

Wheels In The Sky

MDAS February 2022

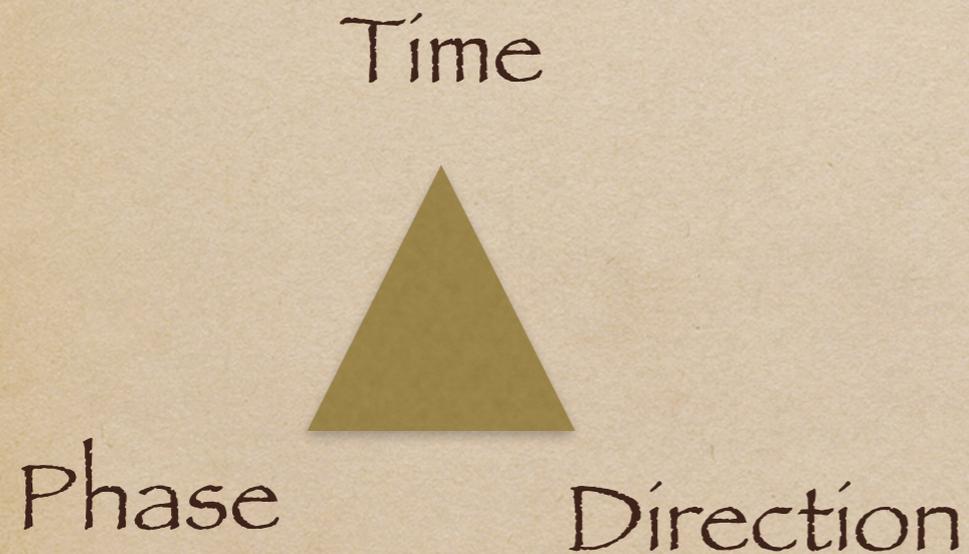
Jeff Adkins

Agenda

- ◆ Moon Phase Calculator
- ◆ Planisphere
- ◆ Astrolabe

Moon Phase Calculator

- ◆ by Jeff Adkins
- ◆ The triangle of moon phase info



moon phase, direction and time

Waxing Gibbous First Quarter Waxing Crescent
Full MIDNIGHT NOON New
Waning Gibbous 3 AM 6 AM 9 AM Waning Crescent
Third Quarter

BASED ON: [HTTPS://SOLARSYSTEM.NASA.GOV/RESOURCES/676/PHASES-OF-THE-MOON/](https://solarsystem.nasa.gov/resources/676/phases-of-the-moon/)

DIRECTIONS:
CUT OUT THE TOOL AND PLACE IT ON THE CENTER OF THE EARTH.

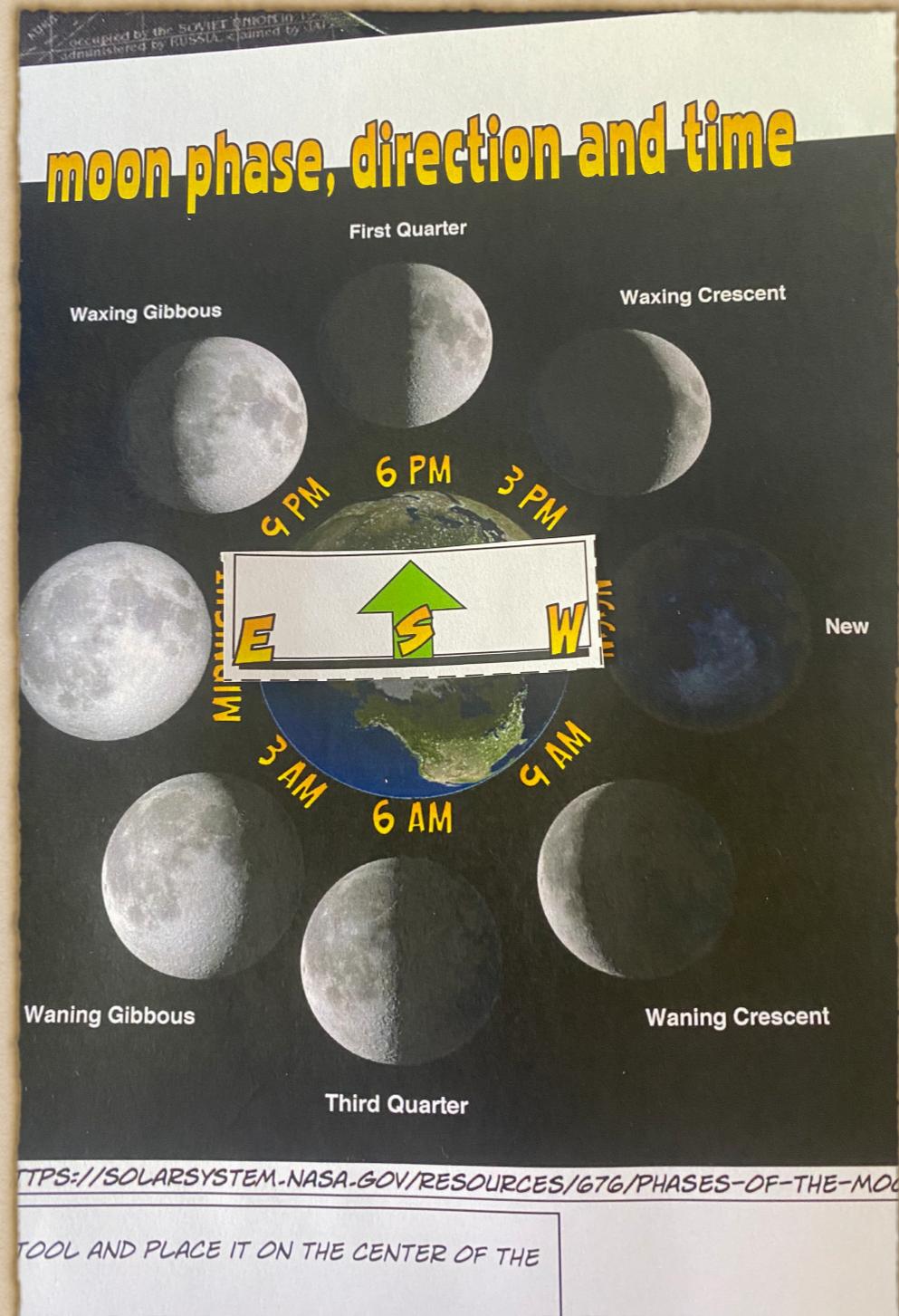
THE GREEN ARROW POINTS SOUTH. IT ALSO INDICATES THE TIME ON THE TIME SCALE AROUND THE EARTH. THE HEAVY BLACK LINE IS THE HORIZON.

DO TWO OF THE FOLLOWING THREE THINGS TO FIND OUT THE THIRD:
PICK A PHASE
PICK A TIME
PICK A DIRECTION

THE TOOL. CUT OUT ALONG THE DOTTED LINE.

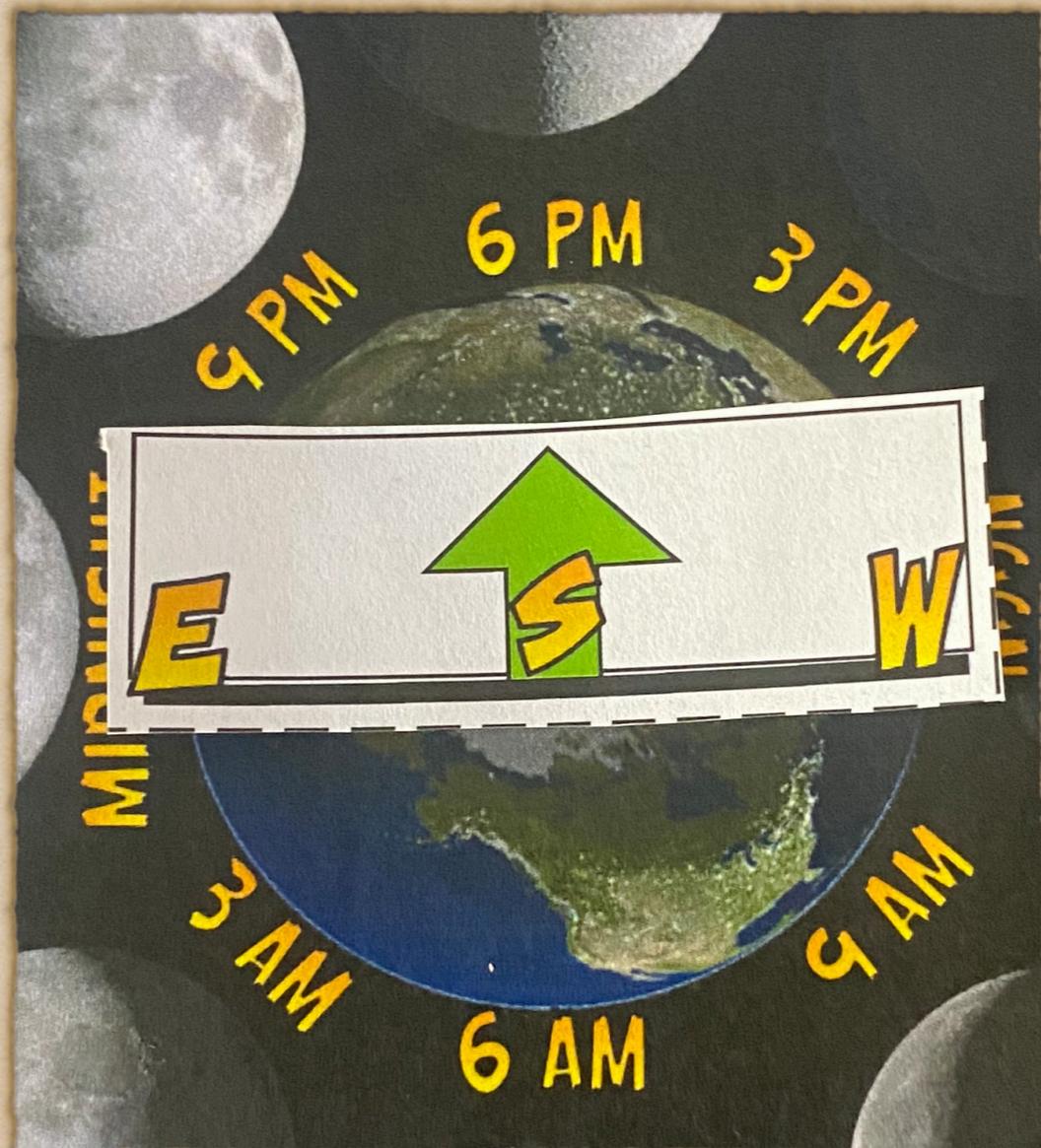
How to assemble

Cut out "the tool."
Lay it on the center.
That's pretty much it.



Interpreting the "tool"

- ◆ The line is the horizon
- ◆ The green arrow tells the time and ALSO points south
 - ◆ "highest"
- ◆ E and W are East and West
 - ◆ "rising" and "setting"
- ◆ SE and SW
- ◆ Why no North?



How to use it

That's a little bit harder.

