Preparation for an astronomical observation

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Objectives

- How to choose a suitable time and place.
- What equipment should I bring?
- What kind of astronomical objects can I observe?
- How to plan the departure?
- Learning how to use the program Stellarium (an introduction).

Place

- Objects of interest when observing from cities: Sun, Moon, planets and constellations.

- Problems: Dark skies reduced by light pollution: streetlights, security lights, advertising signs and motor vehicles.

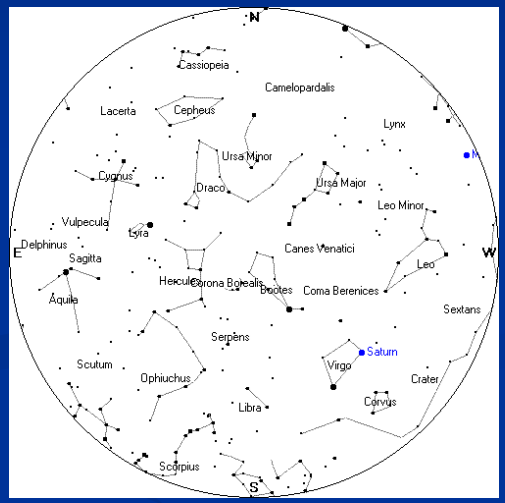
Date

- Try to choose a time of good weather with no clouds.
  See for example: www.accuweather.com.
- Moon Phase: Crescent?. Check the phase when planning the date of the observation.
- Arrive early enough to mount all the instruments during the daylight.

Available Material

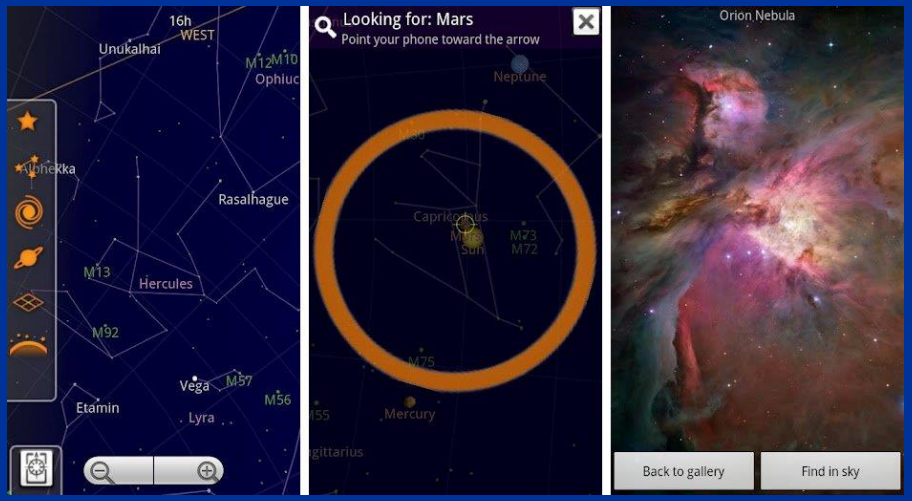
- Celestial Map (on paper, phone or computer)
- Red light flashlight
- Food, drink and warm clothes
- Binoculars, telescope, if available
- Alternatives if there are clouds:

Stories, books, DVDs and web resources.

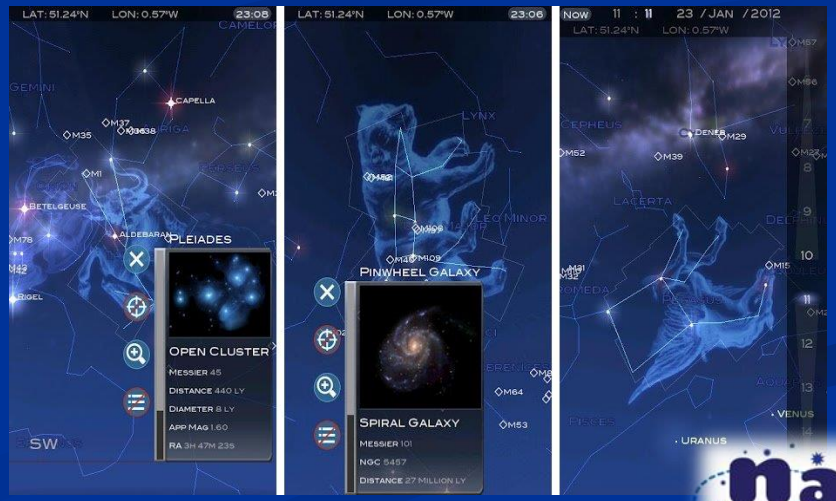


Observations with the naked eye

- Applications for iPhone, iPad and Android
- Recognition of constellations
- Best with Moon between new and crescent



SkyMap



Star Map

Observations with the naked eye

Northern Hemisphere Constellations

Ursa Major, Ursa Minor, Cassiopeia, Cygnus, Lyra, Hercules, Bootes, Corona Borealis, Orion, Canis Major, Auriga, Pegasus and the zodiac

Stars, Clusters, Galaxies

Polaris, Sirius, Aldebaran, Betelgeuse, Rigel, Arcturus, Antares, Pleiades and Andromeda

Southern Hemisphere Constellations

Southern Cross, Carina, Puppis, Vela, Orion, Canis Major and the zodiac

Stars, Clusters, Galaxies

Alpha Centauri, Omega Centauri, 47 Tucanae and the Magellanic Clouds (there is no "southern pole star")

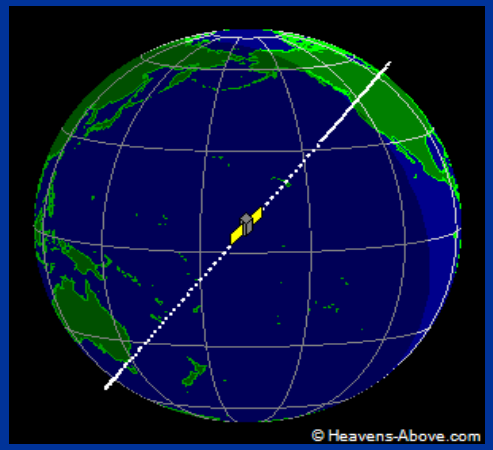
Observations with the naked eye

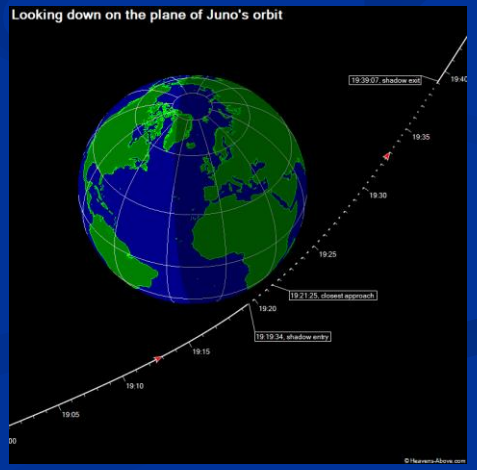
- Change of the Moon's phases and its motion through the constellations for one month.
- Movement of the planets: Venus, Mars, Jupiter and Saturn for one month and one year.
- Meteor showers: Perseids, Quadrantids, Leonids, among others depending on the date and the hemisphere.

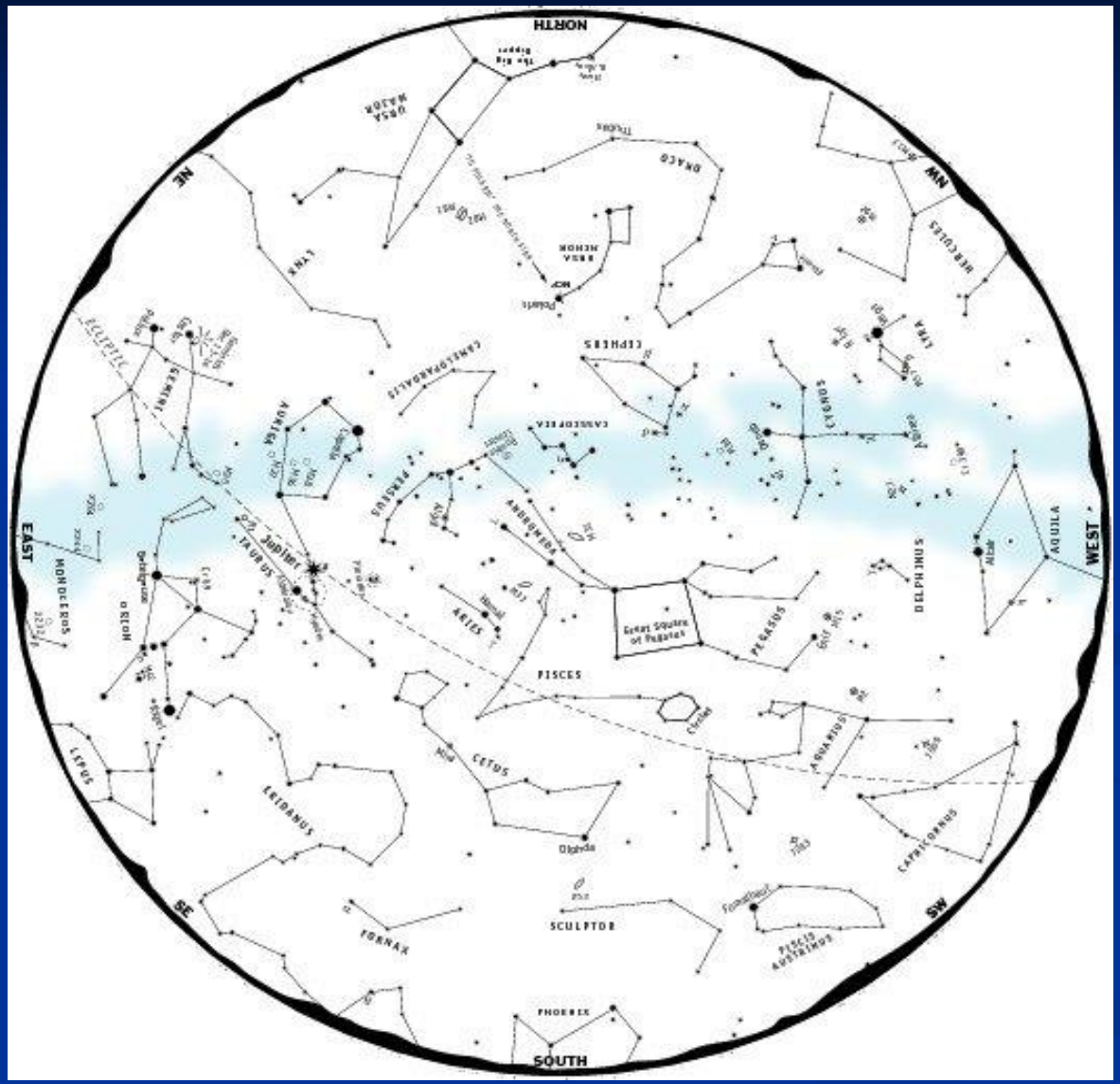
Observations with the naked eye

- It is helpful to have sky charts or maps.
- Observe artificial satellites. Best 1-2 hours after sunset: ISS, Iridium, etc.

