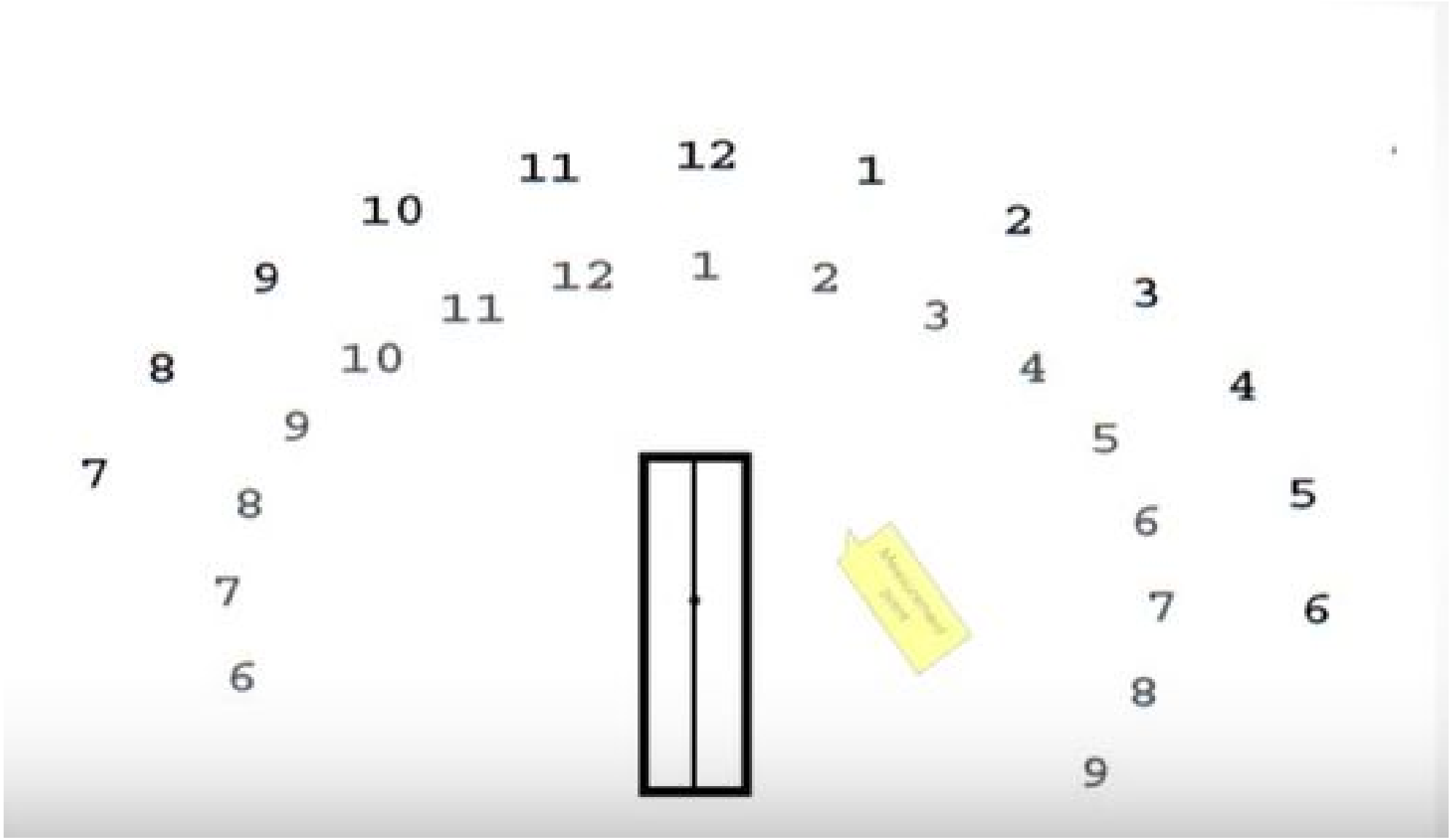
The Analemma Curve

Tools for Construction

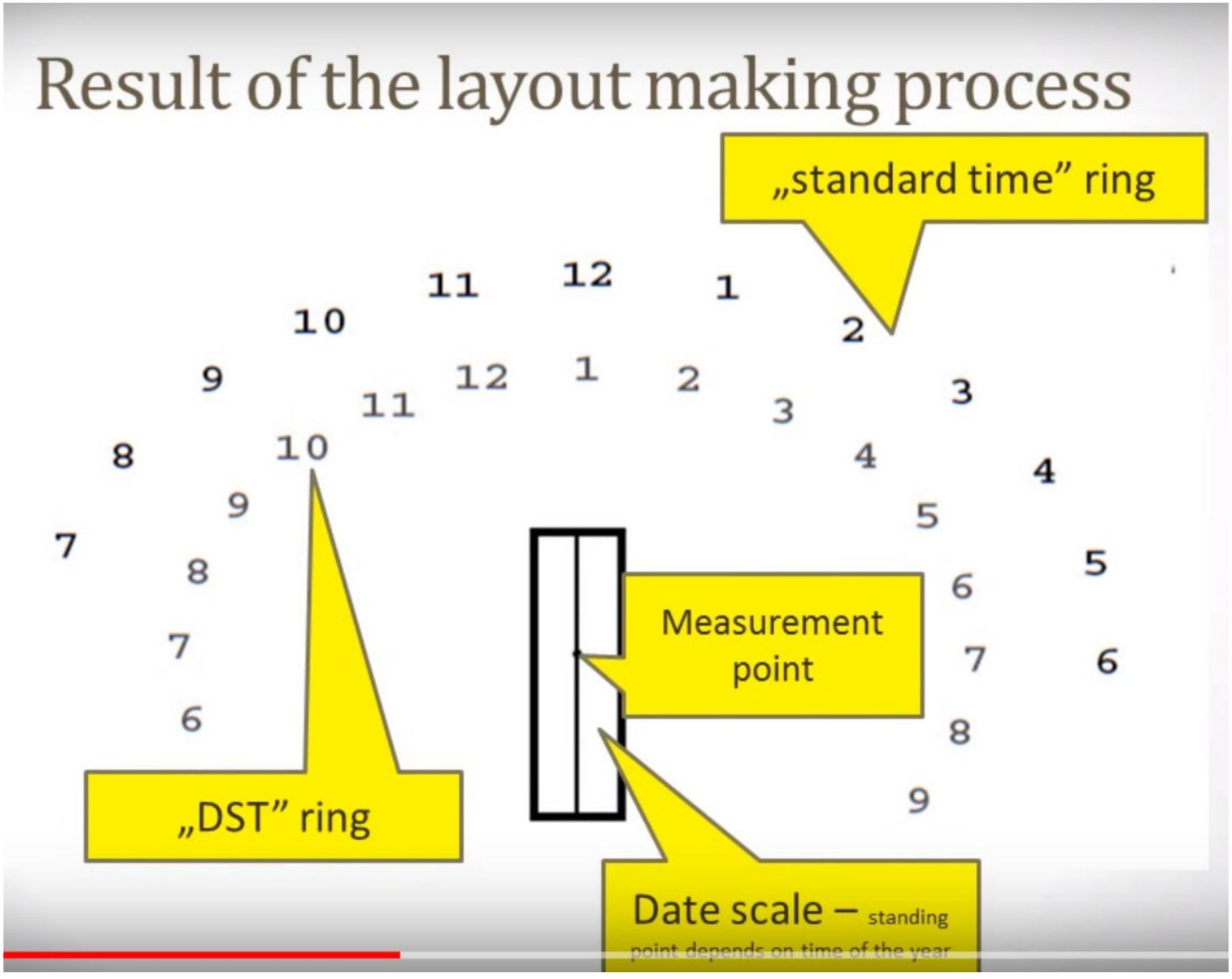
- A piece of Chalk
- A Long Tape Measure
- A Straightedge
- (Yardstick or longer)