1. If you know the time and phase

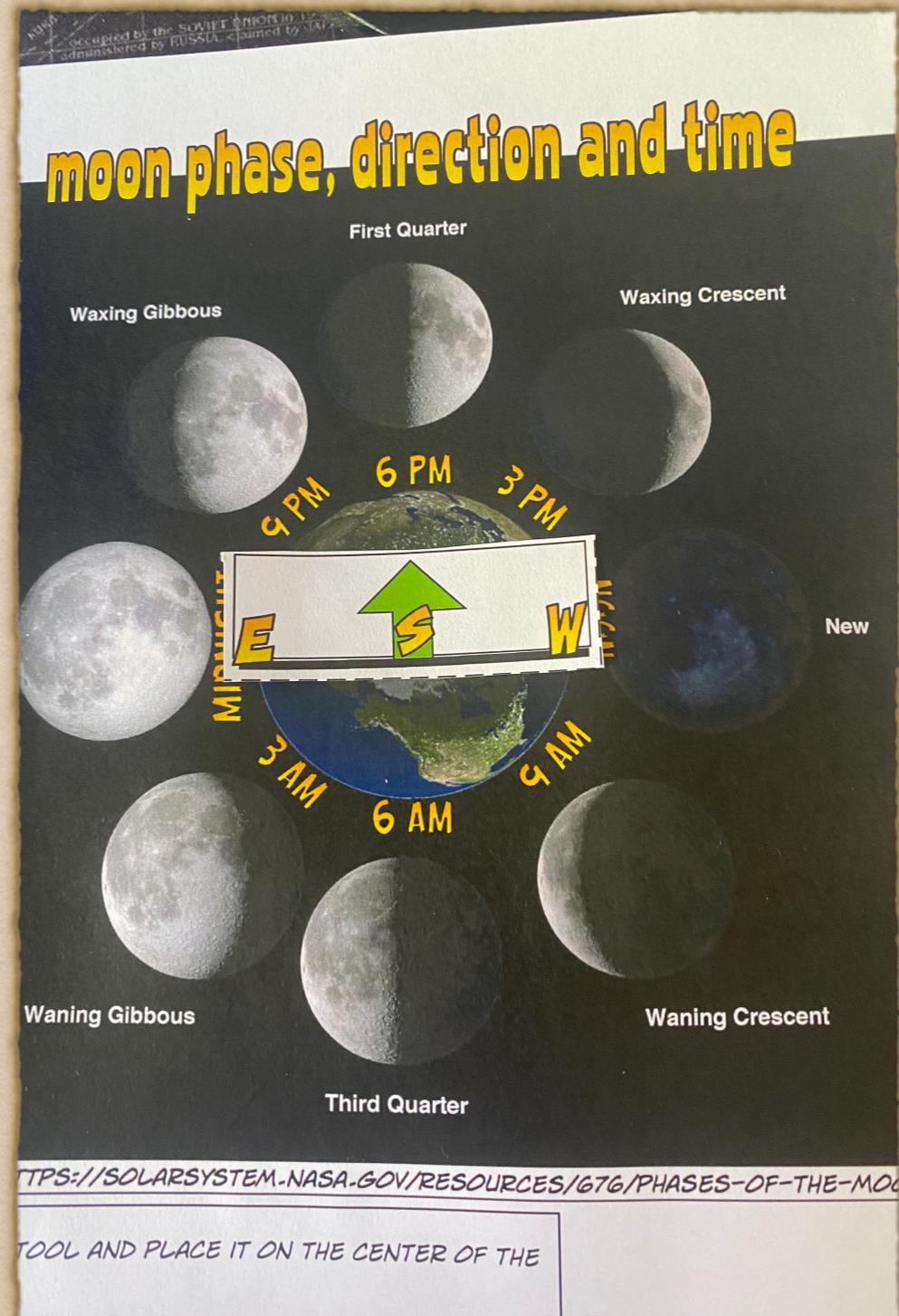
1. Point the green arrow at the time
2. Locate the phase
3. Compare the phase to the direction

2. If you know the phase and direction

1. Locate the phase
2. Rotate the tool to point the direction at the phase
3. Read the time off of the green arrow

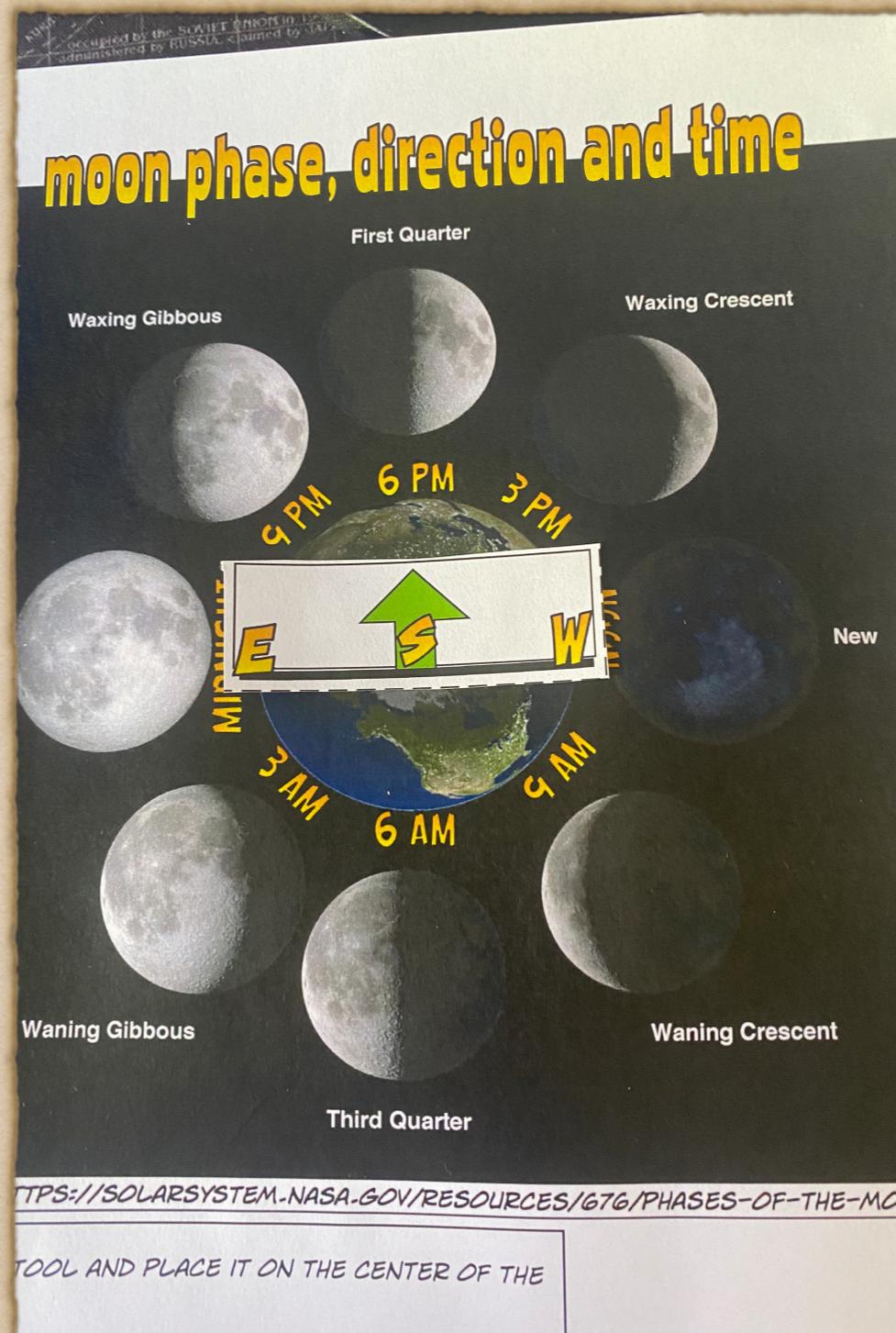
3. If you know the time and direction

1. Point the green arrow at the time
2. Look in the appropriate direction
3. Identify the phase



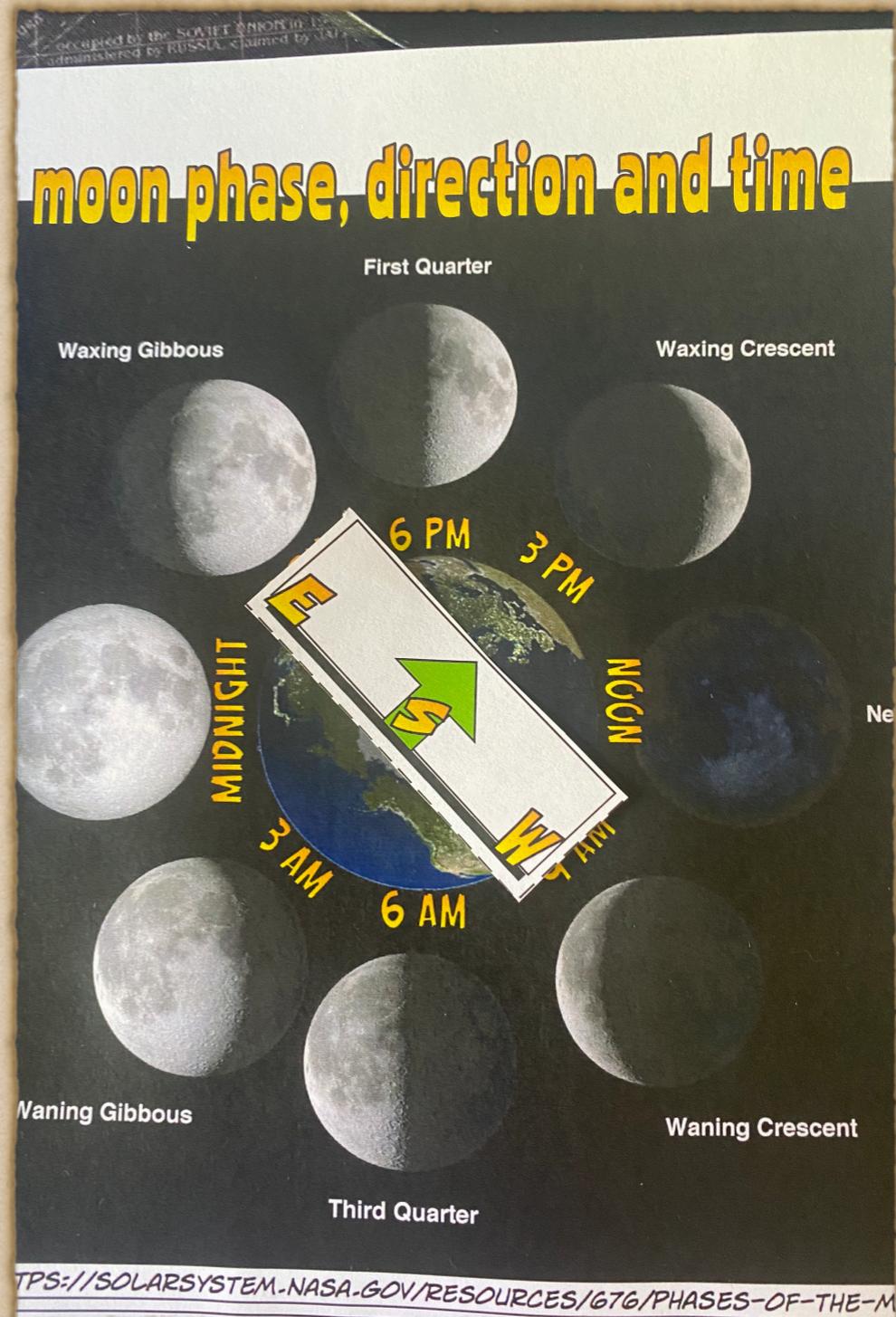
Example 1

1. If you know the time and phase
 1. Point the green arrow at the time
 2. Locate the phase
 3. Compare the phase to the direction
2. Example: It is 6 PM and the phase of the moon is First Quarter. What direction is it in?
 1. South
 2. West
 3. North
 4. East