  See www.heavens-above.com



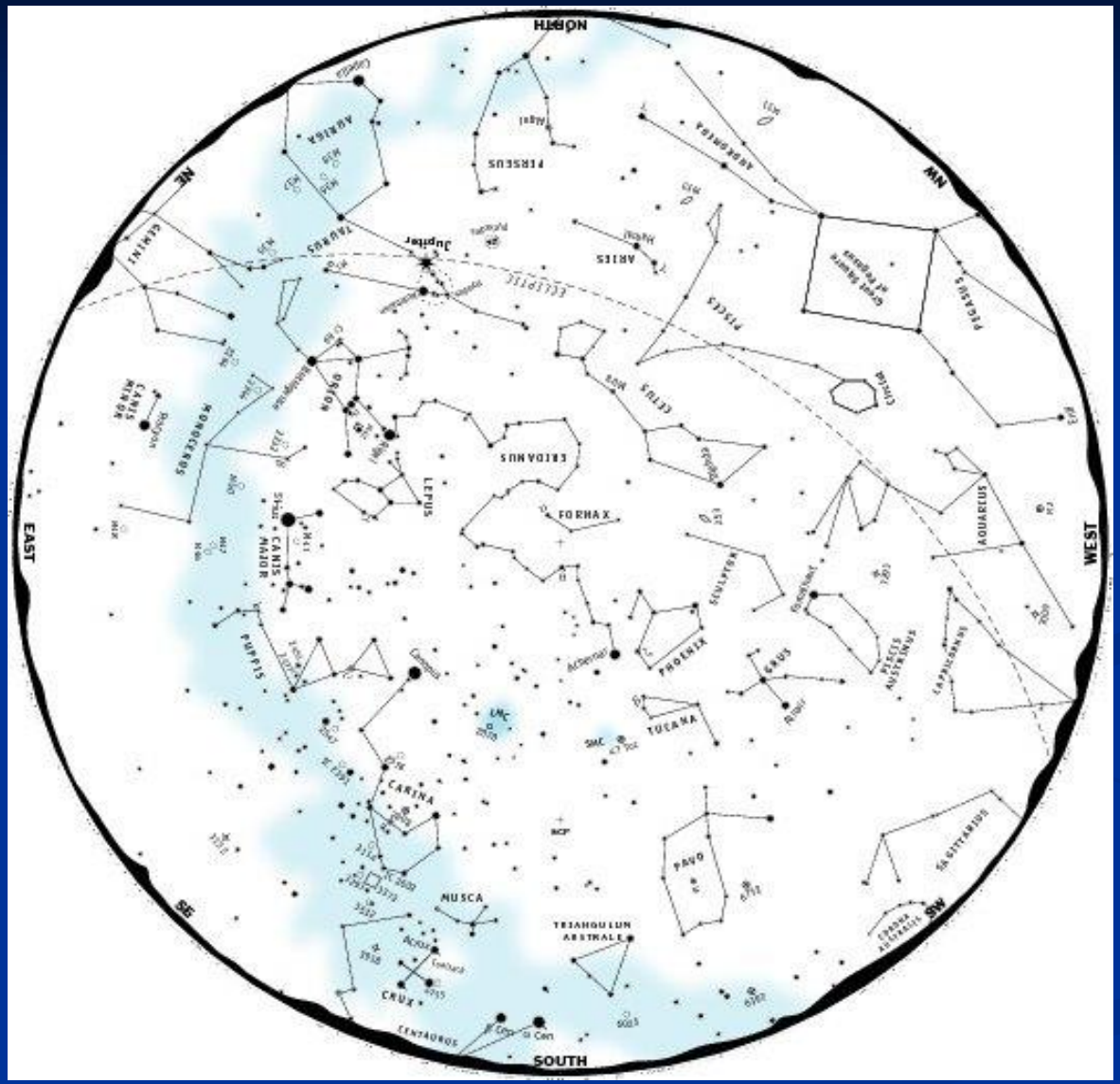




Example of Sky Map for the Northern Hemisphere

The map must be prepared for the observer's location and the date and time of the activity.

www.skymaps.com



Example of Sky Map for the Southern Hemisphere

The map must be prepared for the observer's location and the date and time of the activity.

www.skymaps.com

Observations with binoculars

- Low magnification, but collects more light
- Recommended: 7x50 (7 times magnification and 50mm aperture, i.e. the diameter of the objective lens)

Observations with binoculars

Northern Hemisphere

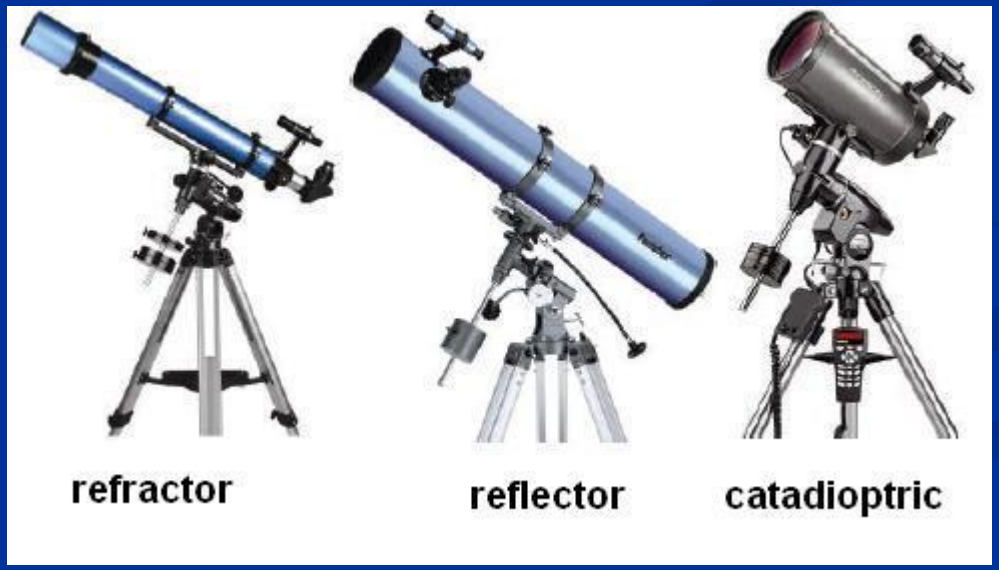
Andromeda Galaxy - M31 (Andromeda),
Orion Nebula - M42 (Orion),
Globular Cluster - M13 (Hercules),
Pleiades Open Cluster - M45 (Taurus),
Praesepe - M44 (Cancer),
Crab Nebula - M1 (Taurus),
Whirlpool Galaxy - M51 (Canes Venatici).

Southern Hemisphere

Large Magellanic Cloud (Dorado),
Small Magellanic Cloud (Tucana),
Eta Carinae - NGC 3372 (Carina),
Centaurus A - NGC 5128 (Centaurus),
47 Tucanae Globular Cluster (Tucana),
Jewell Box Open Cluster - NGC 4755 (Crux).

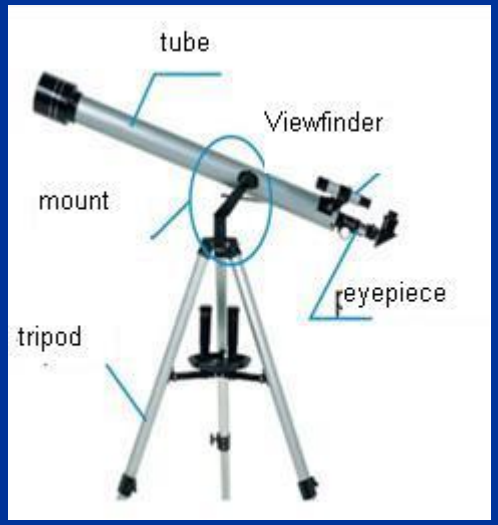
Observations with a telescope

- Mission: To collect more light
- Optics: Objective and eyepiece
- Types: Refractor and reflector; Newtonian, Cassegrain and catadioptric



Observations with a telescope

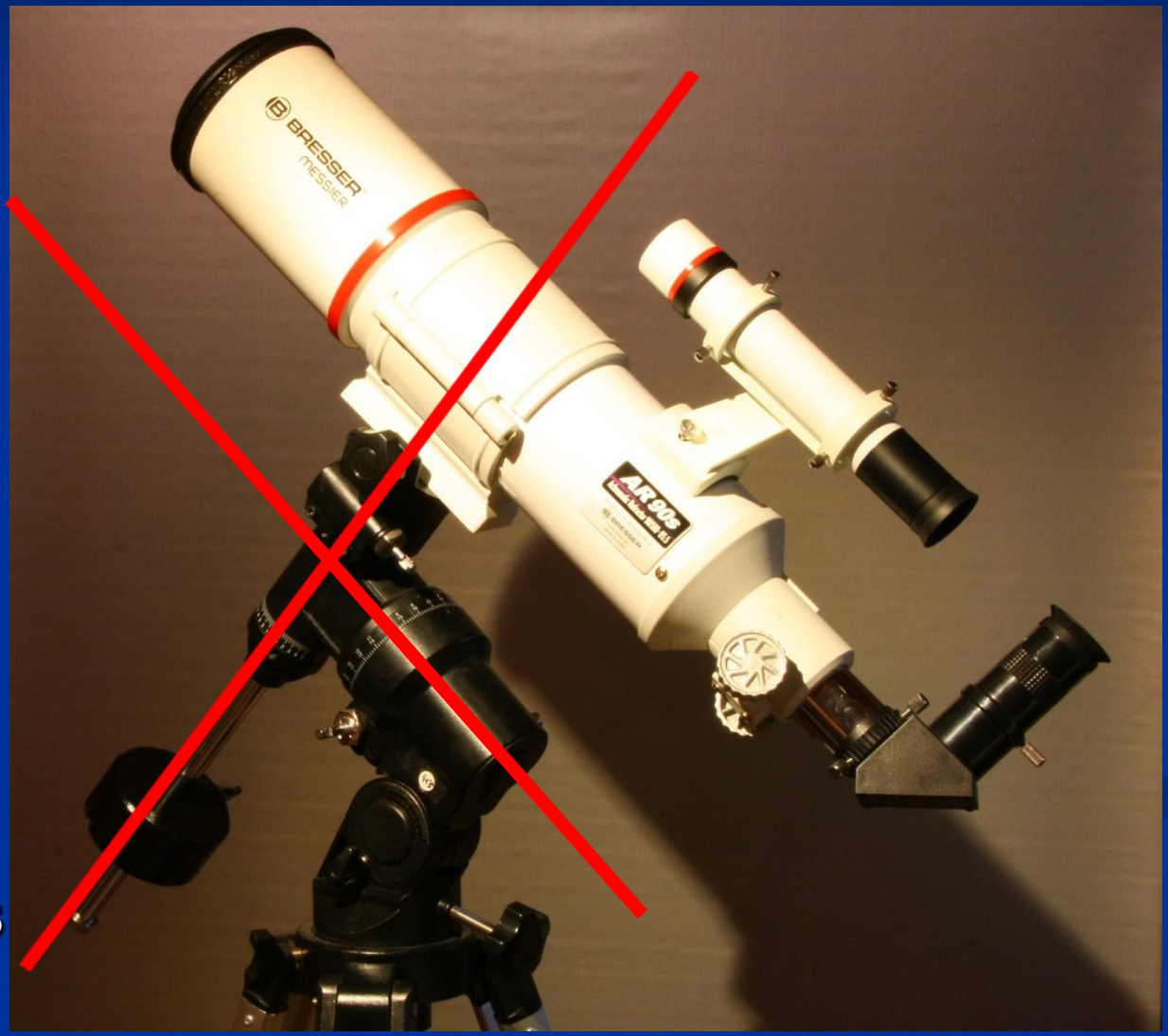
- Image: Could be inverted
- Telescope mount: azimuthal, equatorial or Dobsonian.
- Sky charts are required for proper and easier identification of the field to be observed