You will need a minimum area of 22 x 15 feet



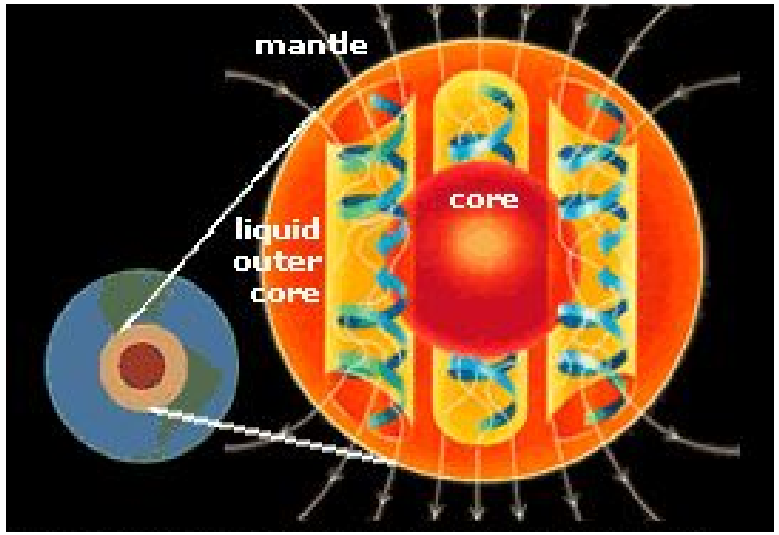
Result of the layout making process

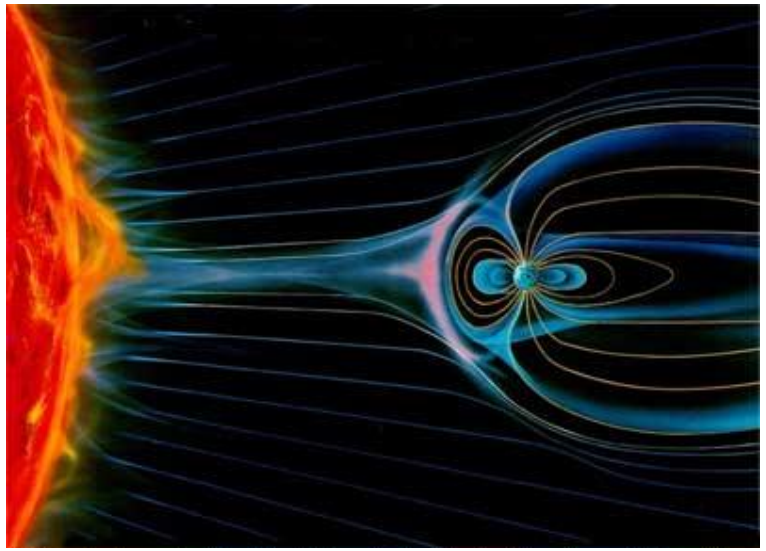


First, we need to set up a N-S line and a E-W line. But how do we find True North?

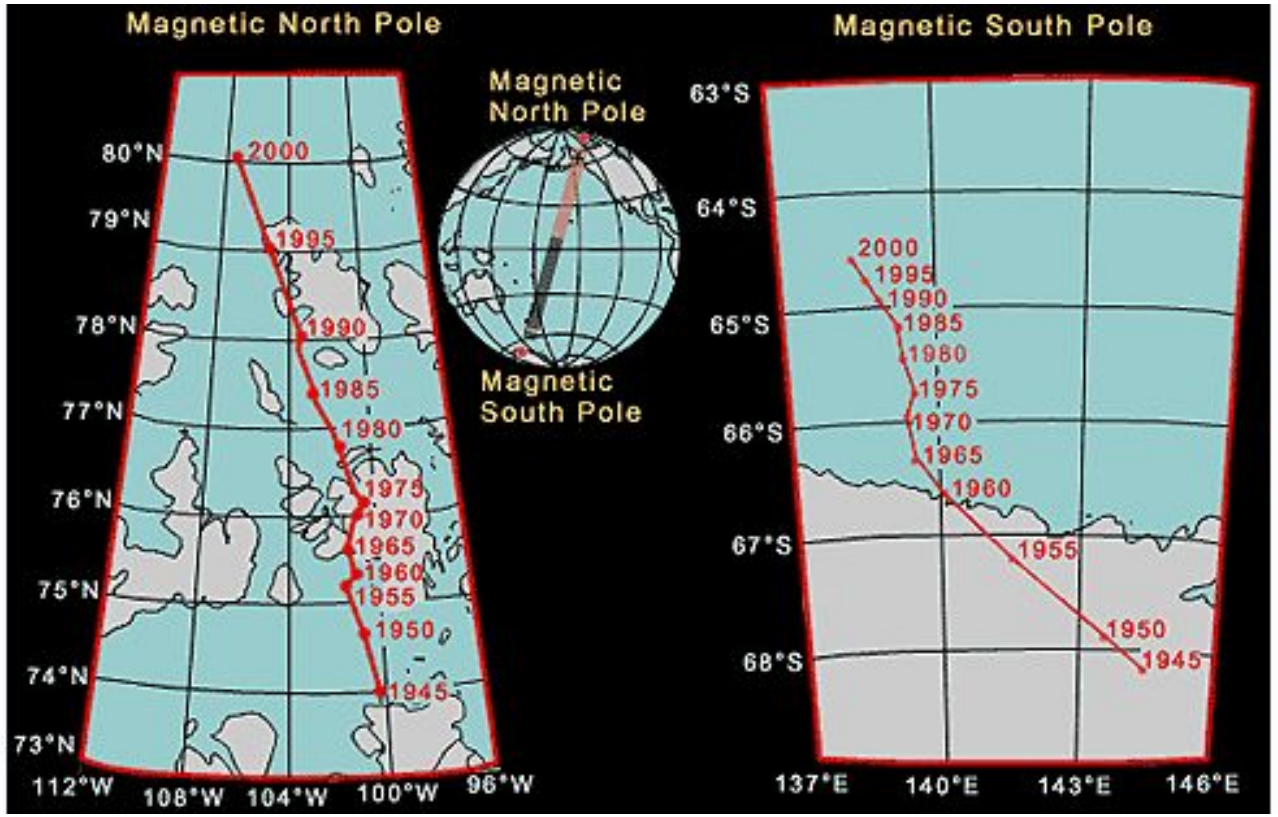
- Use a Compass
- Use a GPS unit
- Use a Map
- Use Polaris
- Use the Sun

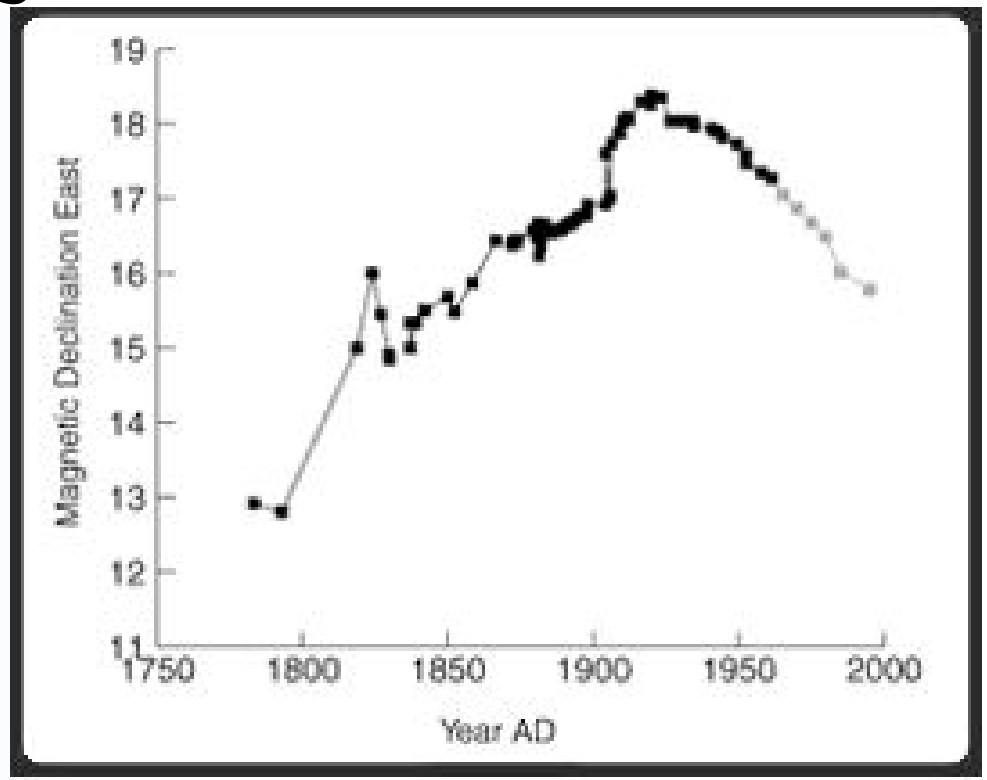
Using a compass and Earth's Magnetic Field