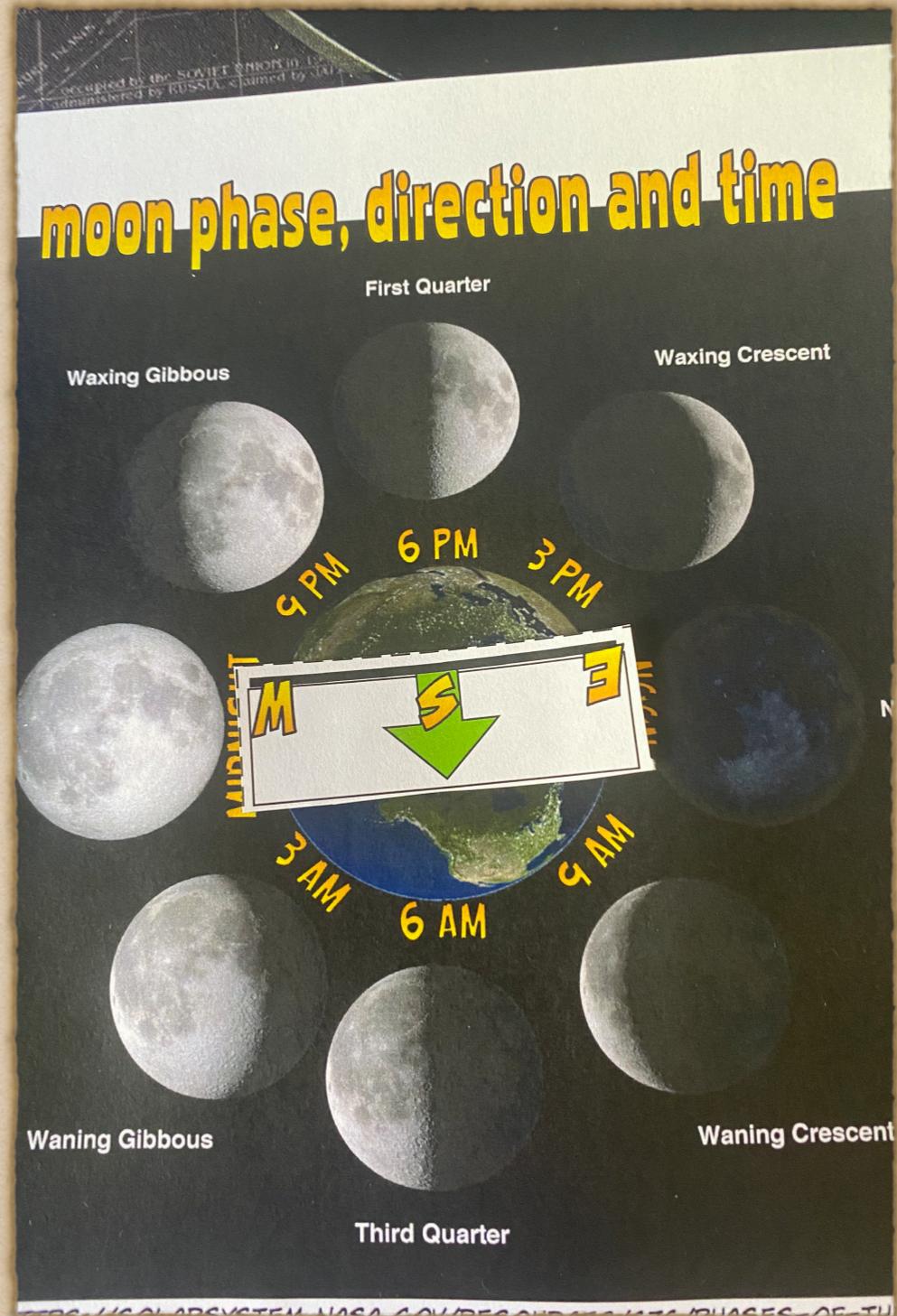
Example 2

1. If you know the phase and direction
 1. Locate the phase
 2. Rotate the tool to point the direction at the phase
 3. Read the time off of the green arrow
2. A waxing gibbous moon is seen rising in the east. Roughly what time is it?
 1. 3 PM
 2. 9 PM
 3. Midnight
 4. Noon



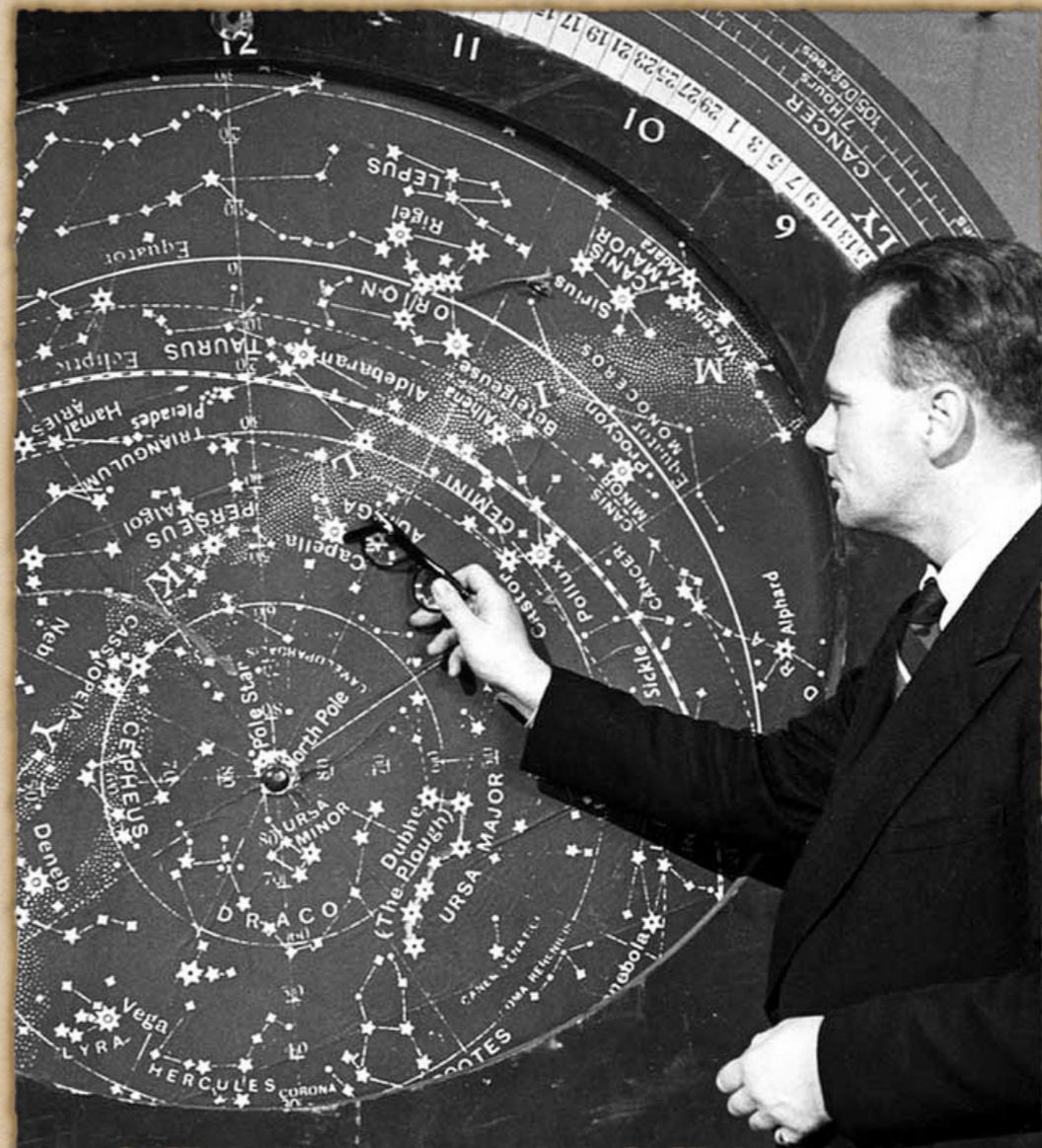
Example 3

1. If you know the time and direction
 1. Point the green arrow at the time
 2. Look in the appropriate direction
 3. Identify the phase
2. It is 6 AM and you see the moon in the West. What phase is it?
 1. New
 2. Waning Crescent
 3. Full
 4. New



The Planisphere

- ◆ Literally means “flat-sphere.”
- ◆ Originally included globes of the earth as well as the sky
- ◆ Project a spherical map onto a 2-D flat surface
- ◆ Used to predict the nearby constellations, direction, visibility, etc. for casual observing
- ◆ Why not use an app?



Brief History

<https://en.wikipedia.org/wiki/Planisphere>

The first star chart to have the name "planisphere" was made in 1624 by [Jacob Bartsch](#). Bartsch was the son-in-law of [Johannes Kepler](#), discoverer of [Kepler's laws of planetary motion](#).

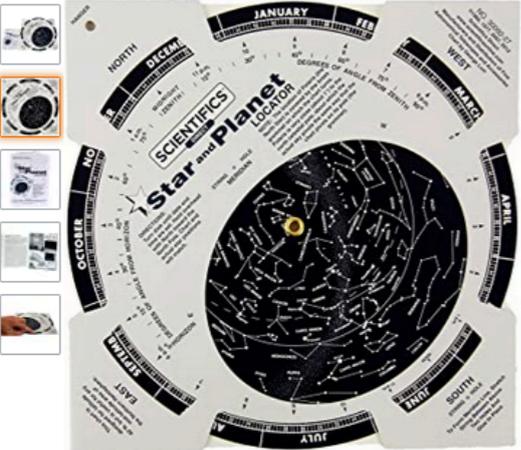


Tigris, a constellation introduced around 1613 by Petrus Plancius, as depicted by Jakob Bartsch



Medieval planisphere, c.1000. [National Library of Wales MS 735C](#), [Aberystwyth](#).

- ◆ Commerically made versions
- ◆ <https://www.walrecht.nl/en/news/super-planisphere>