Commissioning of a telescope

Axes of an equatorial mount

Polar axis



Declination axis

Commissioning of a telescope

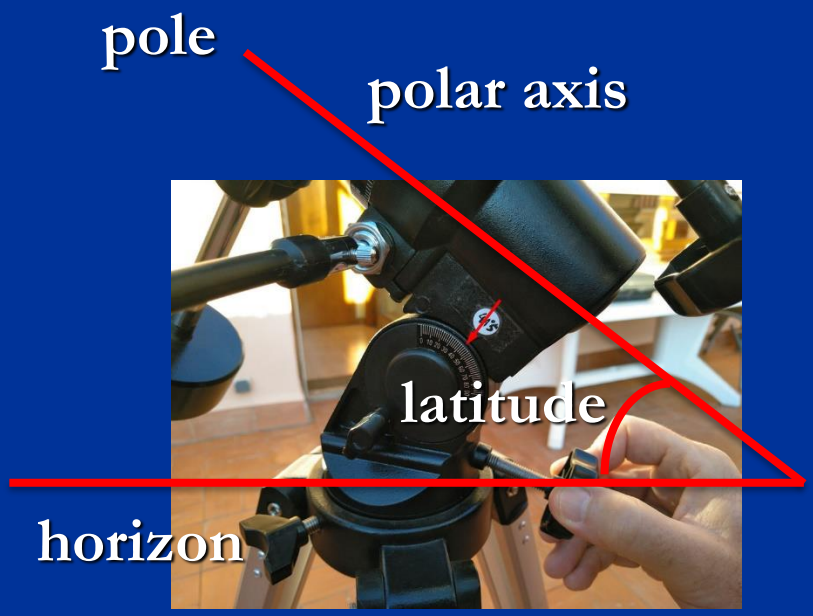
- Leveling of the mount

- Balance the tube

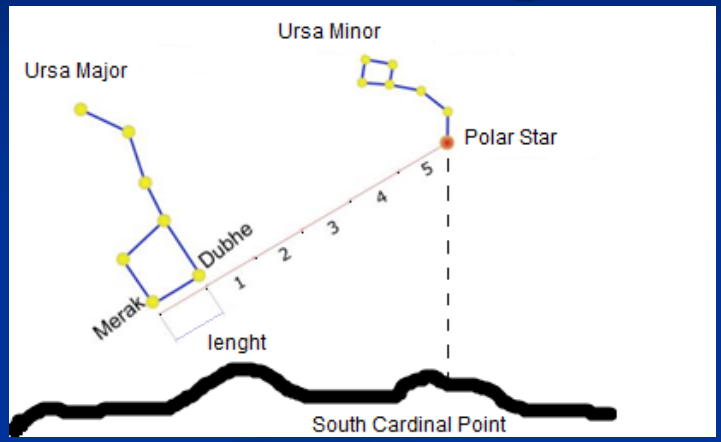
- Balance polar axis

Commissioning of a telescope

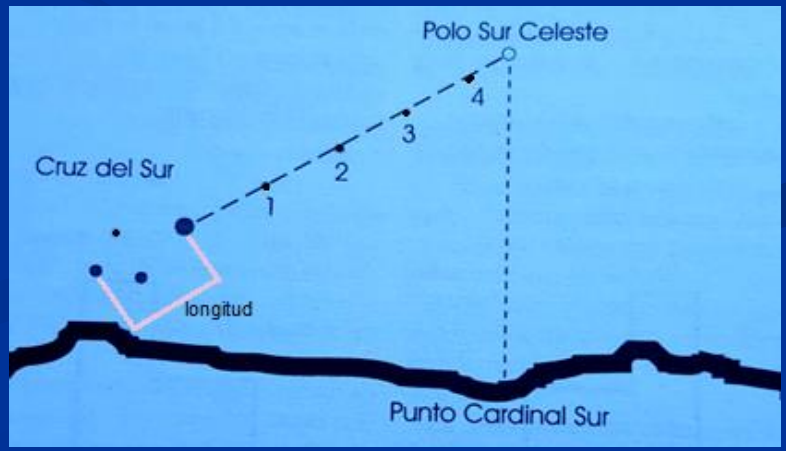
- Set latitude and direct the polar axis to the pole



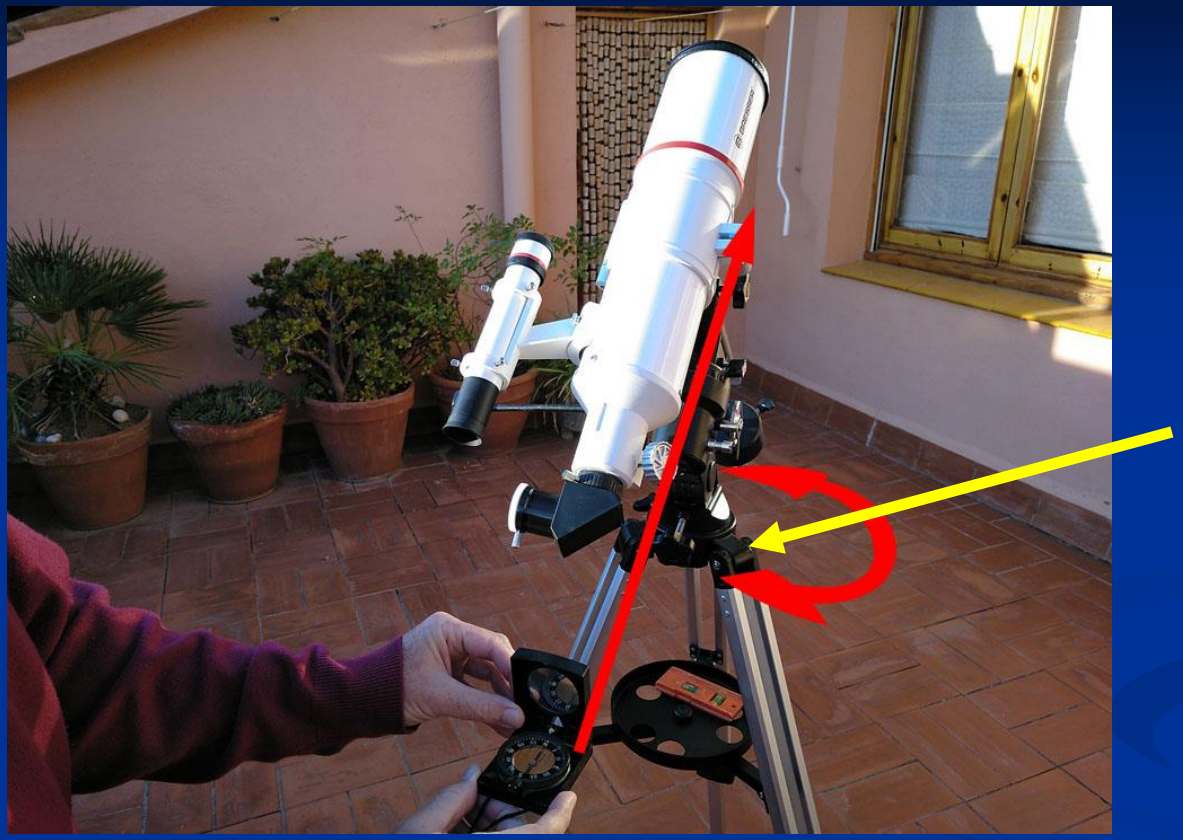
NH at the North Pole is the polar star



SH at the South Pole there is no star and the place with the South Cross is located



Commissioning of a telescope



Aligning the polar axis to the N or the S

Orient the base of the mount to the N or the S:

"Turn right or left

the base of the mount or tripod ”

Commissioning of a telescope

Aligning the polar axis to the N or the S

"test the aligning turning the tube around the polar axis 360° without loosing the polar star or the South Pole"