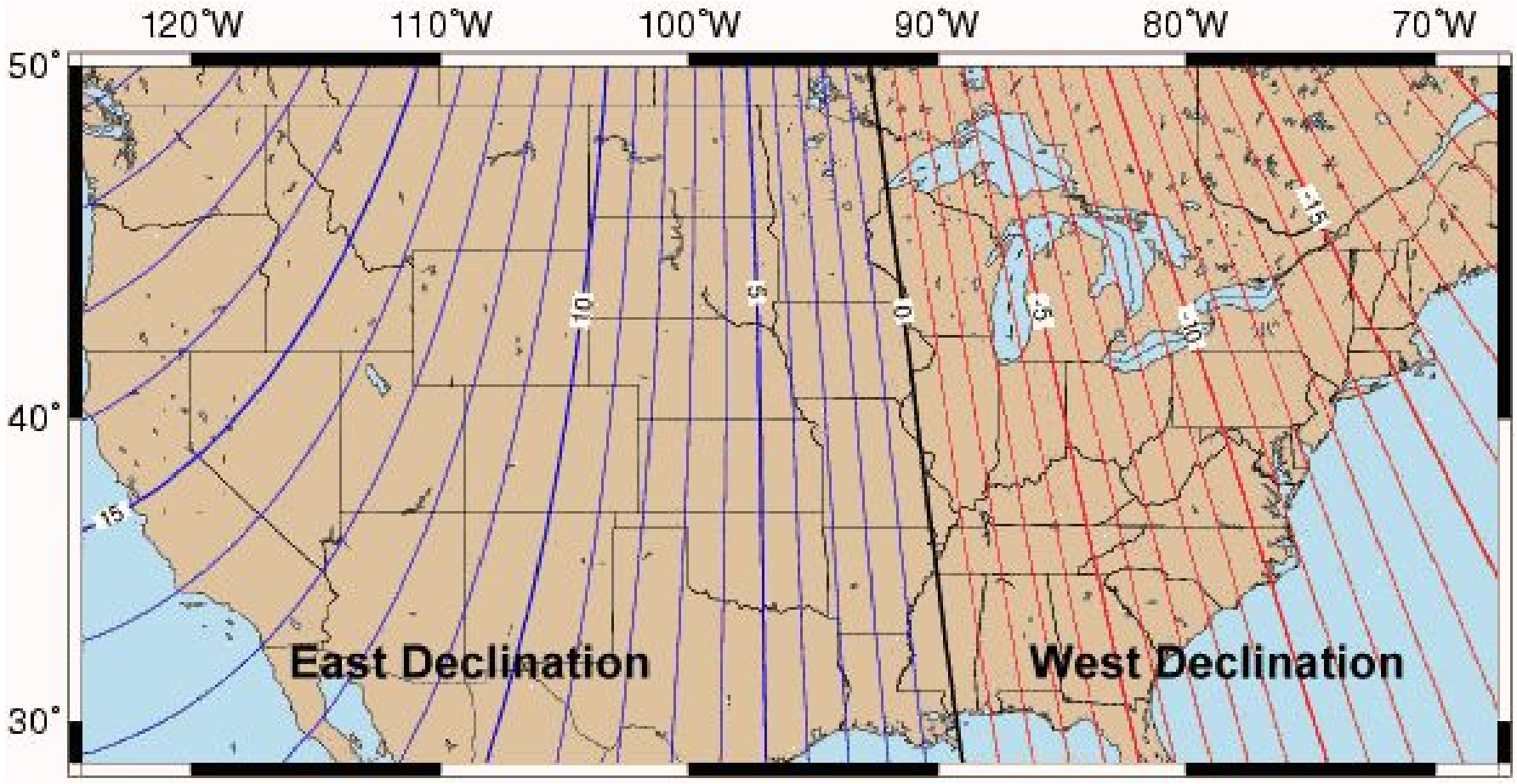
Where is the North Magnetic Pole?





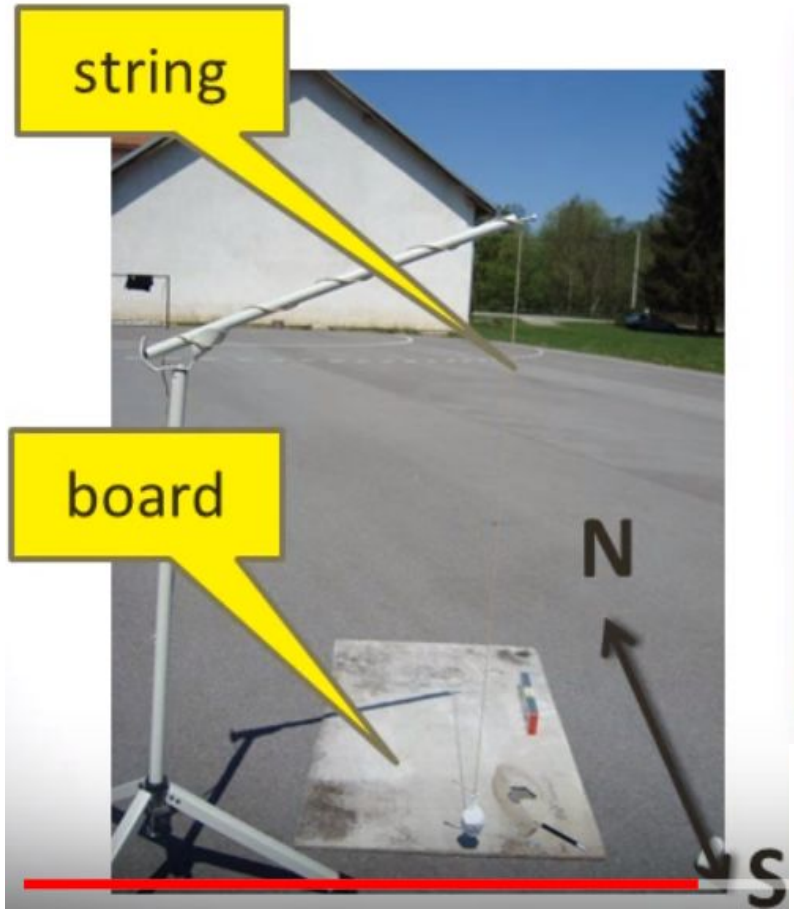
Magnetic Declination Observations at San Francisco, California (1783-1961) and IGRF Models (1965-1995)