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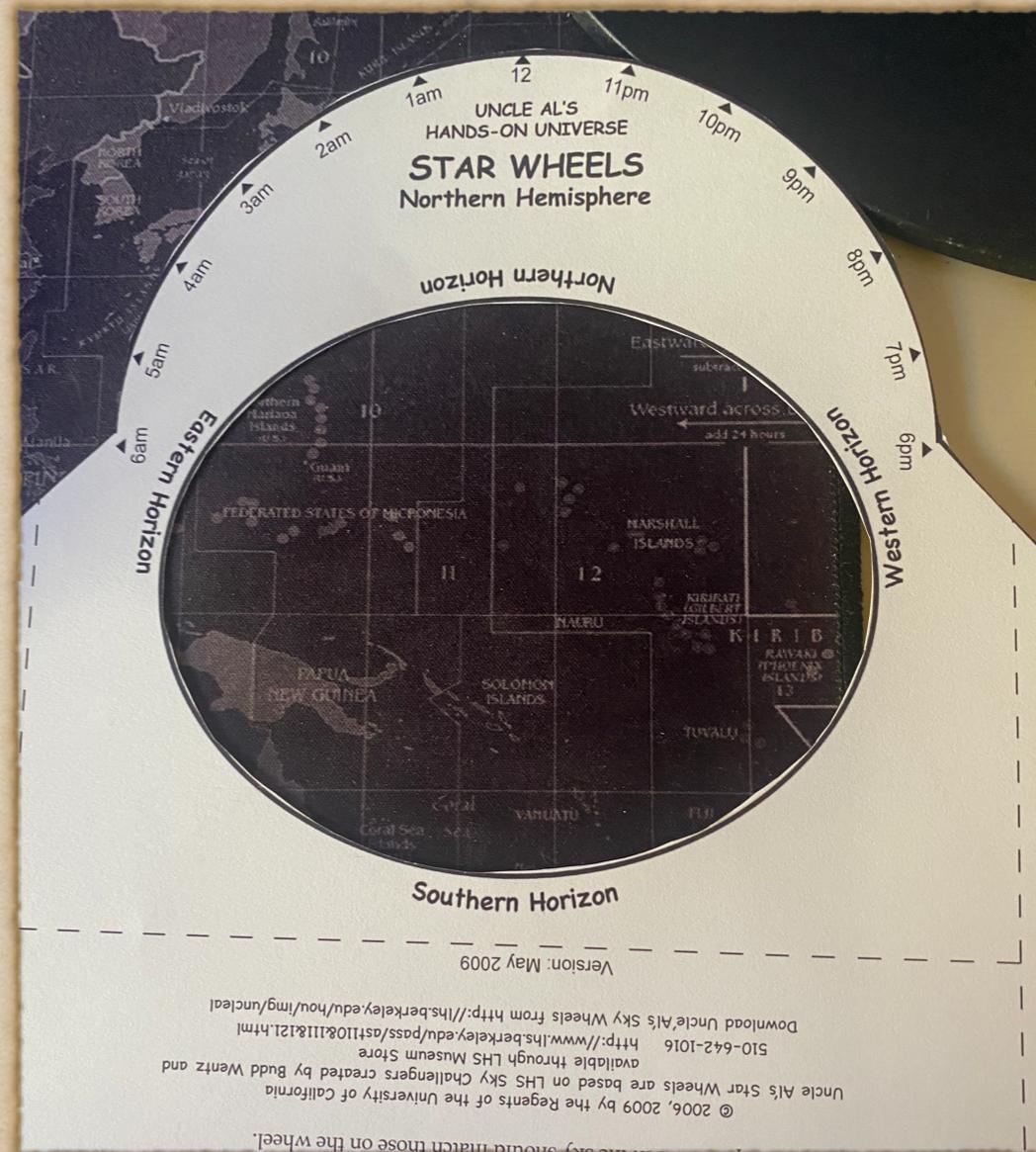
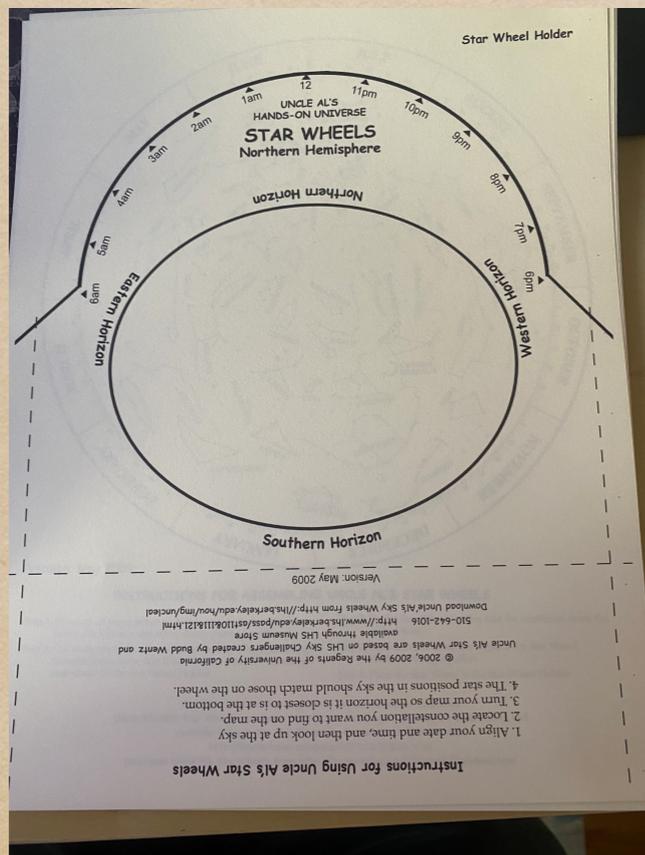
From 3D to 2D

- ◆ Concept of the 3D celestial sphere projected onto a plane
- ◆ Live Demo w/camera



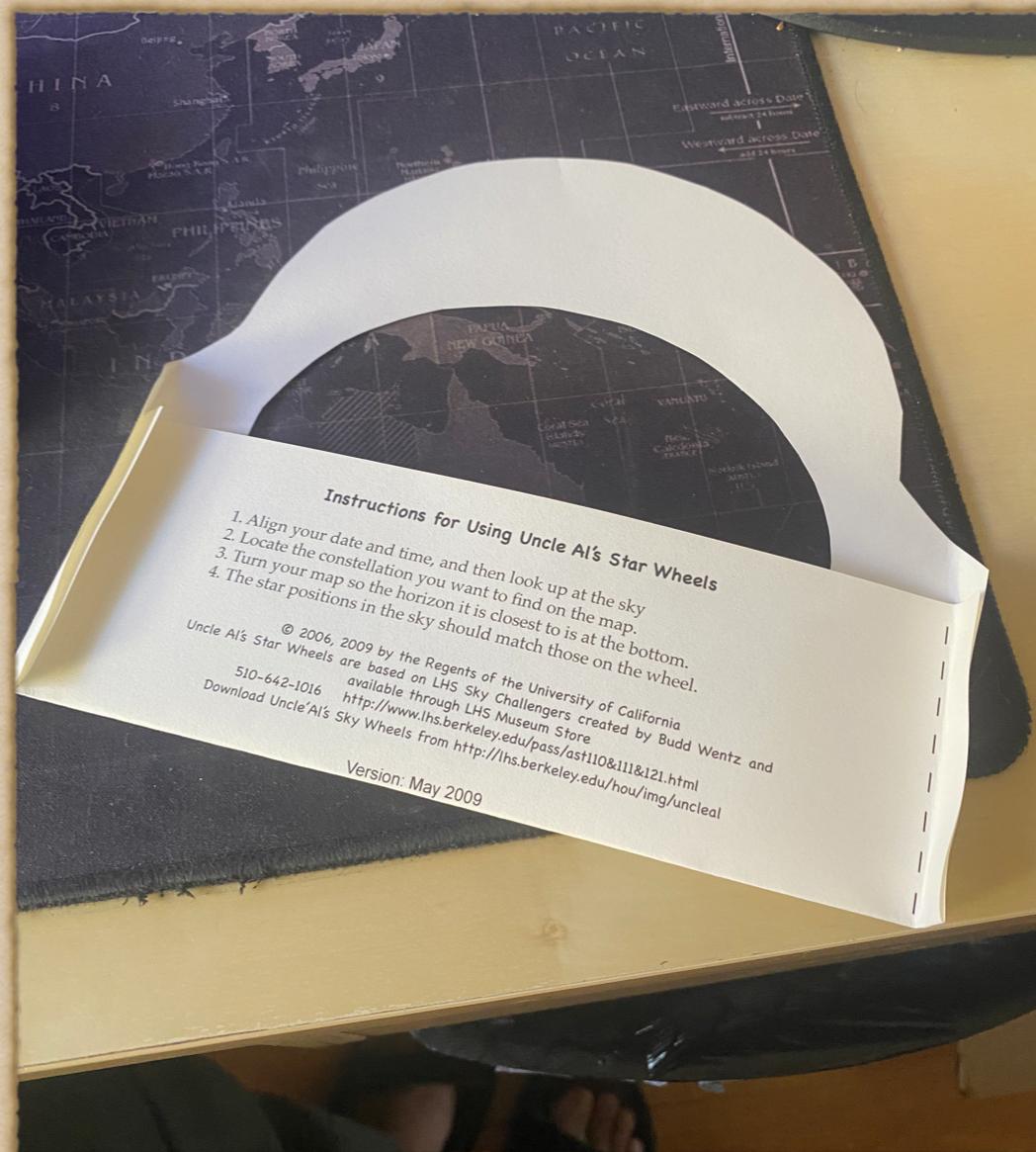
Construction, cont.

- ◆ Cut out the frame
- ◆ Top edge & hole
- ◆ Do NOT cut dotted lines



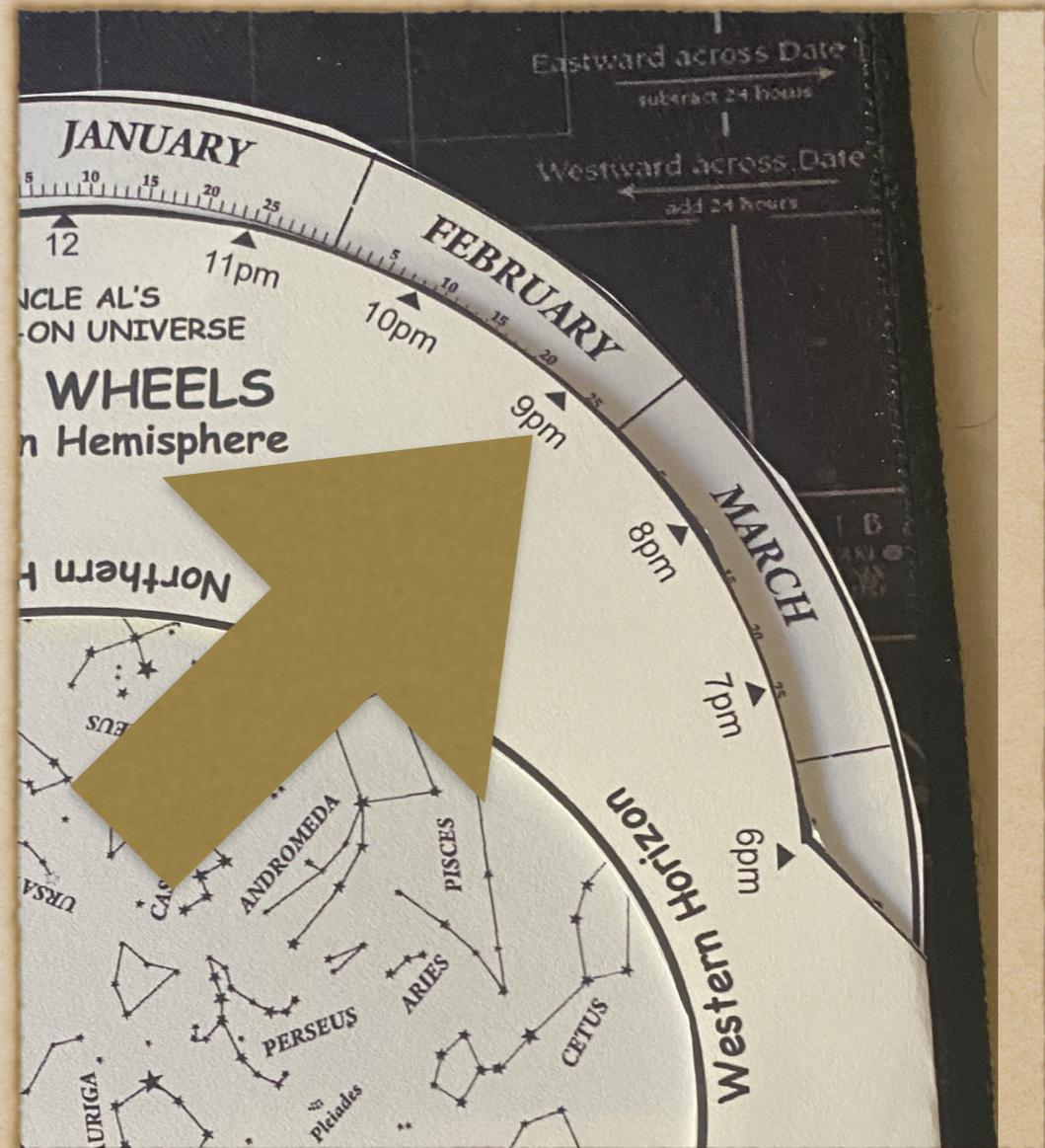
Construction, cont.