Commissioning of a telescope

Finder alignment on
a terrestrial object

Naked eye
vision

Vision through
the finder

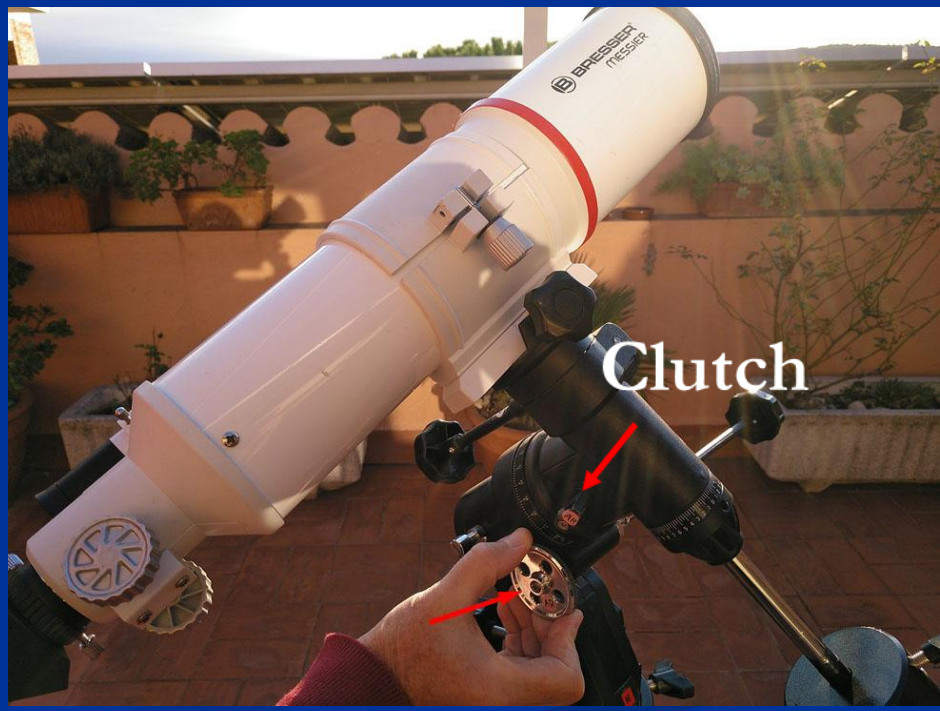
Vision through
the telescope

Commissioning of a telescope

Telescope oriented east of the meridian

Tracking using the flexible control of the polar axis

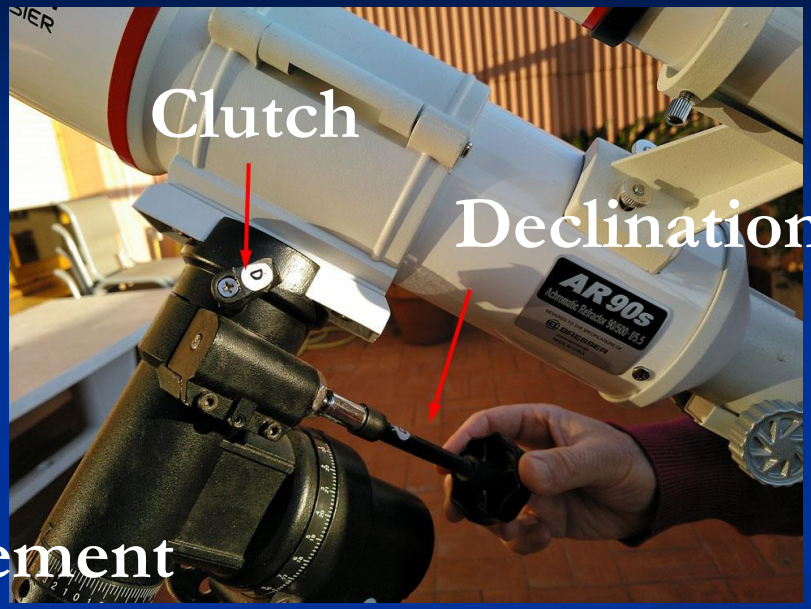
Telescope oriented west of the meridian



Tracking using the wheel

Commissioning of a telescope

Declination axis



Eyepiece placement

Focus

Commissioning of a telescope

To locate and track different objects you only have to operate the polar axis (Right Ascension) and the declination axis (Declination)

Don't misalign the telescope during the observation!

The sky's movements

The movement of the sky that we observe corresponds to relative motion of rotation and translation (orbit) of the Earth.

Diurnal movement: Fast, the Earth rotates around 360º in 24 hours; this is 15º every hour.

Translational motion (orbit): Slow, 360º every 365 days, about one degree each day.

The sky's movements

- Imagine that the Earth did not rotate.
- We would see the same night sky from one night to the next.
- The same star would be in almost the same position each night.
- It would have moved by only about one degree (i.e. the thickness of an index finger at the extended arm) compared to the previous day.

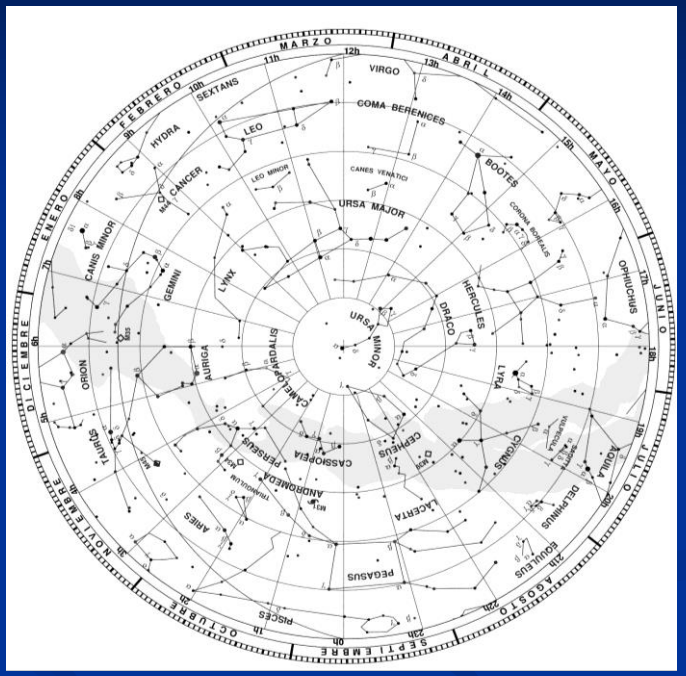
The sky's movements

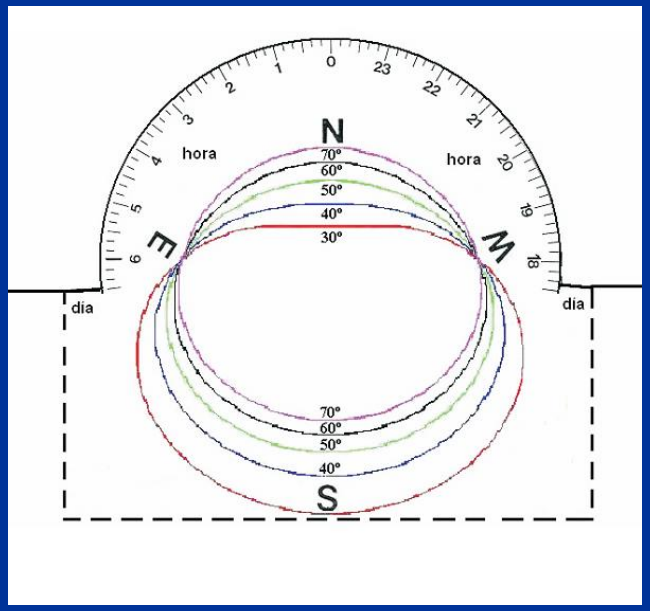
The translation movement of the Earth is almost negligible. If we do not have a reference it is not visible to the naked eye, but what we do notice is that the sky from one night of the year is completely different after three or six months.

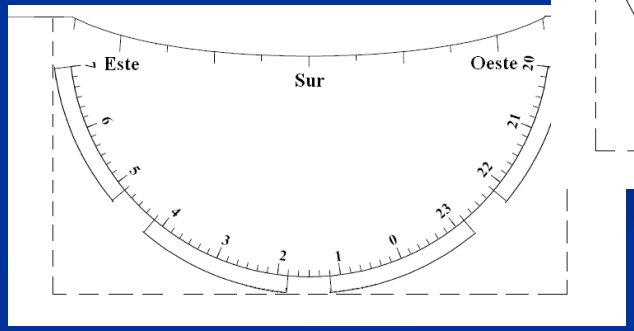
After three months the translation corresponds to 90º, or about ¼ of the sky. In half a year it is ½ of the sky, that is the other side of heavens, diametrically opposed to our starting point.

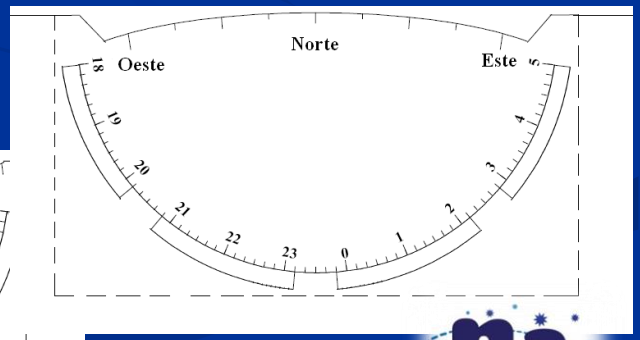
Activity 1: Construction of the Planisphere

- Constellation disk
- Inside the Latitudes bag

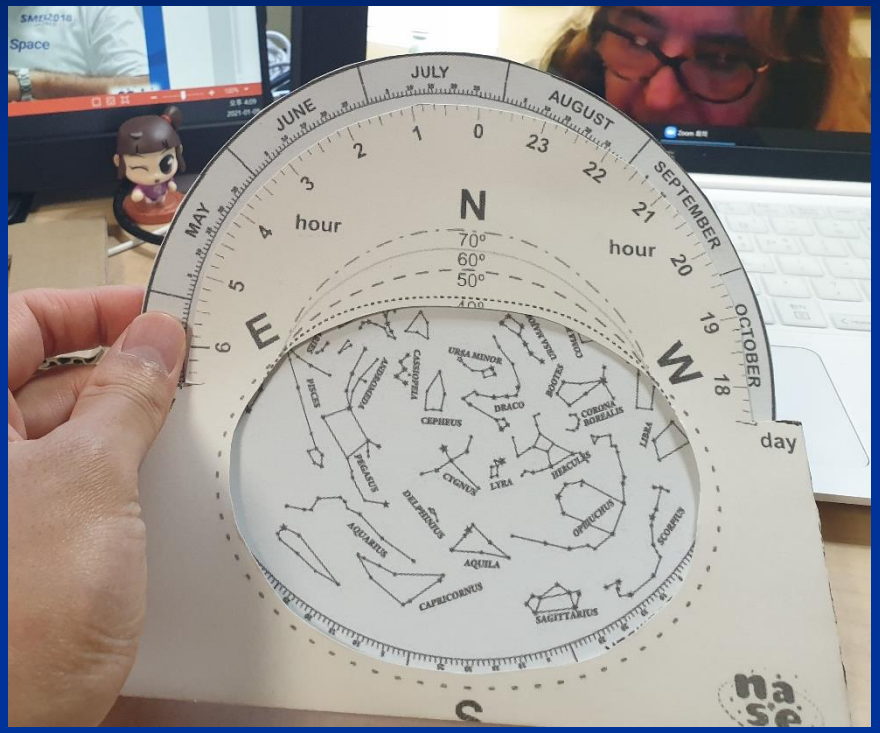




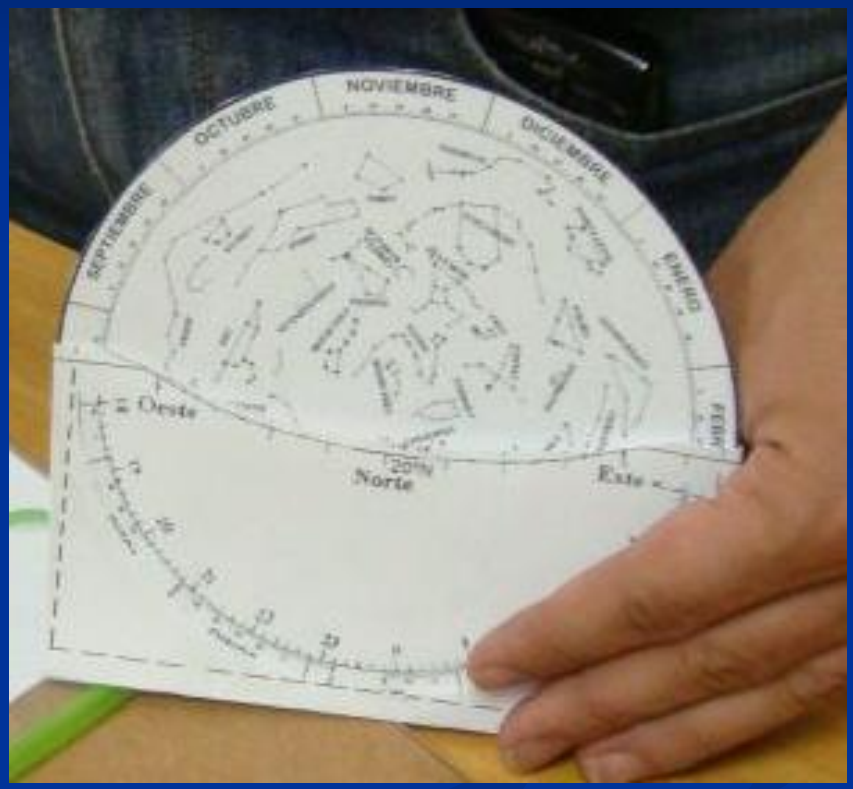




Actividad 1: Construcción del Planisferio



- Latitude 30º-70º N or S



- Latitude 0º-20º N or S

Activity 2: Celestial Dome Umbrella

Objectives

- **Understanding the translation movement of the Earth and compare it to the rotation movement.**
- **Display the translation movement "without rotation movement".**
- **Consider some constellations in the opposite hemisphere - North/South umbrella.**