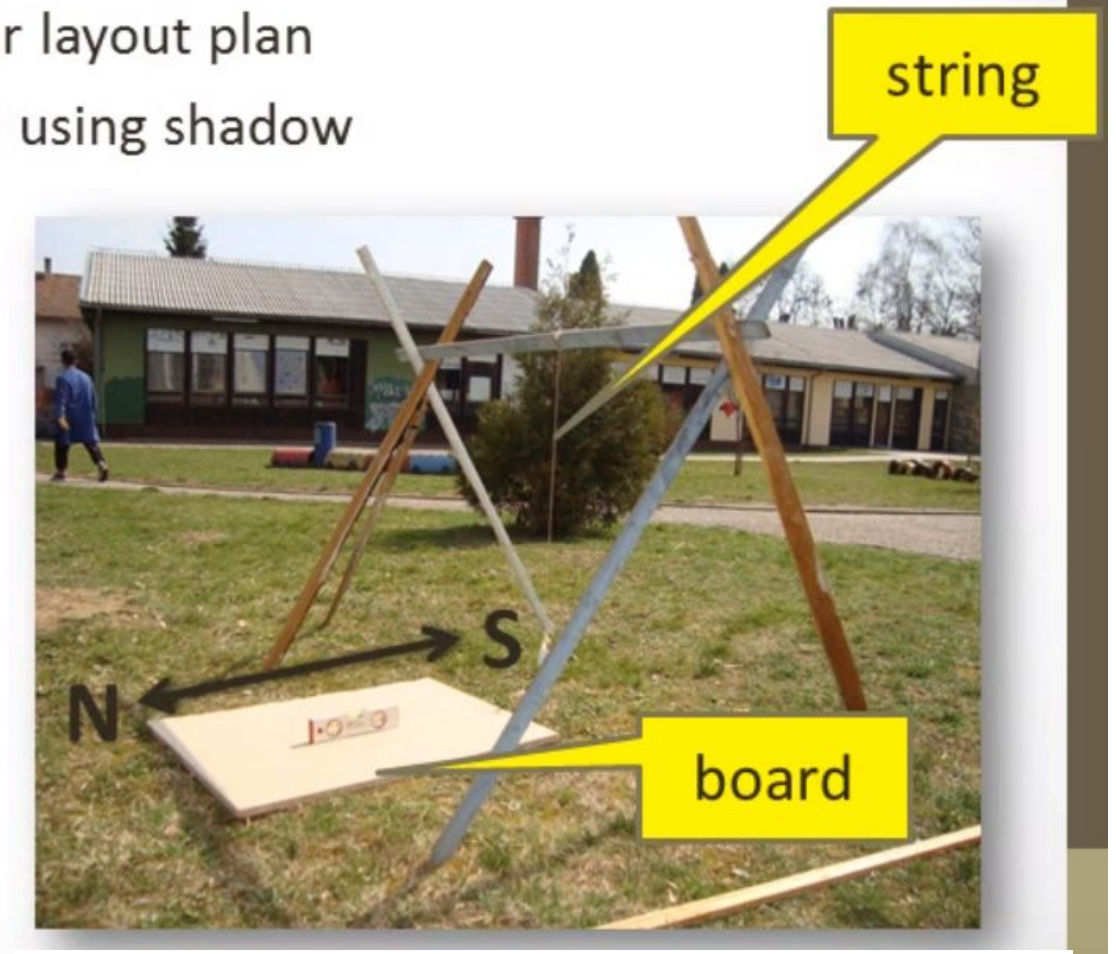
Magnetic Declination in the US



How to determine „true North”?

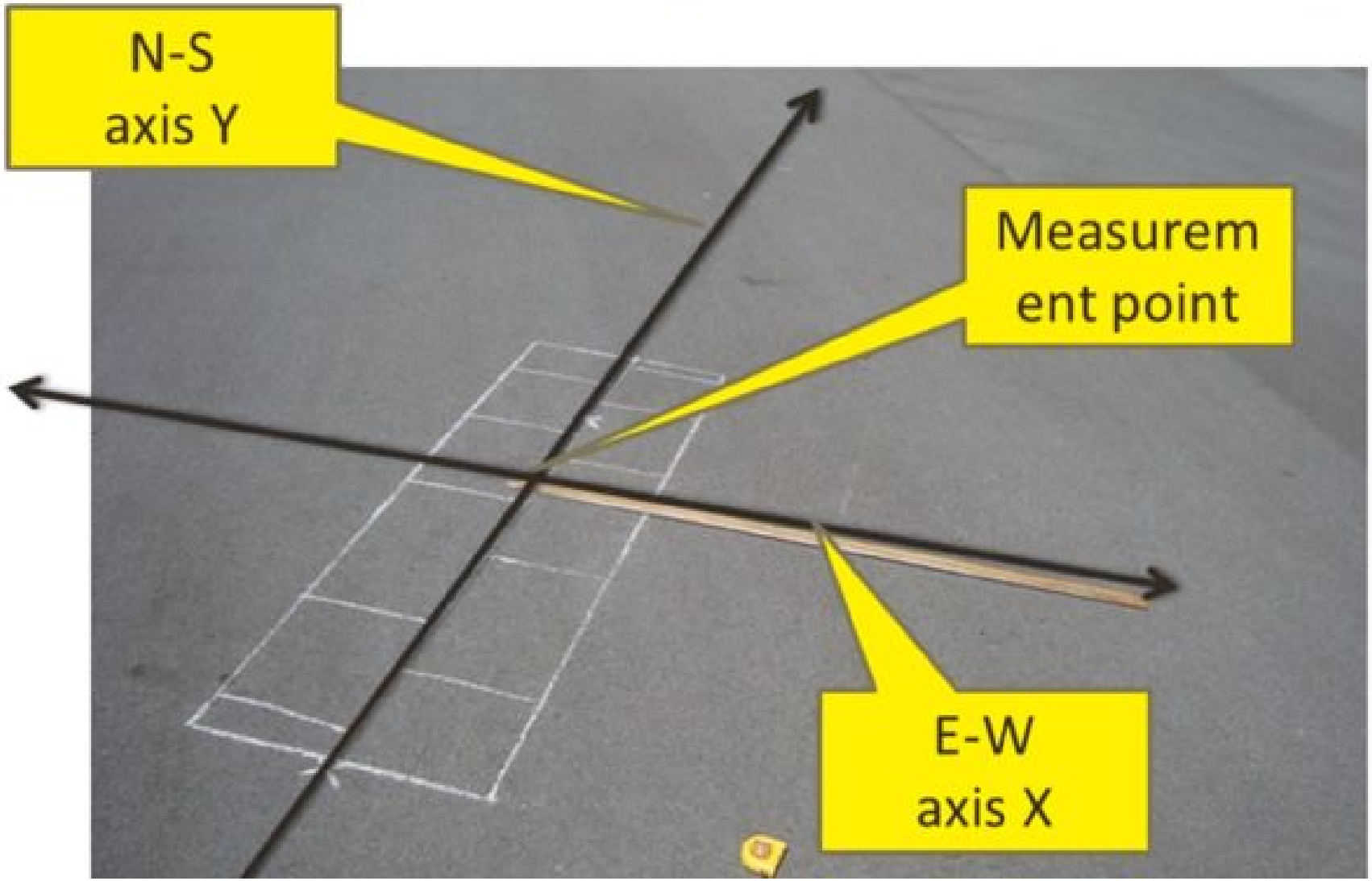
- First step when using our layout plan
- Determine N-S direction using shadow