- ◆ Fold on the dotted lines to form a pocket on the back side of the frame
- ◆ Fasten with staples or tape (tape's better)



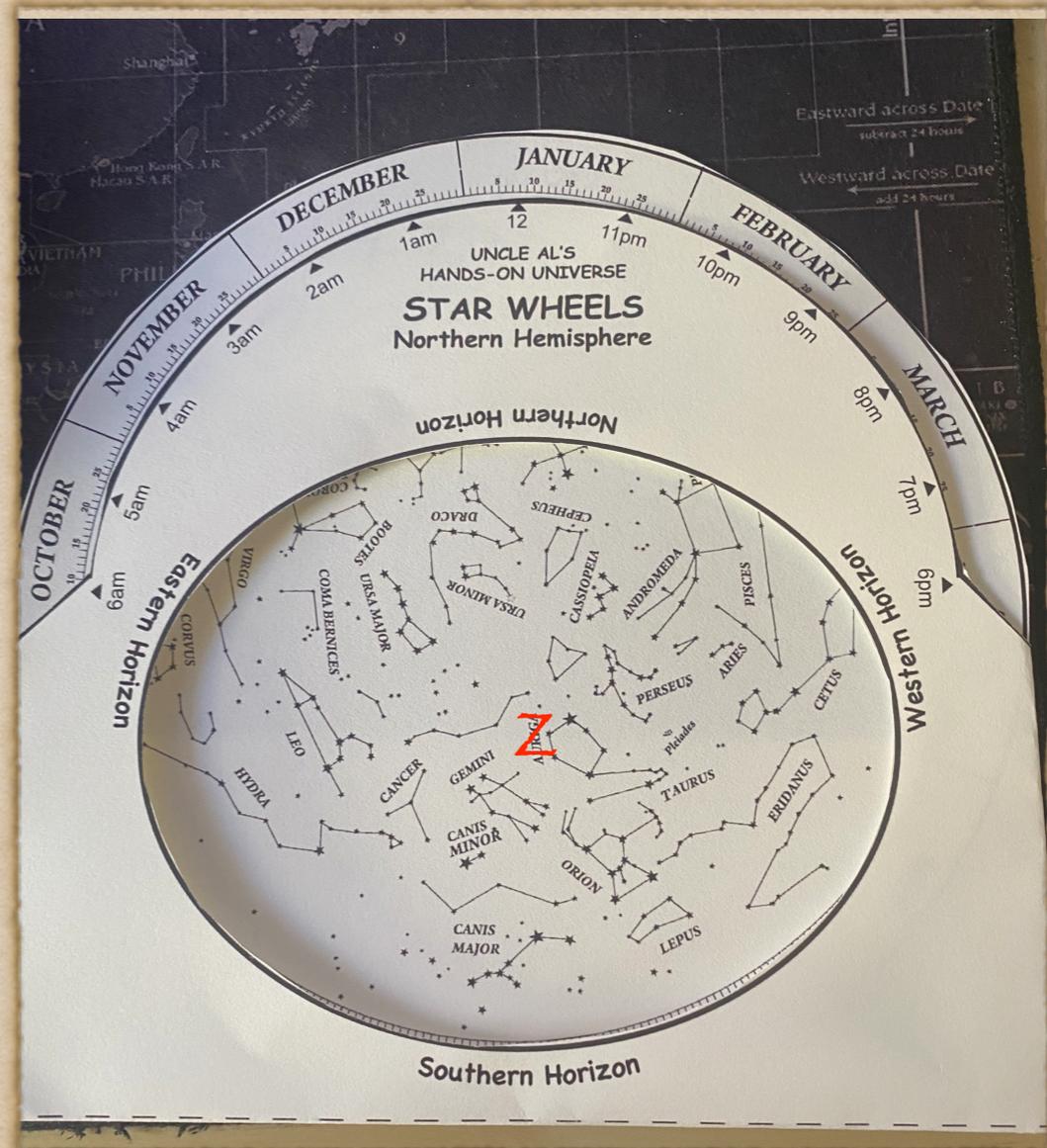
Construction Complete

- ◆ Put the wheel in the pocket
- ◆ Rotate the wheel to make the DATE match the TIME
- ◆ EXAMPLE HERE: 9 PM ON FEB. 23
- ◆ What's in the hole is in the sky



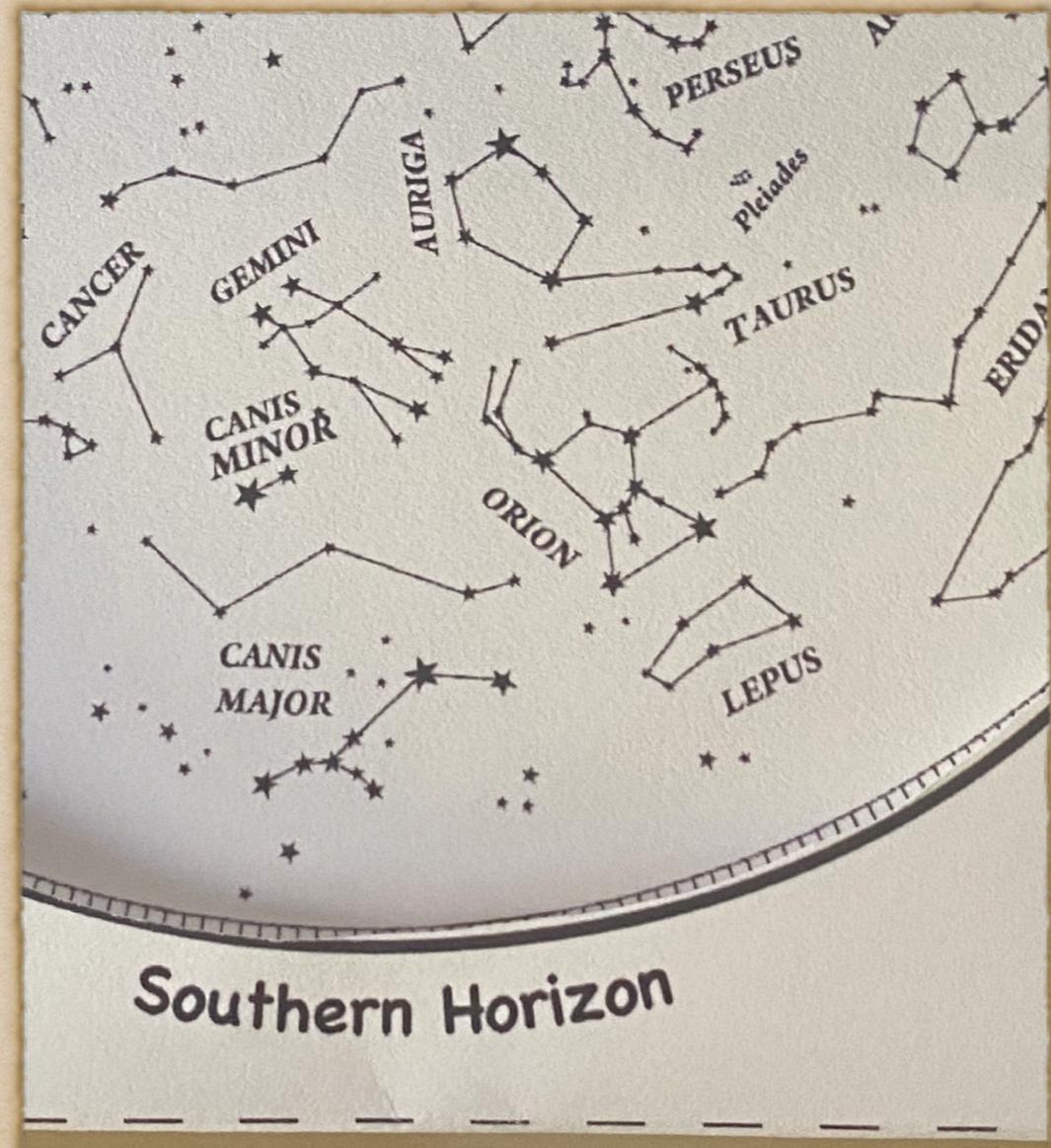
How to use it

- ◆ The edge of the hole is the horizon.
- ◆ The center of the hole (marked Z here) is the zenith
- ◆ Pretend to stretch it over your head like an umbrella
- ◆ Rotate the view so the direction you are facing is on the bottom



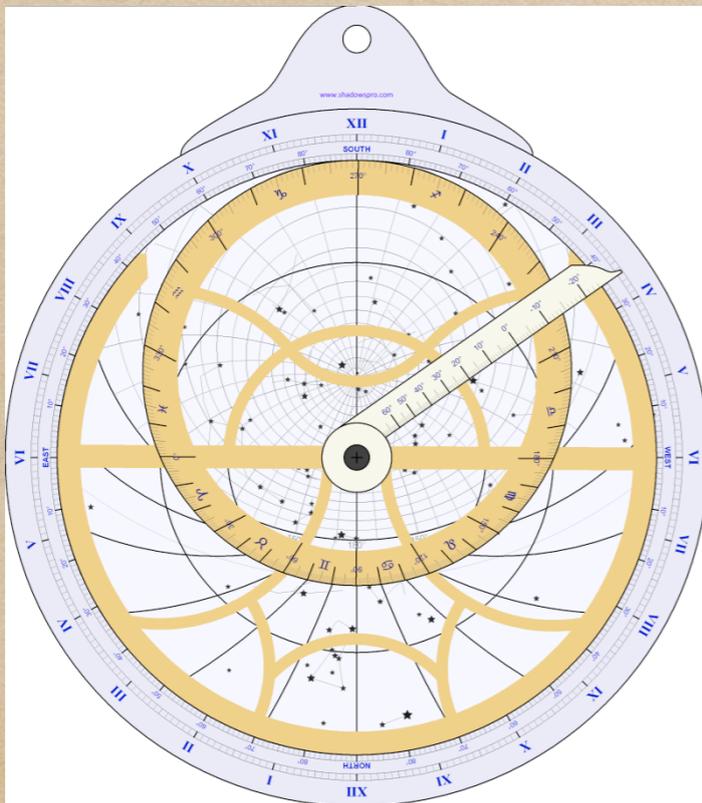
Example

- ◆ Looking south at 9 PM
(8 PM standard time)
- ◆ Orion already high in the southern sky
- ◆ Use as a landmark
(skymark?) to find
nearby constellations