Activity 2: Celestial Dome Umbrella

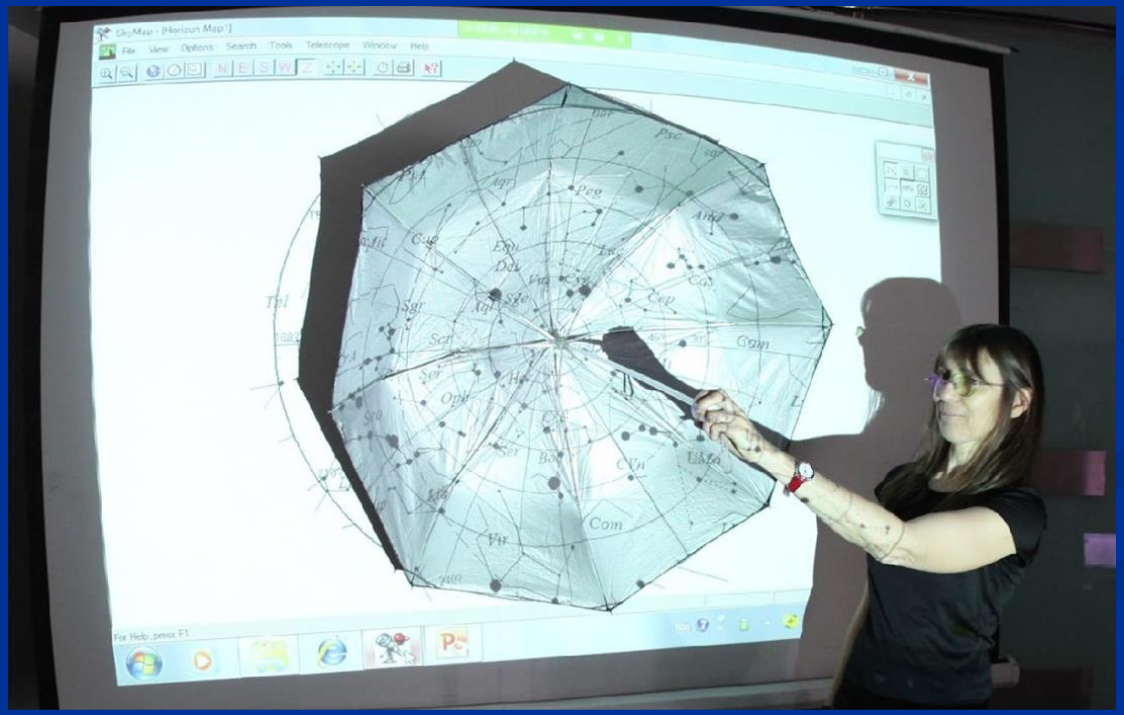
Draw the umbrella of one Hemisphere

- North Pole Environment:
  Ursa Major and Cassiopeia
- Outermost area:
  - Leo (Spring)
  - Cygnus (Summer)
  - Pegasus (Autumn)
  - Orion (Winter).

- South Pole Environment:
  South Cross
- Outermost area:
  - Aquarius (Spring)
  - Orion (Summer)
  - Leo (Autumn)
  - Scorpios (Winter).

Activity 2: Celestial Dome Umbrella

Locate the constellations by projecting the hemisphere using Stellarium, with the celestial equator (Orion) near the edge, but within the umbrella.

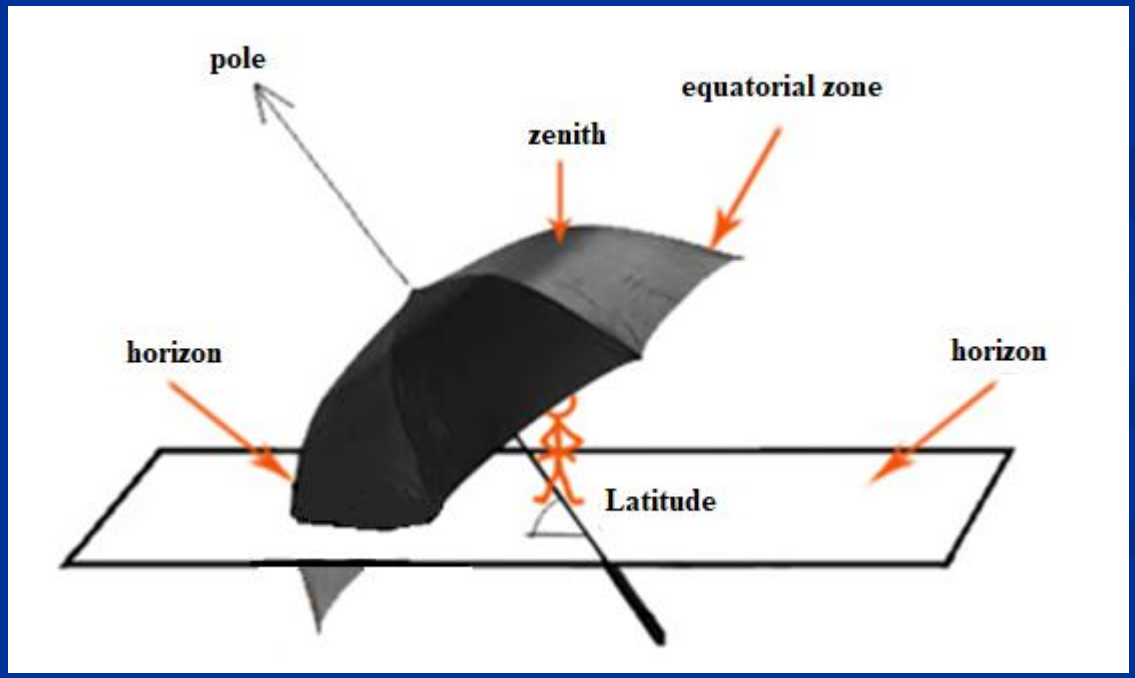


Activity 2: Celestial Dome Umbrella

Use a black umbrella and draw the constellations on it with white paint, chalk or corrector fluid.

Activity 2: Celestial Dome Umbrella

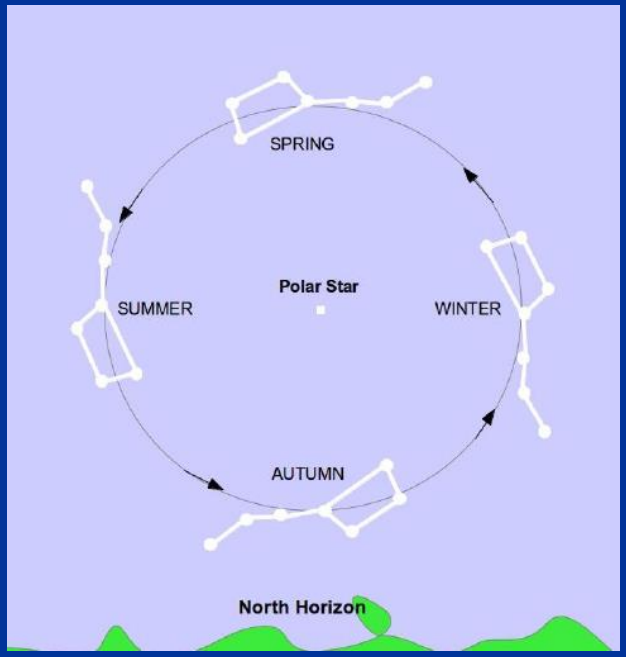
Use the umbrella over our heads with the stick of the umbrella directed towards the pole (inclined at the latitude of our location).



Activity 2: Celestial Dome Umbrella

Using the umbrella in the Northern Hemisphere

Northern Hemisphere
and
Northern Horizon



Local midnight

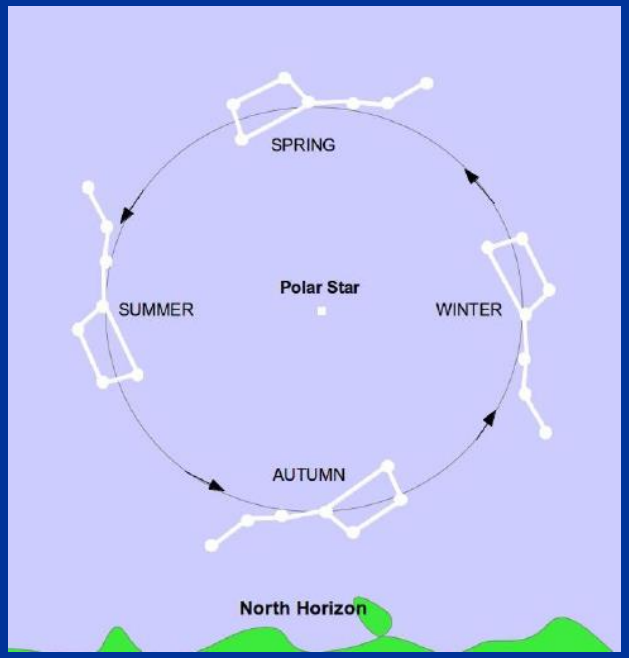
- SPRING: Looking to the North horizon, the Big Dipper is above the Pole Star, Leo is to the South horizon.
- SUMMER: Looking to the North horizon, the Big Dipper is to the left of the Pole Star, Cygnus is to the South horizon.
- AUTUMN: Looking to the North horizon, when the Big Dipper is below the Pole Star, Pegasus is to the South horizon.
- WINTER: Looking to the North horizon, the Big Dipper is to the right of the Pole Star, Orion to the South horizon.