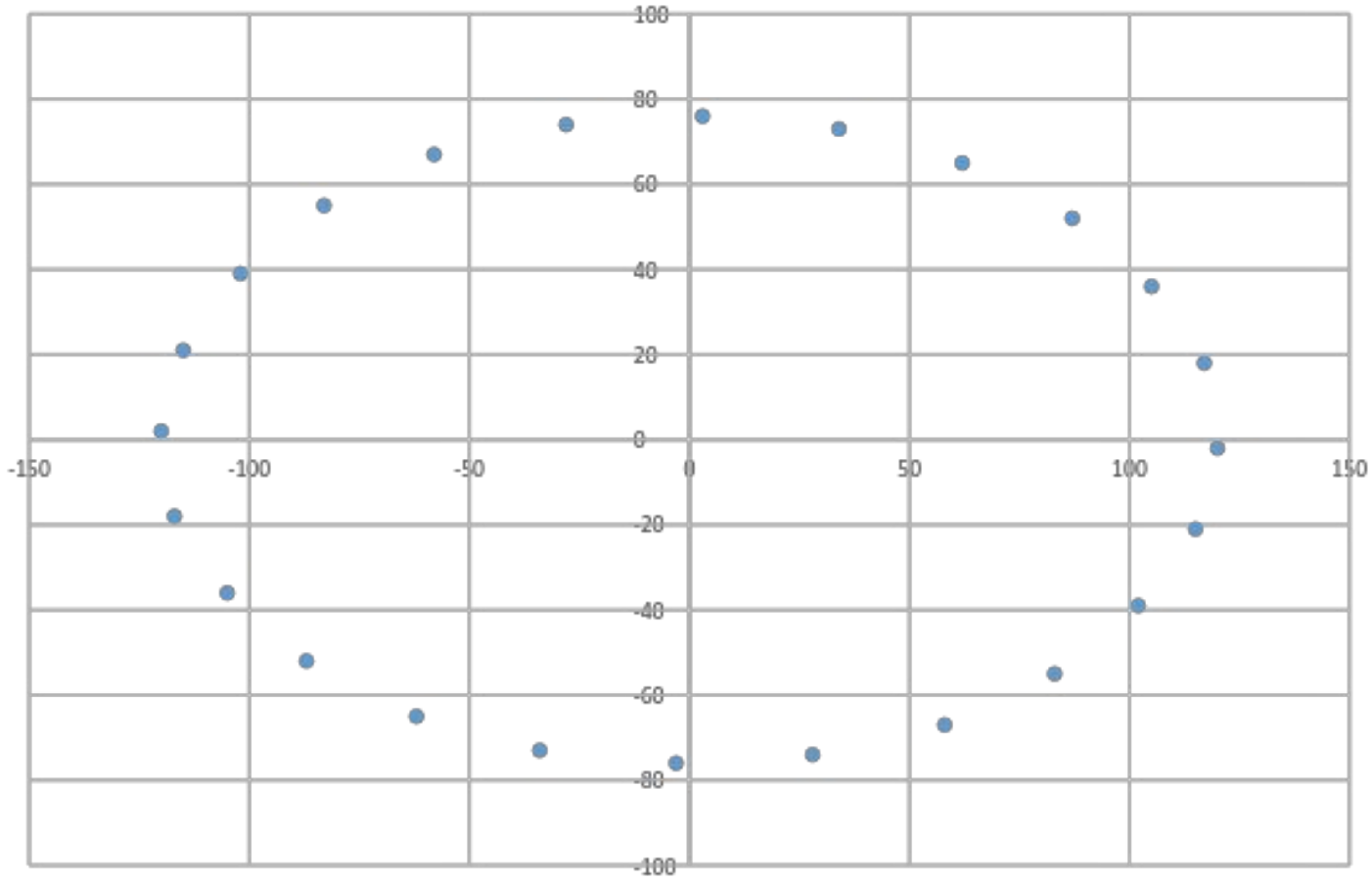


Jan	-38
Feb	-28
Mar	-12
Apr	7
May	25
Jun	38
Jul	40
Aug	30
Sep	14
Oct	-4
Nov	-22
Dec	-36

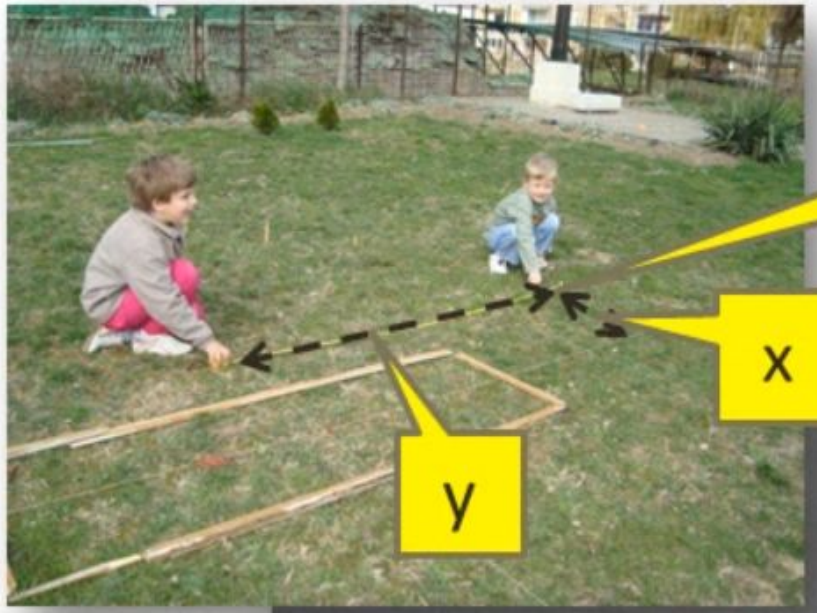
Measurement point marking



Time	x	y
12:00 PM	3	76
1:00 PM	34	73
2:00 PM	62	65
3:00 PM	87	52
4:00 PM	105	36
5:00 PM	117	18
6:00 PM	120	-2
7:00 PM	115	-21
8:00 PM	102	-39
9:00 PM	83	-55
10:00 PM	58	-67
11:00 PM	28	-74
12:00 AM	-3	-76
1:00 AM	-34	-73
2:00 AM	-62	-65
3:00 AM	-87	-52
4:00 AM	-105	-36
5:00 AM	-117	-18
6:00 AM	-120	2
7:00 AM	-115	21
8:00 AM	-102	39
9:00 AM	-83	55
10:00 AM	-58	67
11:00 AM	-28	74



„Ring" elements marking



Hour marking

x

y

x

y


AUG
SEP
OCT
NOV
FEB
JAN

Analemmatic Sundial PDF Generator

Detailed instructions for using this script are given in my Instructable for it.

For a small, paper sundial project, go here.

Enter location parameters

You must enter the width of the sundial you wish to build, enter either a zip code or latitude/longitude, and select your timezone and daylight savings option. Required options are in bold.

Sundial width: 360 cm

Zip code: 20878 ***or* Latitude:** **and Longitude:**

Time zone: Eastern Standard Time (North America) (UTC-05)

Daylight savings:

- ○ **No daylight savings at my location**
- ○ **Put summer time on sundial**
- ◉ **Put winter time on sundial**

Numerals: Arabic

☑ Include (x,y) coordinates of hour points

Location name: Gaithersburg (e.g., "Paris" or "My backyard")