The Astrolabe

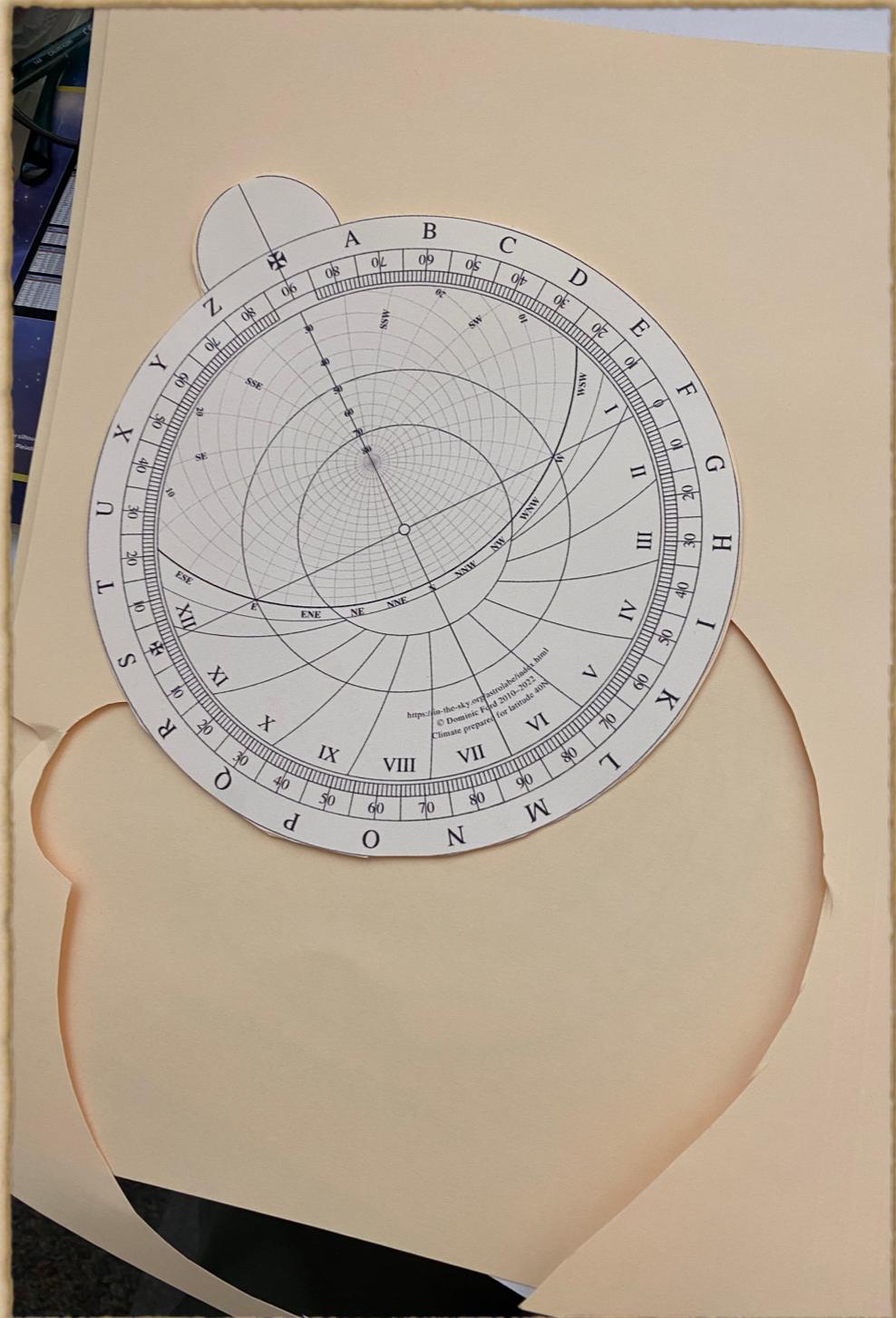
- ◆ An “advanced planisphere” capable of making “precise” predictions of when objects will rise, set, cross the meridian, etc.