Activity 2: Celestial Dome Umbrella

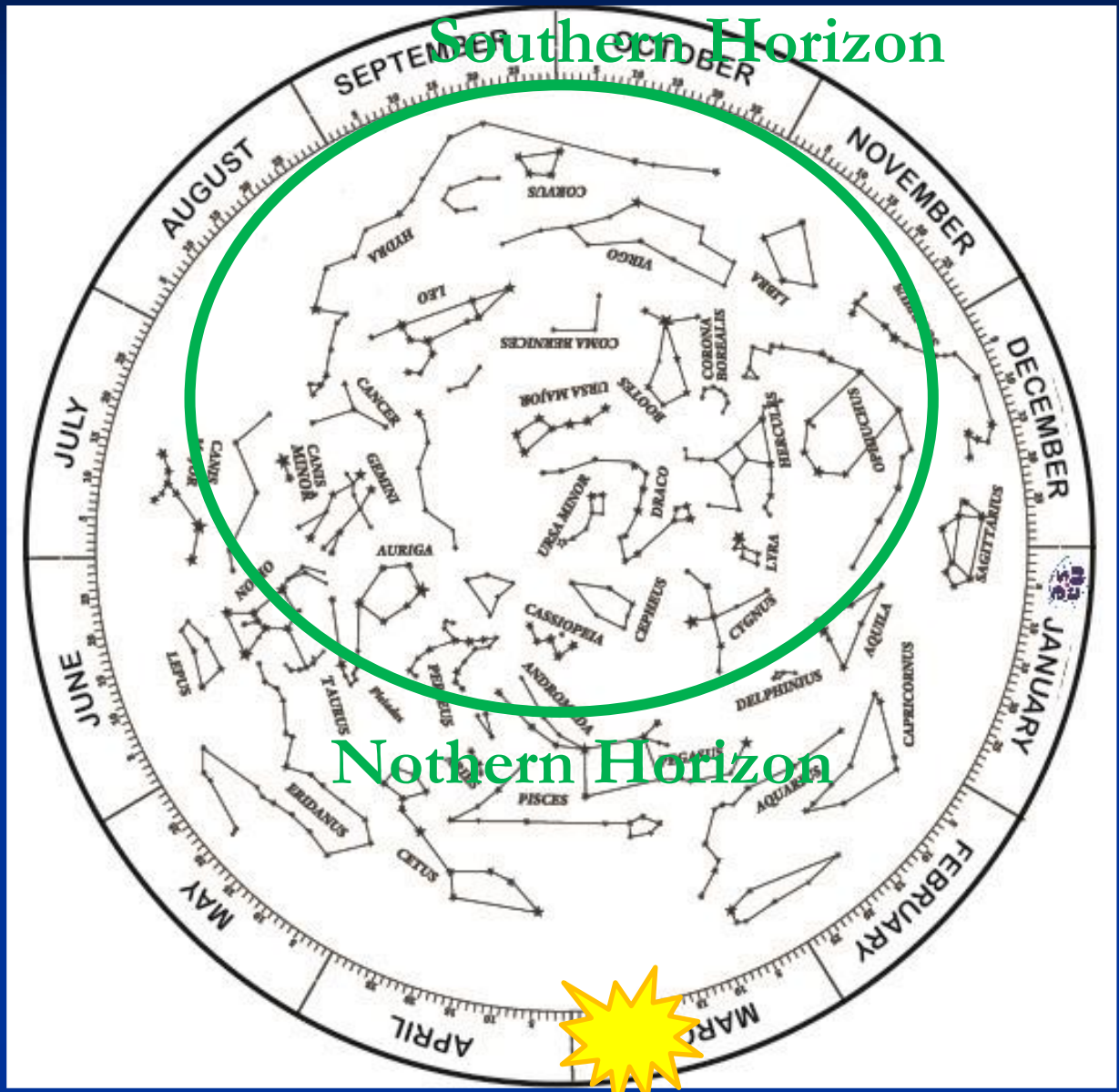
Northern Hemisphere

Spring

Northern Horizon



Local midnight

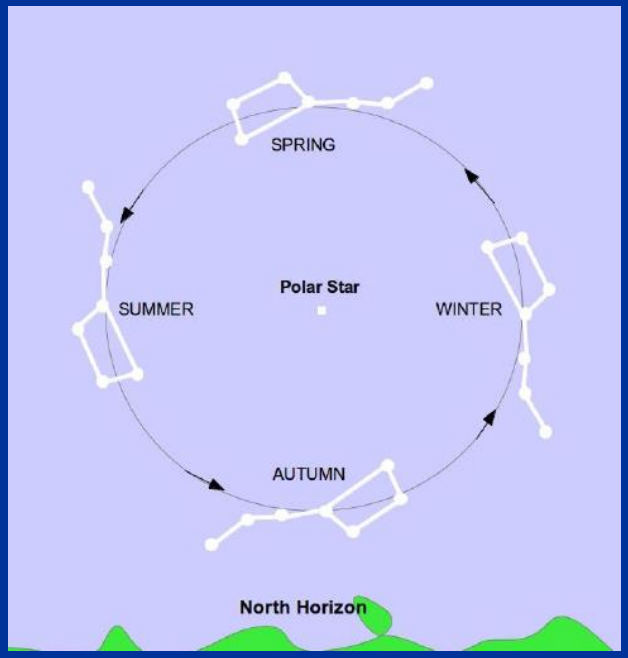


Activity 2: Celestial Dome Umbrella

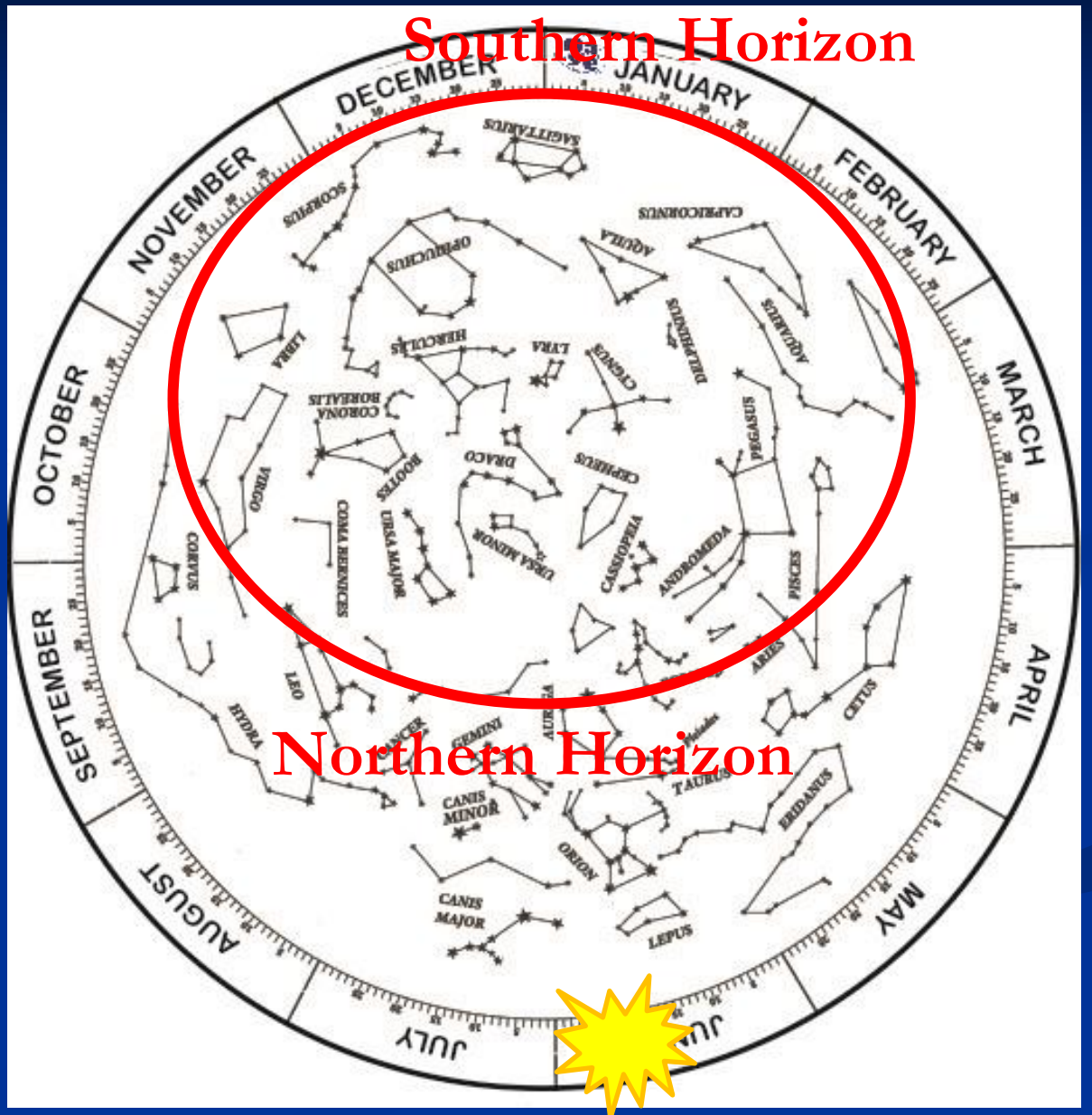
Northern Hemisphere

Summer

Northern Horizon



Local midnight

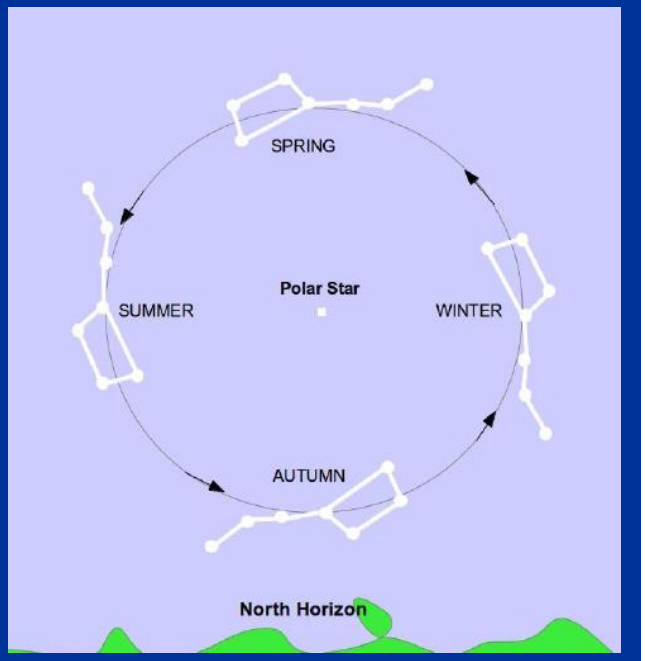


Activity 2: Celestial Dome Umbrella

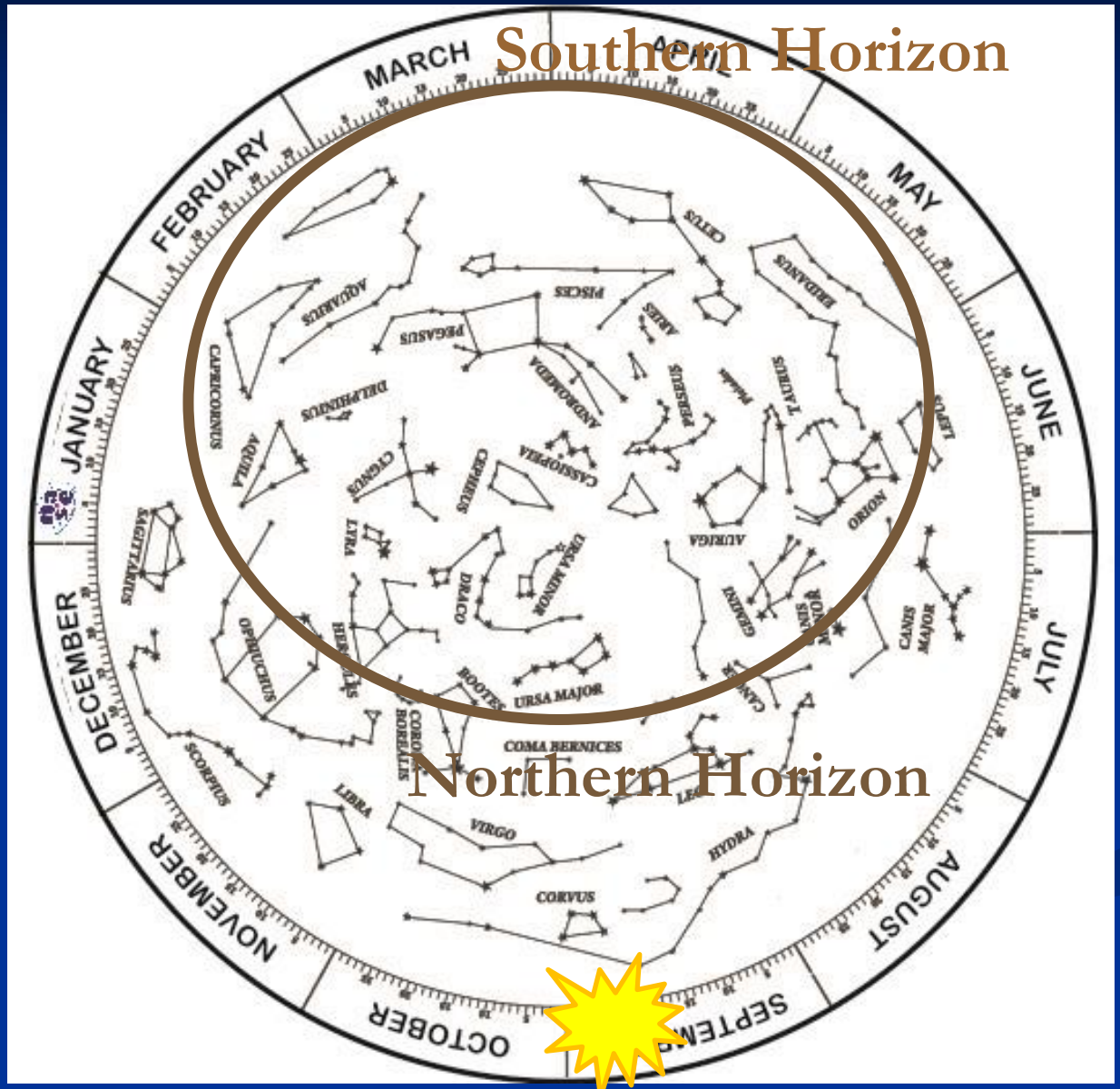
Northern Hemisphere

Autumn

Northern Horizon



Local midnight

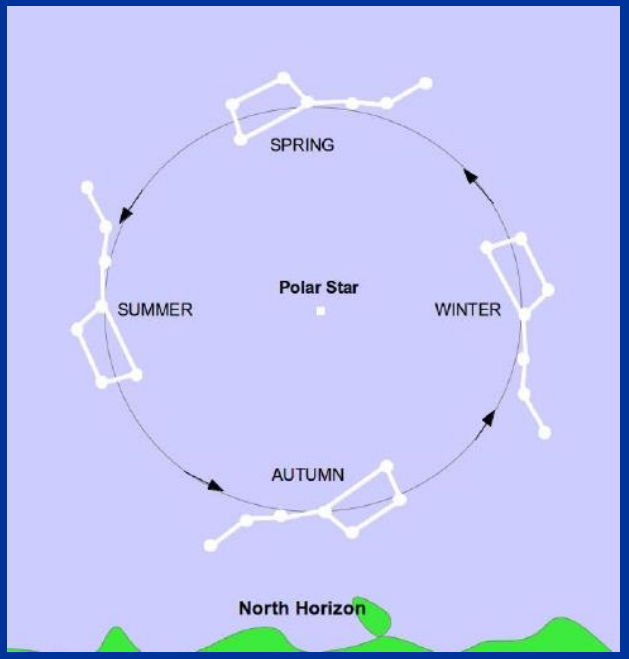


Activity 2: Celestial Dome Umbrella

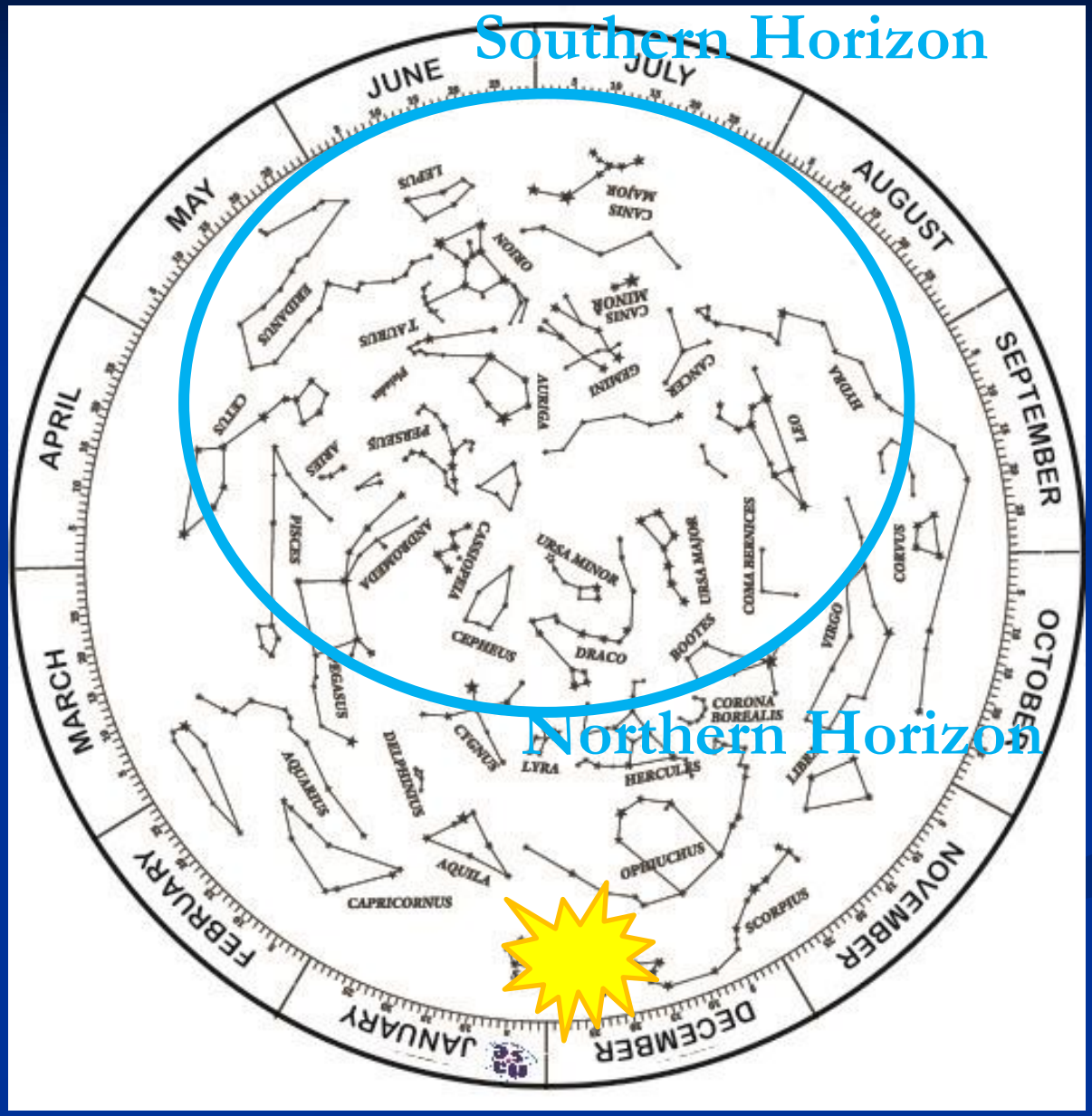
Northern Hemisphere

Winter

Northern Horizon



Local midnight



Activity 2: Celestial Dome Umbrella

Using the umbrella in the Southern Hemisphere

Southern Hemisphere and Southern Horizon

Local midnight

SPRING: to the Southern Horizon, when the Cross is bellow the pole, Aquarius is to the Northern Horizon.

SUMMER: to the Southern Horizon, when the Cross is at the left of the pole, Orion is to the Northern Horizon.

AUTUMN: to the Southern Horizon, when the Cross is above the pole,

Leo is to the Northern Horizon.

WINTER: to the Southern Horizon, when the Cross is at the right of the pole, Scorpio is to the Northern Horizon.