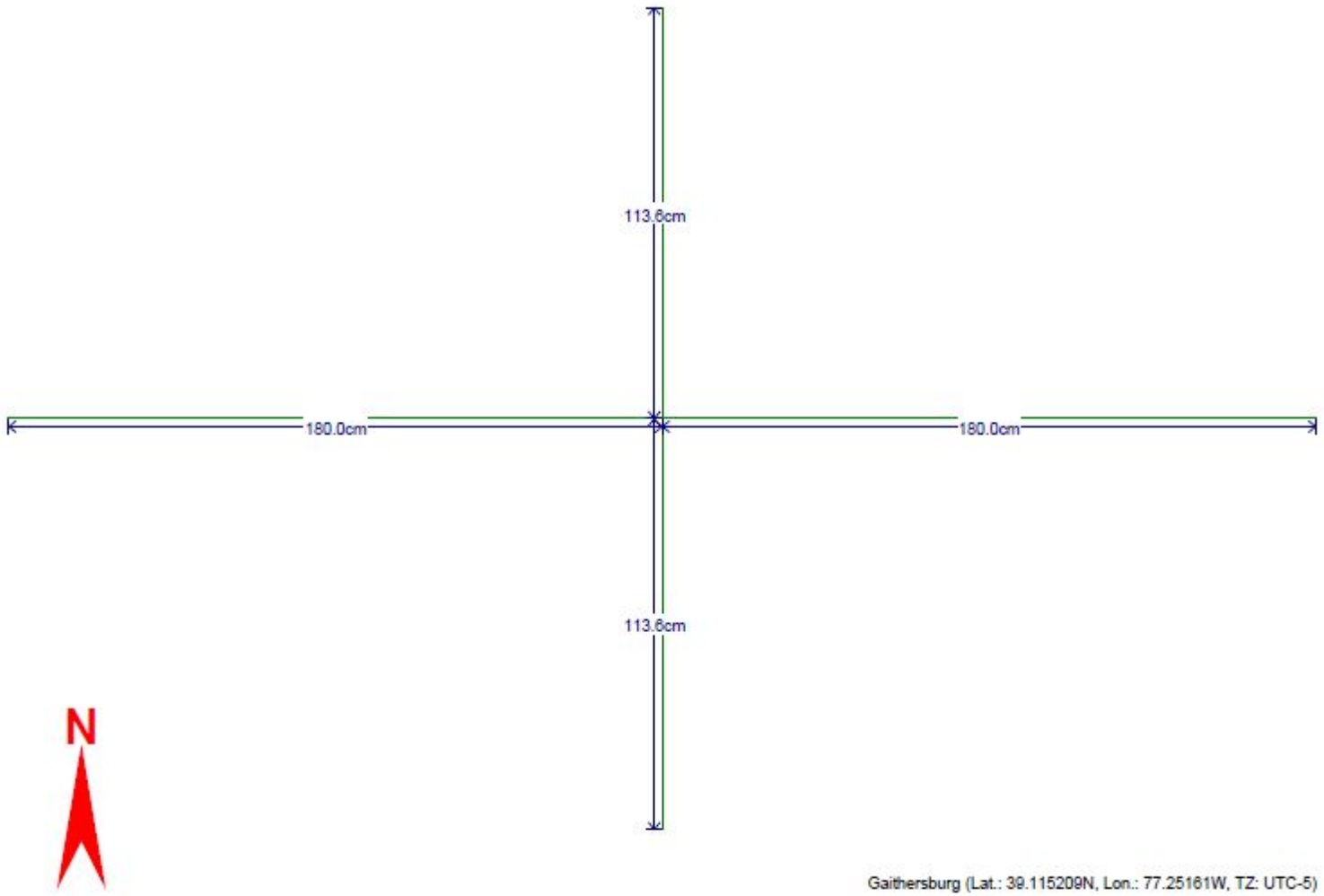
☑ Include dimensions and instructions

Go!

http://analemmatic.sourceforge.net/cgi-bin/sundial.pl

Step 2: Draw the axes

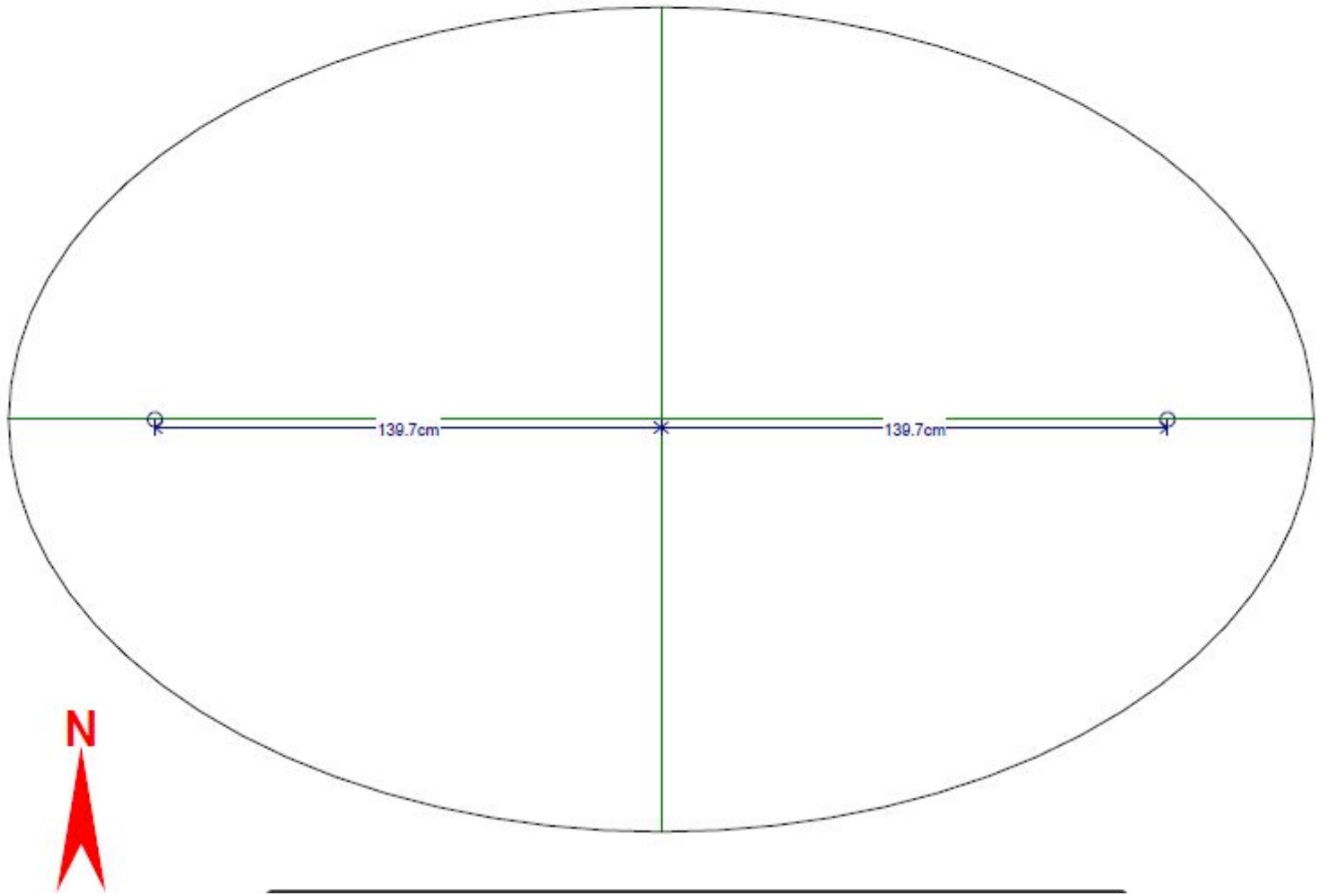
Make sure to align the N arrow to true north (not magnetic)