<https://in-the-sky.org/astrolabe/>

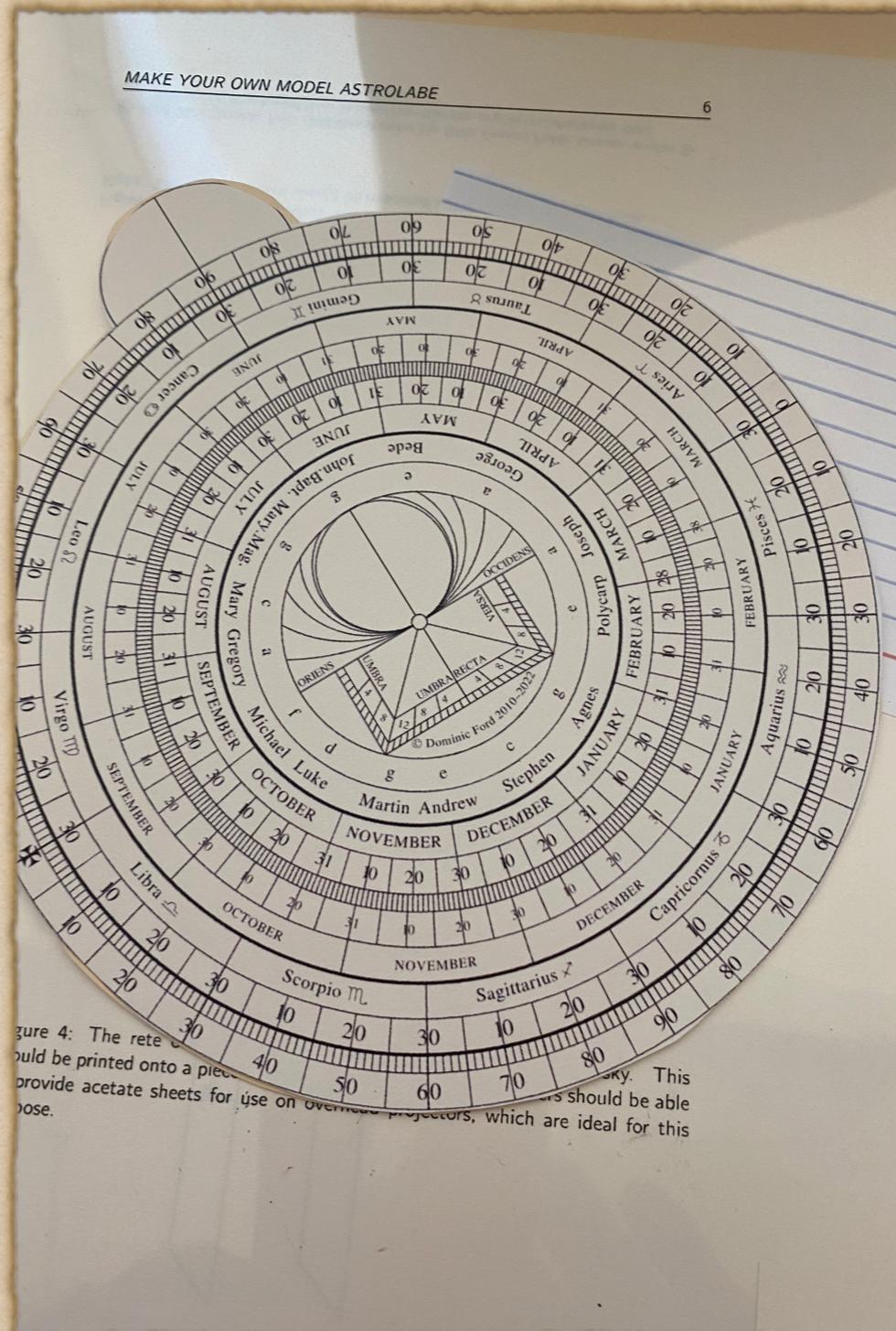
How to build the model

1. Glue the front of the
mother to cardboard or
card stock and cut it out.



How to build the model

2. Glue the back of the
mother to the back of the
card.



How to build the model

3. Print the rete on a
transparency and cut it
out.

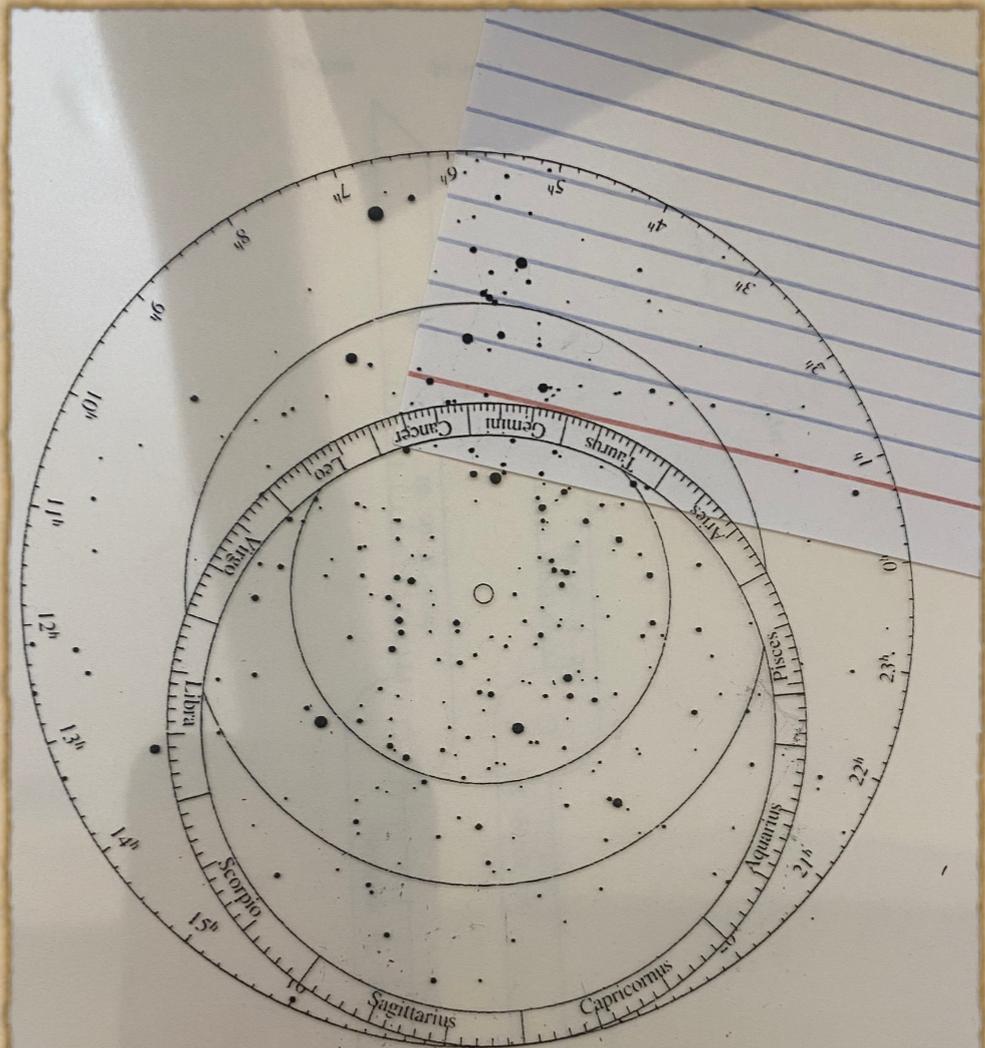


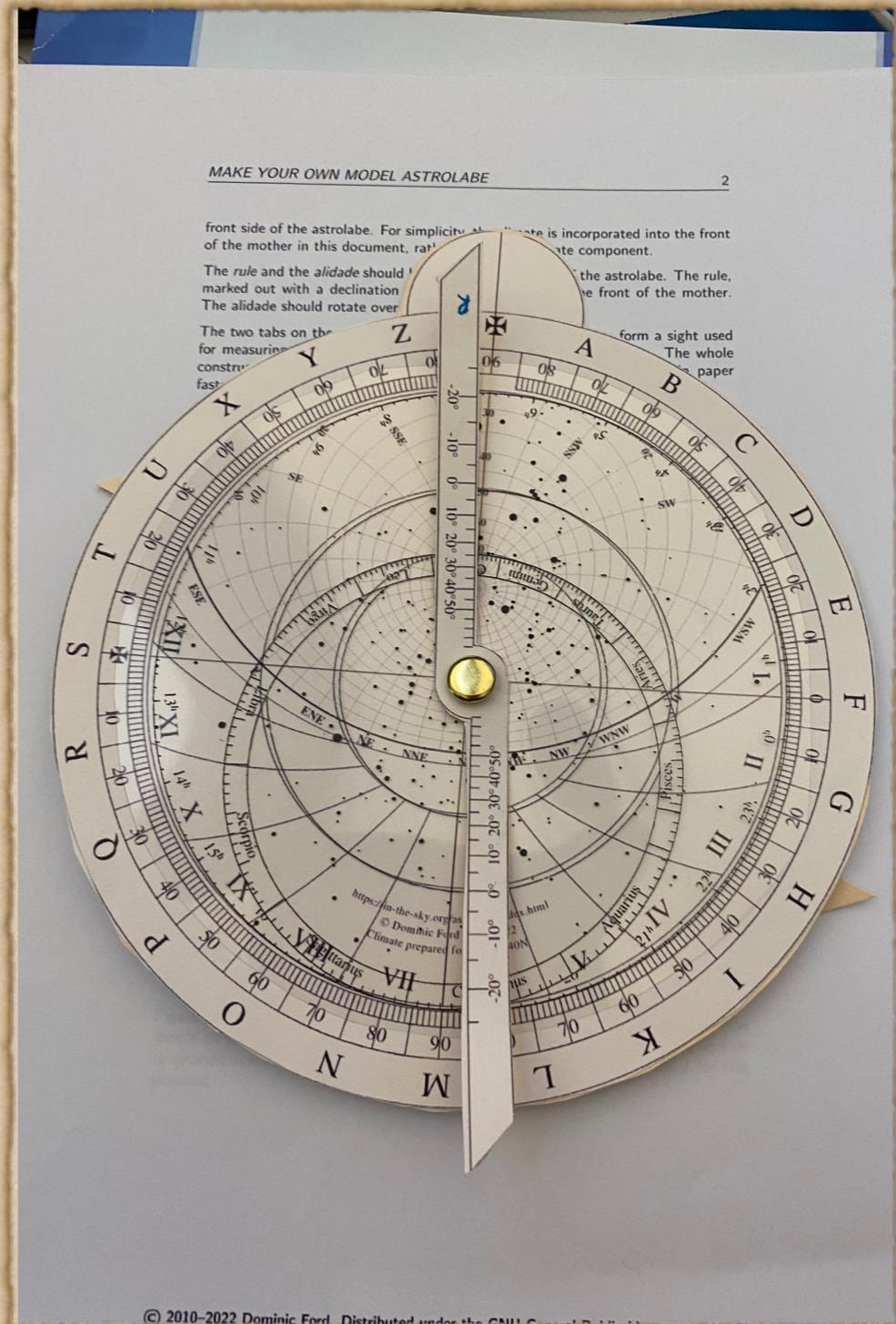
Figure 4: The rete of the astrolabe, showing the stars of the night sky. This should be printed onto a piece of transparent plastic; most stationers should be able to provide acetate sheets for use on overhead projectors, which are ideal for this purpose.

How to build the model

5. Assemble in this order:
rule, rete, mother, adelaide.

Use a brass paper fastener to hold
together.

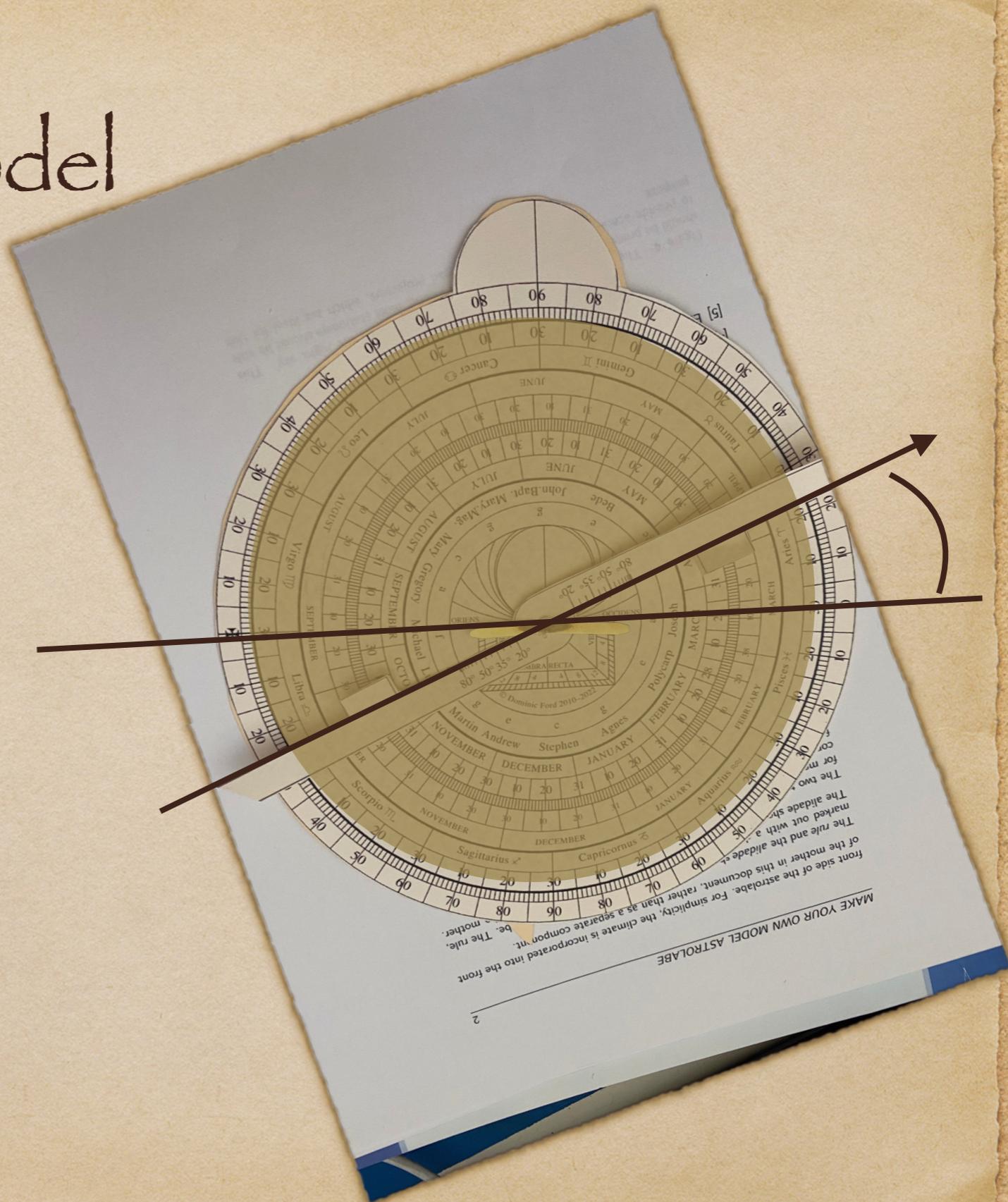
Note: stars are backwards on the rete on purpose;
use printed words to tell which side is up



How to use the model

Altitude of stars

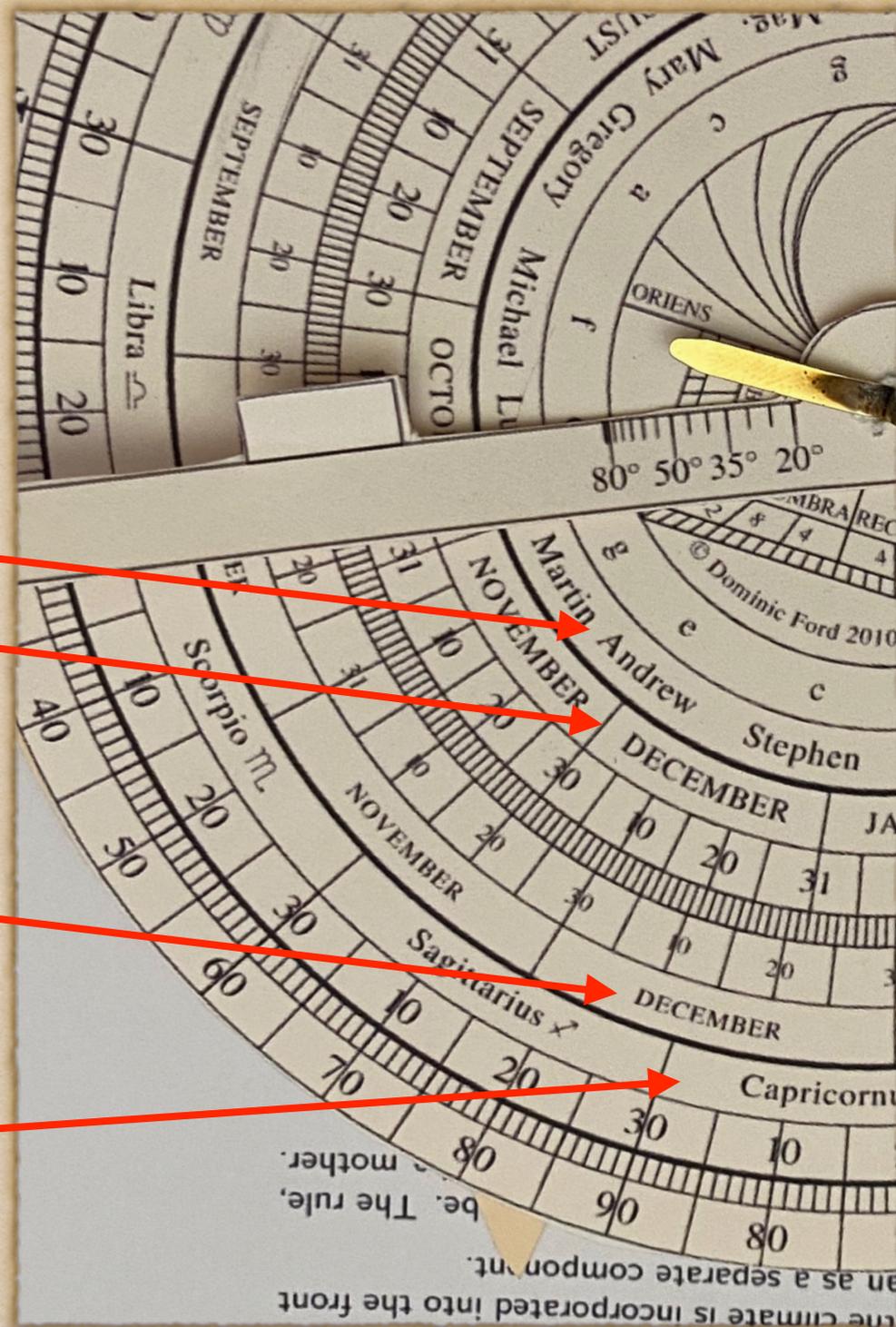
1. Hold the astrolabe by the top tab and let it dangle.
2. fold up tabs on the adelaide (on the back)
3. Rotate adelaide until tabs line up on a star
4. Read altitude on outermost scale.