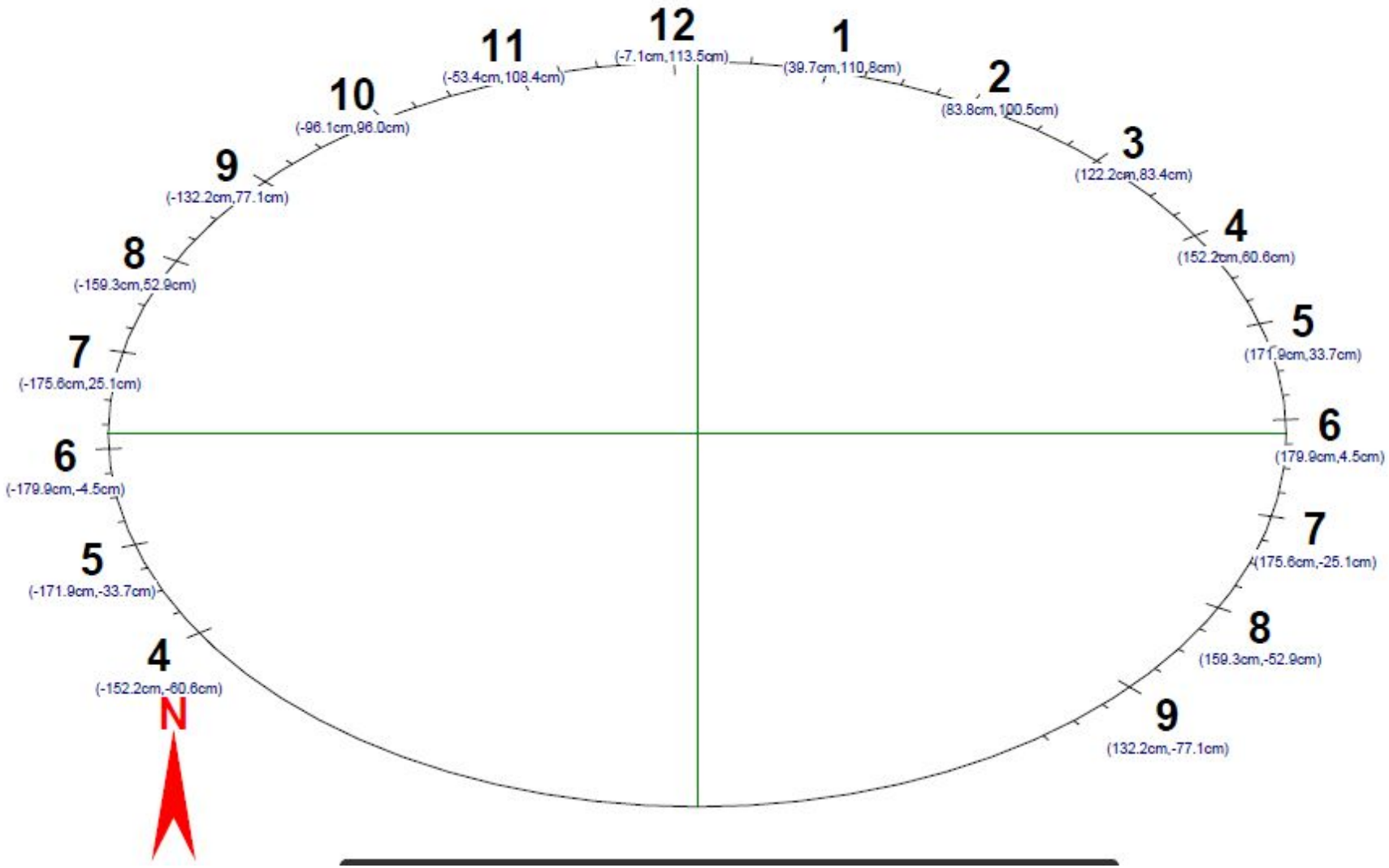
Gaithersburg (Lat.: 39.115209N, Lon.: 77.25161W, TZ: UTC-5)

Step 3: Draw the ellipse

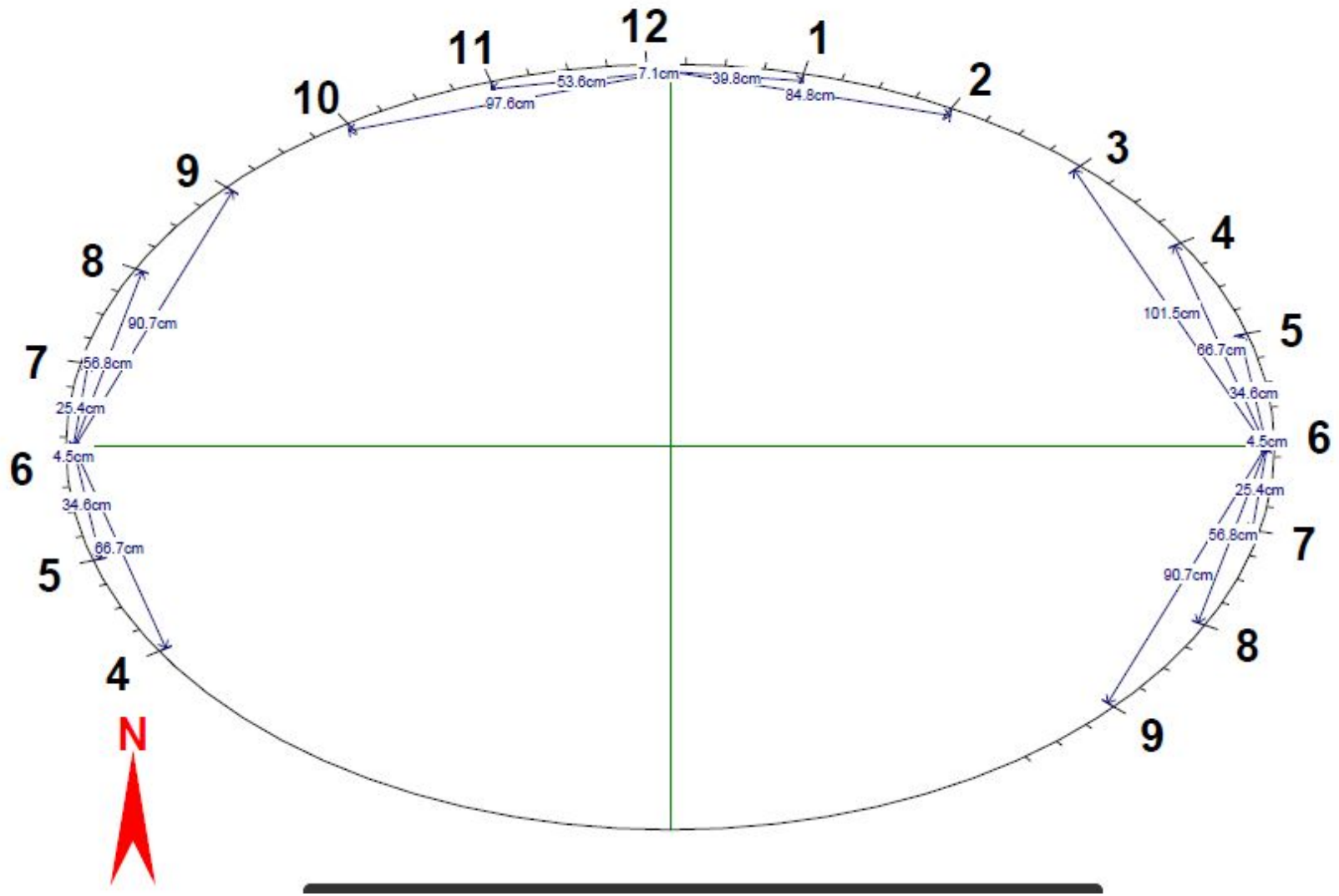
Use a loop of length 639.3cm to draw ellipse.



Step 4a: Draw the hour labels

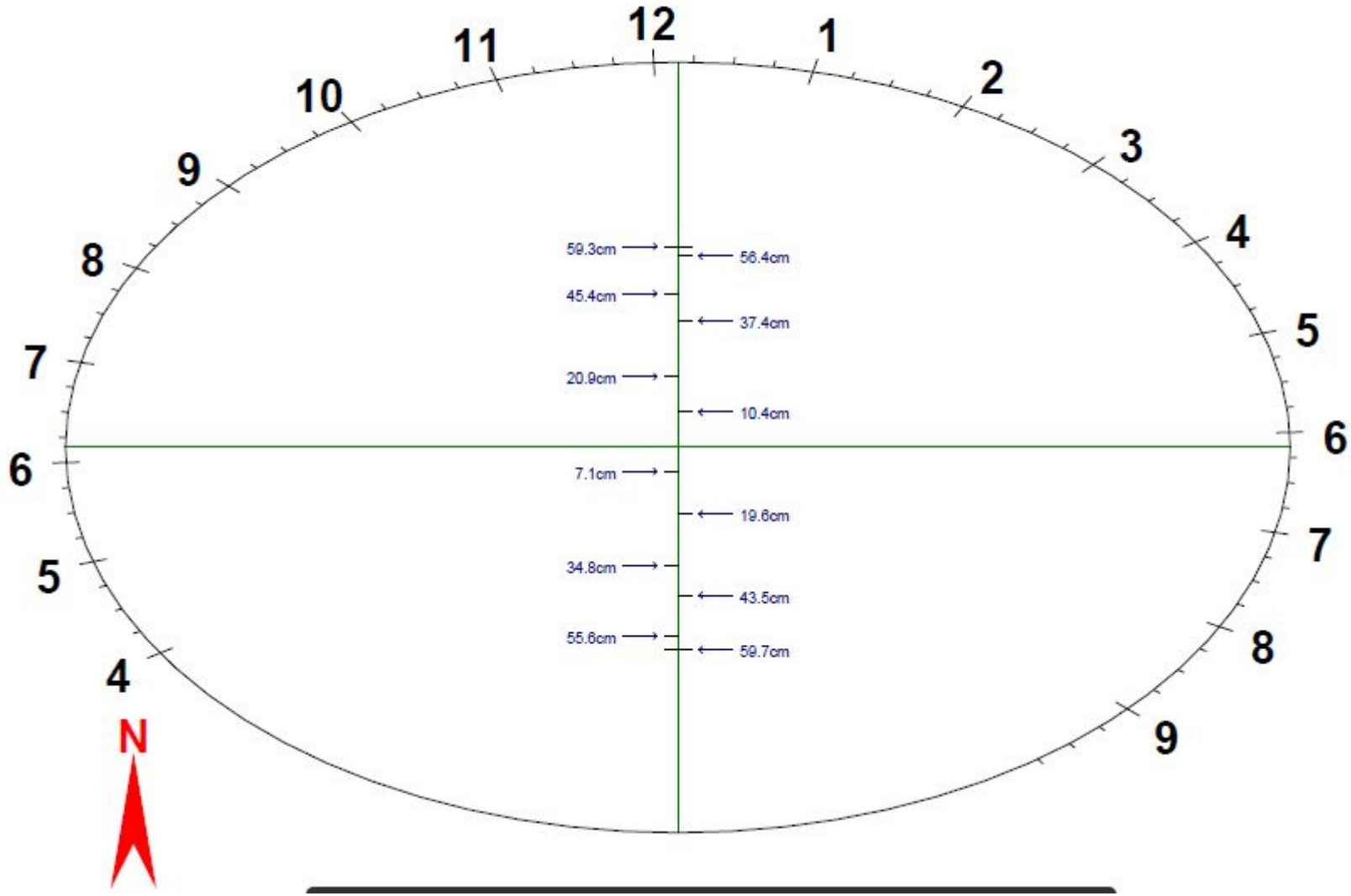


Step 4b: Verify hour label distances



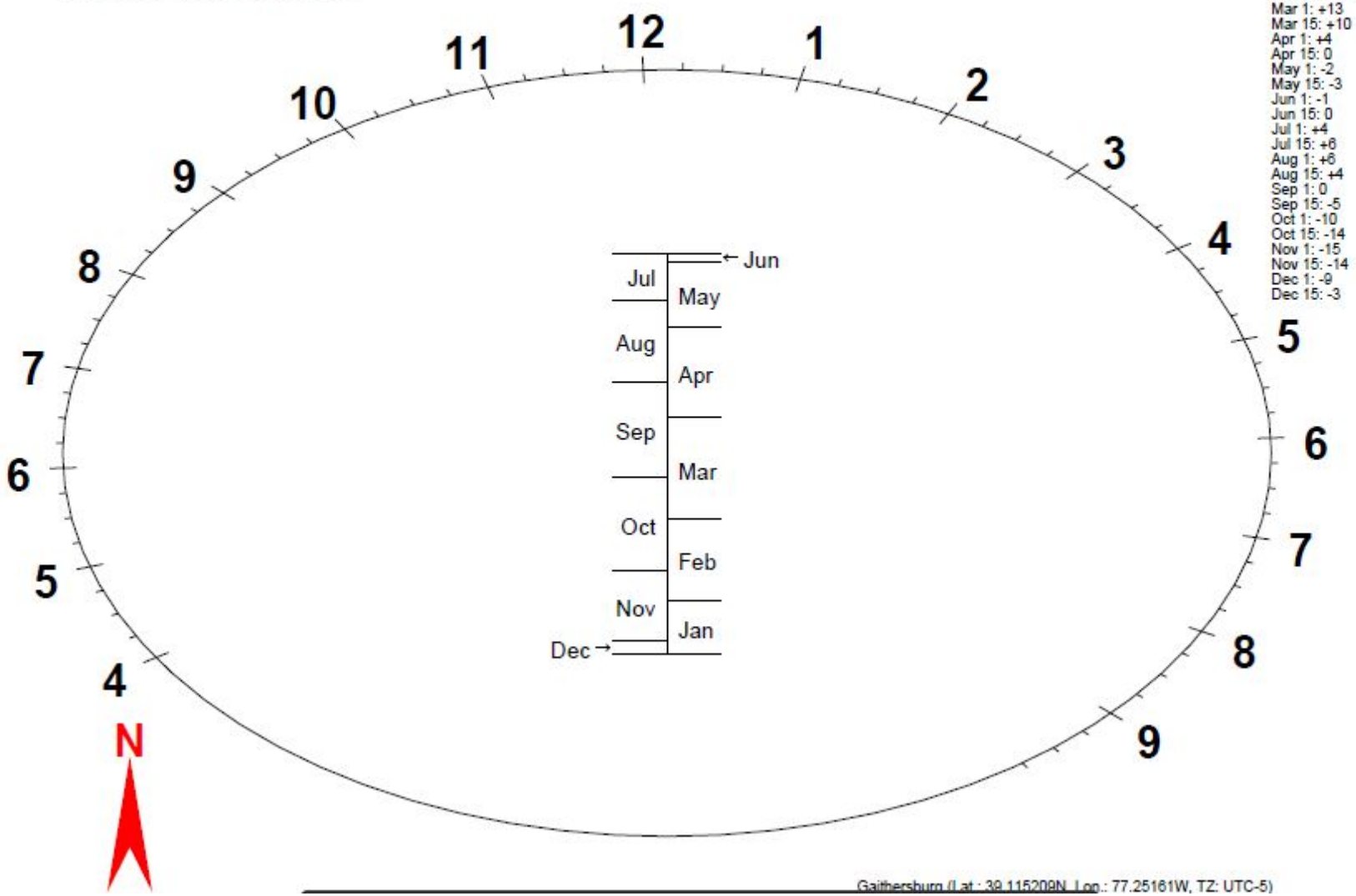
Step 5: Draw monthly gnomon position tickmarks

Put the tickmarks at the indicated distances from the horizontal line.



Step 6: Indicate monthly gnomon positions

Add one hour for summer time



Correction (min.):
Jan 1: +4
Jan 15: +9
Feb 1: +14
Feb 15: +15
Mar 1: +13
Mar 15: +10
Apr 1: +4
Apr 15: 0
May 1: -2
May 15: -3
Jun 1: -1
Jun 15: 0
Jul 1: +4
Jul 15: +6
Aug 1: +6
Aug 15: +4
Sep 1: 0
Sep 15: -5
Oct 1: -10
Oct 15: -14
Nov 1: -15
Nov 15: -14
Dec 1: -9
Dec 15: -3

Gaithersburg (Lat.: 39.115209N, Lon.: 77.25161W, TZ: UTC-5)

That's all, Folks!

Thanks for your Time and Attention