How to use the model

Calendars

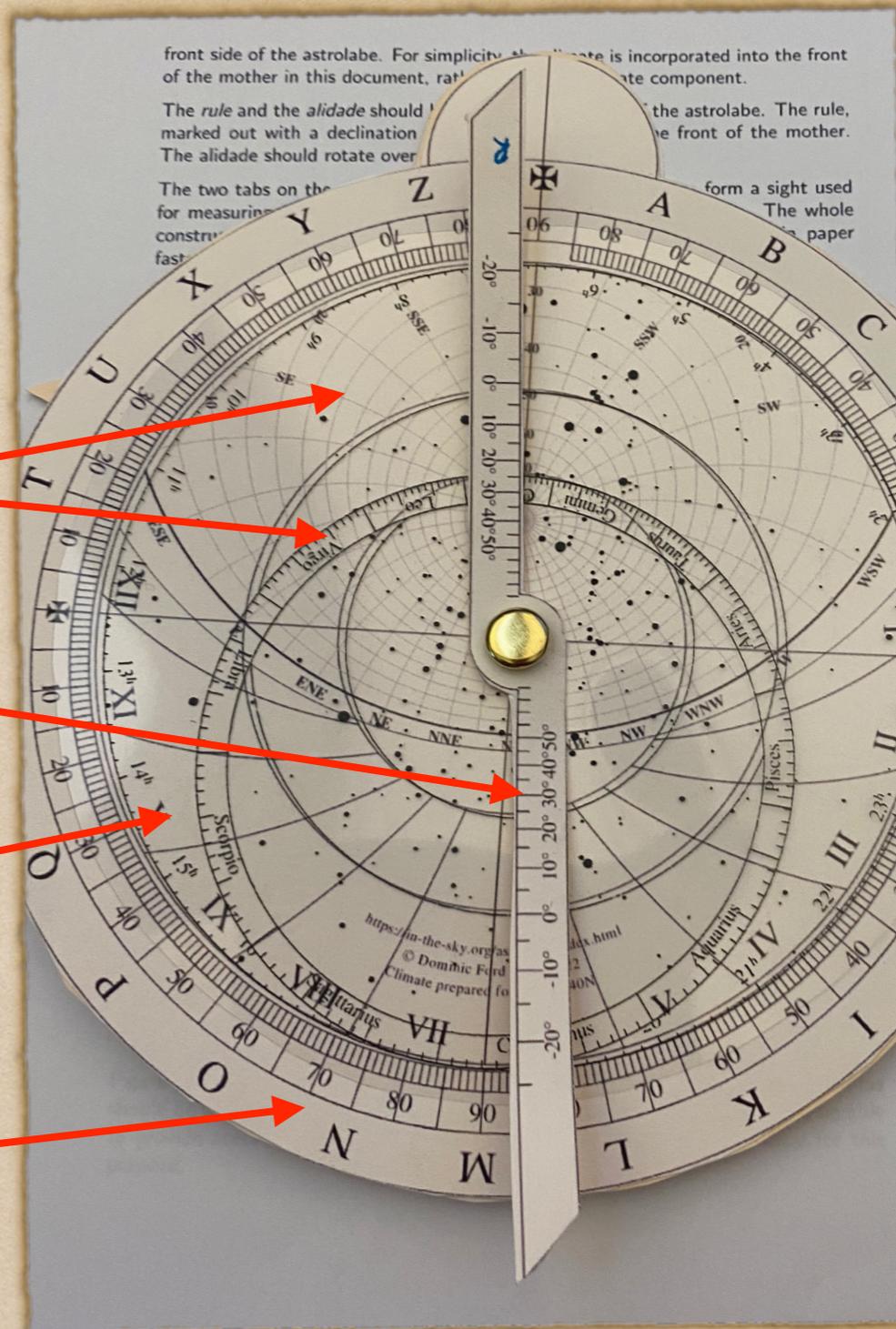
1. Christian Saints
2. Based on 1974 (present day)
3. Based on Geoffery Chaucer's treatise on Astrolabes (1394)
4. Ancient equi-angled zodiac (not aligned with modern constellations)



How to use the model

Various lines

1. The annual path of the sun.
2. Altitude/Azimuth grid
3. The rule (marked for declination from the celestial equator
3. The climate (latitude-specific) - like a planisphere frame
2. 24 hour clock (M = midnight)



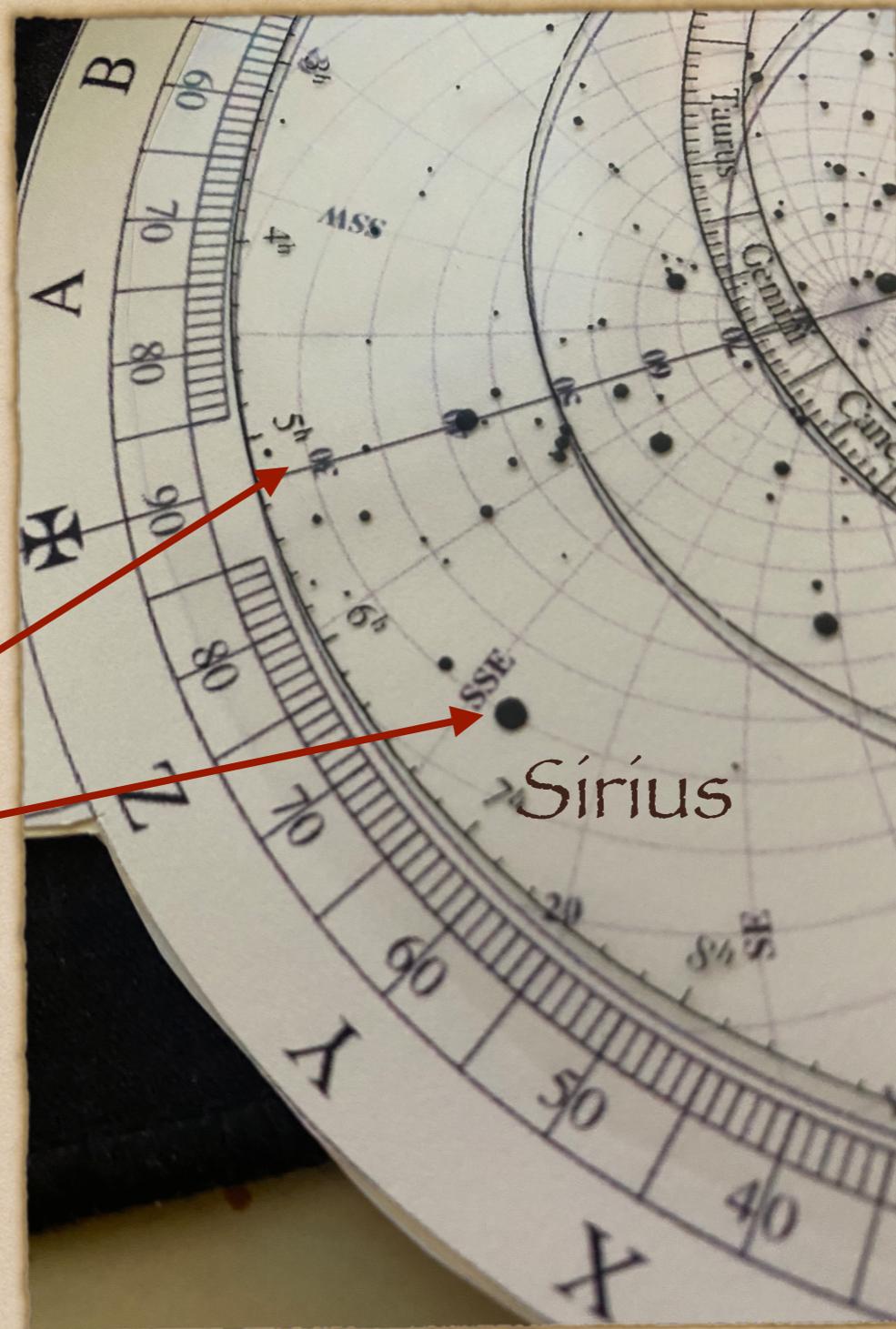
How to use the model

“Planisphere Mode”

1. “Alignment is usually achieved by measuring the altitude of a reference object – either the Sun or a star – using the alidade and then rotating the rete until its projection lies on the appropriate almucantar” (altitude line on the alt-az grid)

Here you can see Sirius (to the RIGHT of Orion) is on the alumcantar for 30 degrees altitude.

2. Unlike a planisphere you don't need to know what time it is; The placement of the star on the grid replaces the clock time.



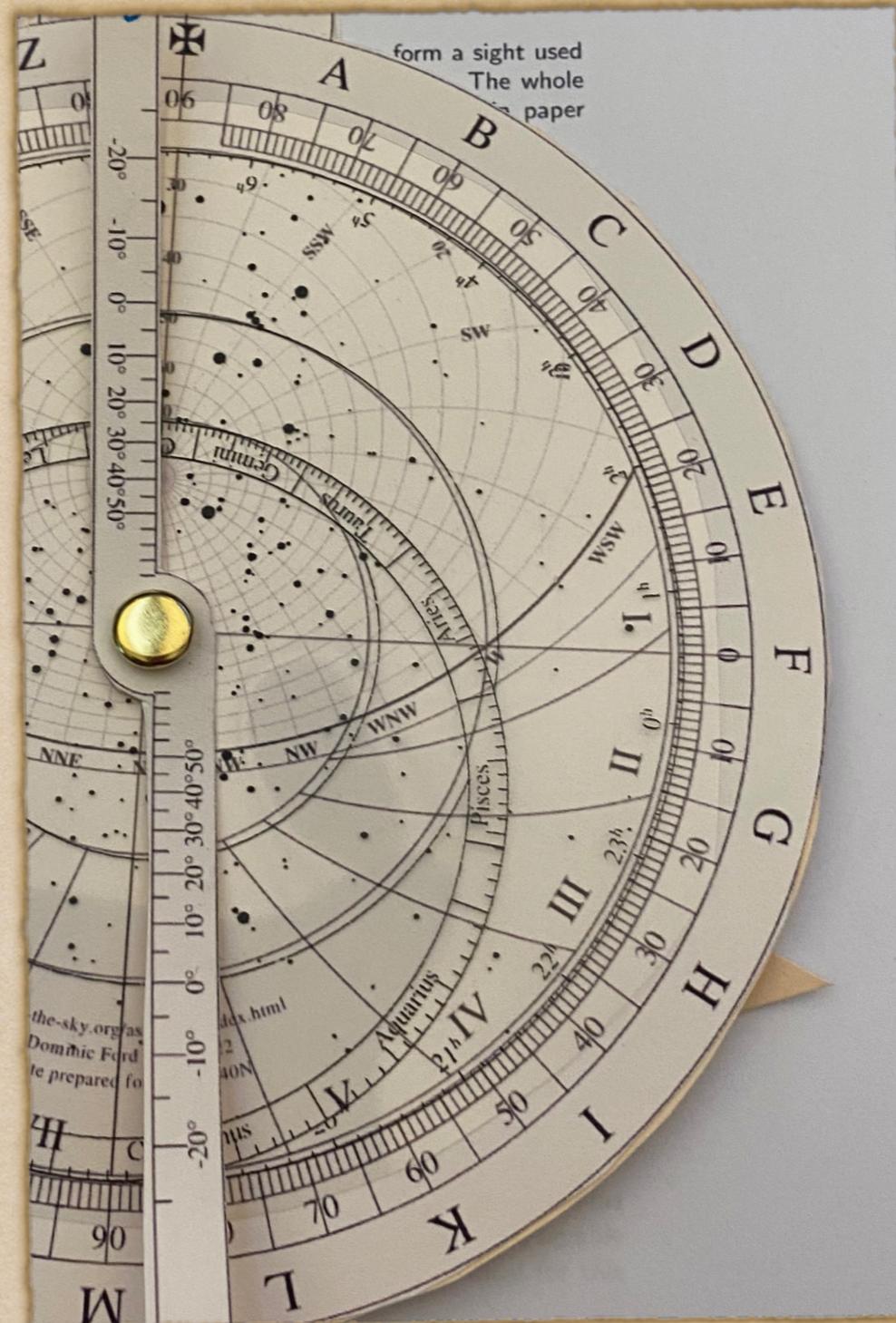
How to use the model

“Unequal hours”

1. Medieval timekeeping sometimes divided the day into six daylight hours and six nighttime hours regardless of the season. The roman numerals on the astrolabe use this system, which is useful for determining the position of the sun if the cardinal directions are known.

“Equal hours”

2. The letters around the edge use modern equal hours. Using the two scales you can convert between the two systems.



How to use the model

“The shadow scale”

1. The shadow scale allows you to effectively calculate the tangent of an angle, useful for estimating heights of buildings and structures based on the angles of their shadows.

In the example the building's height is $4/12$ of the distance to the building.