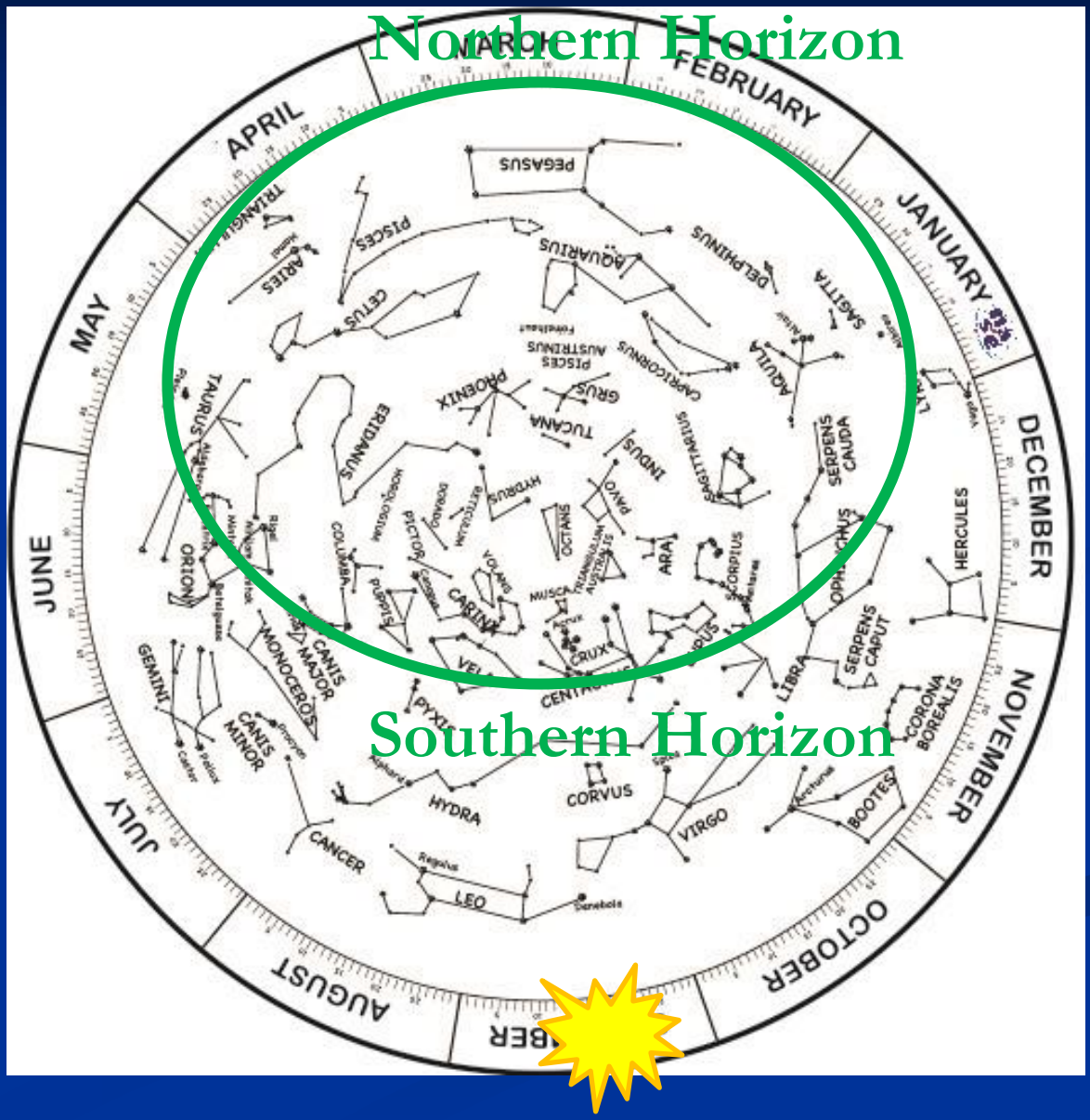
Activity 2: Celestial Dome Umbrella

Southern Hemisphere

Spring

Southern Horizon

Local midnight



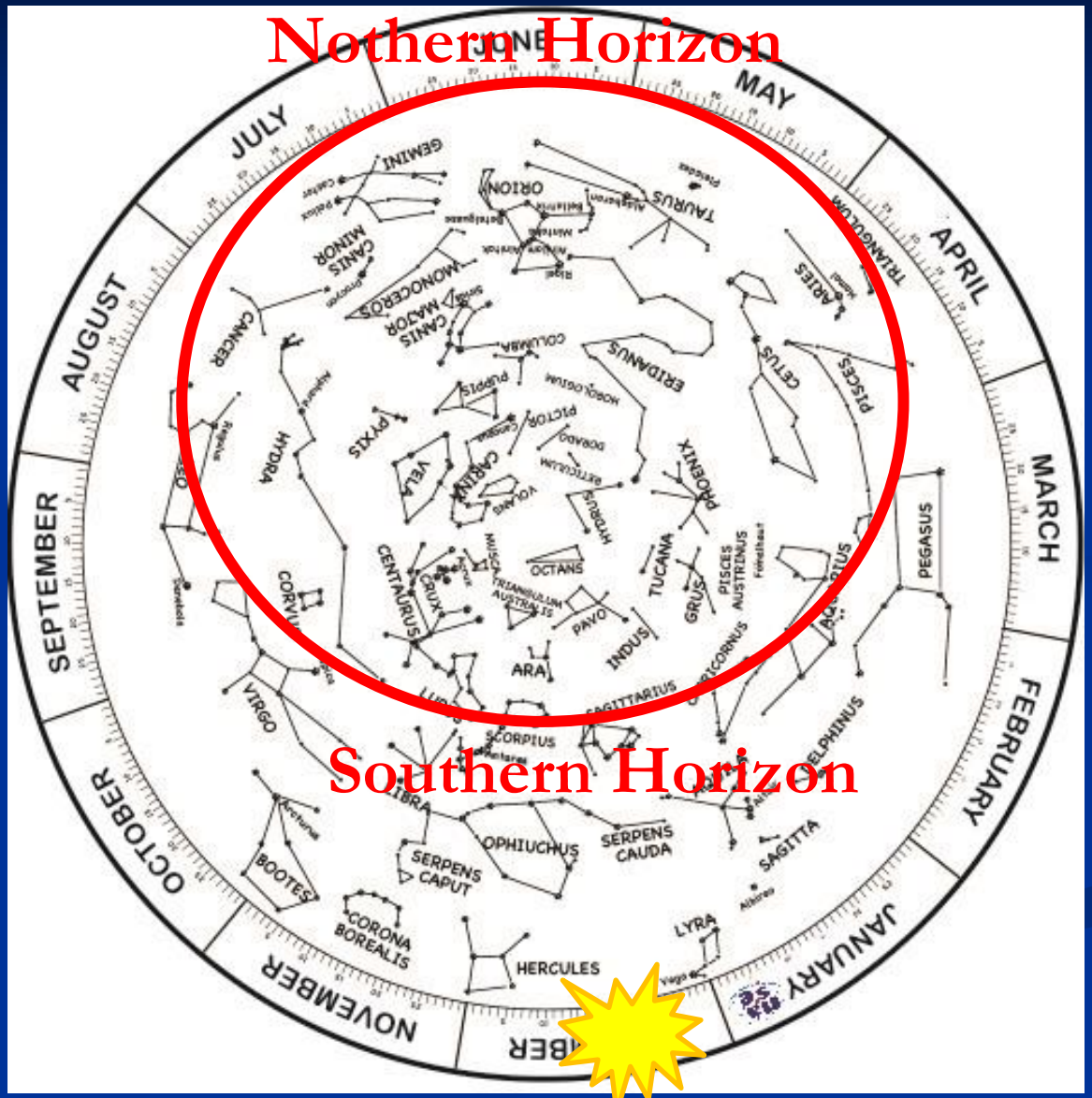
Activity 2: Celestial Dome Umbrella

Southern Hemisphere

Summer

Southern Horizon

Local midnight



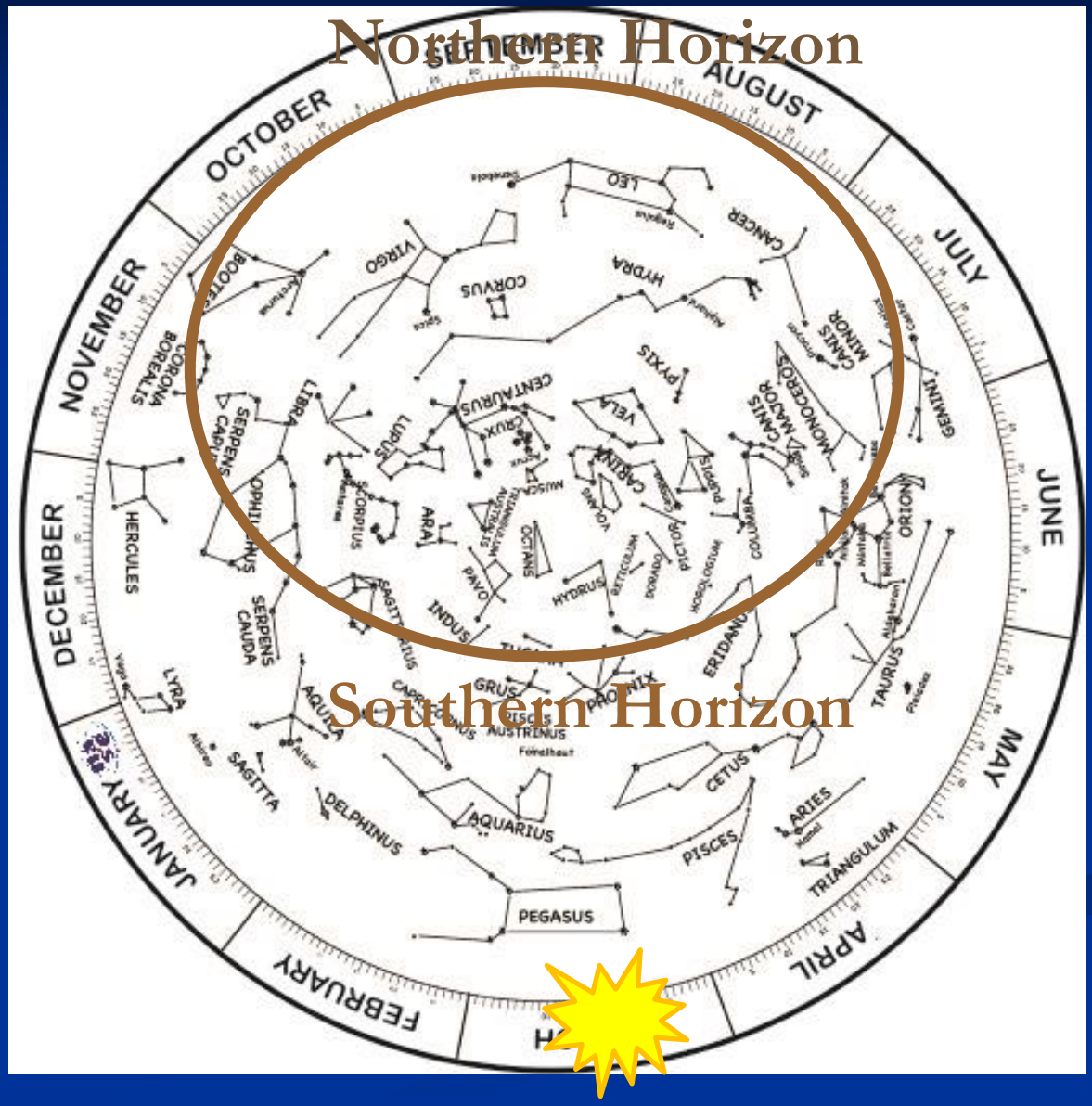
Activity 2: Celestial Dome Umbrella

Southern Hemisphere

Autumn

Southern Horizon

Local midnight



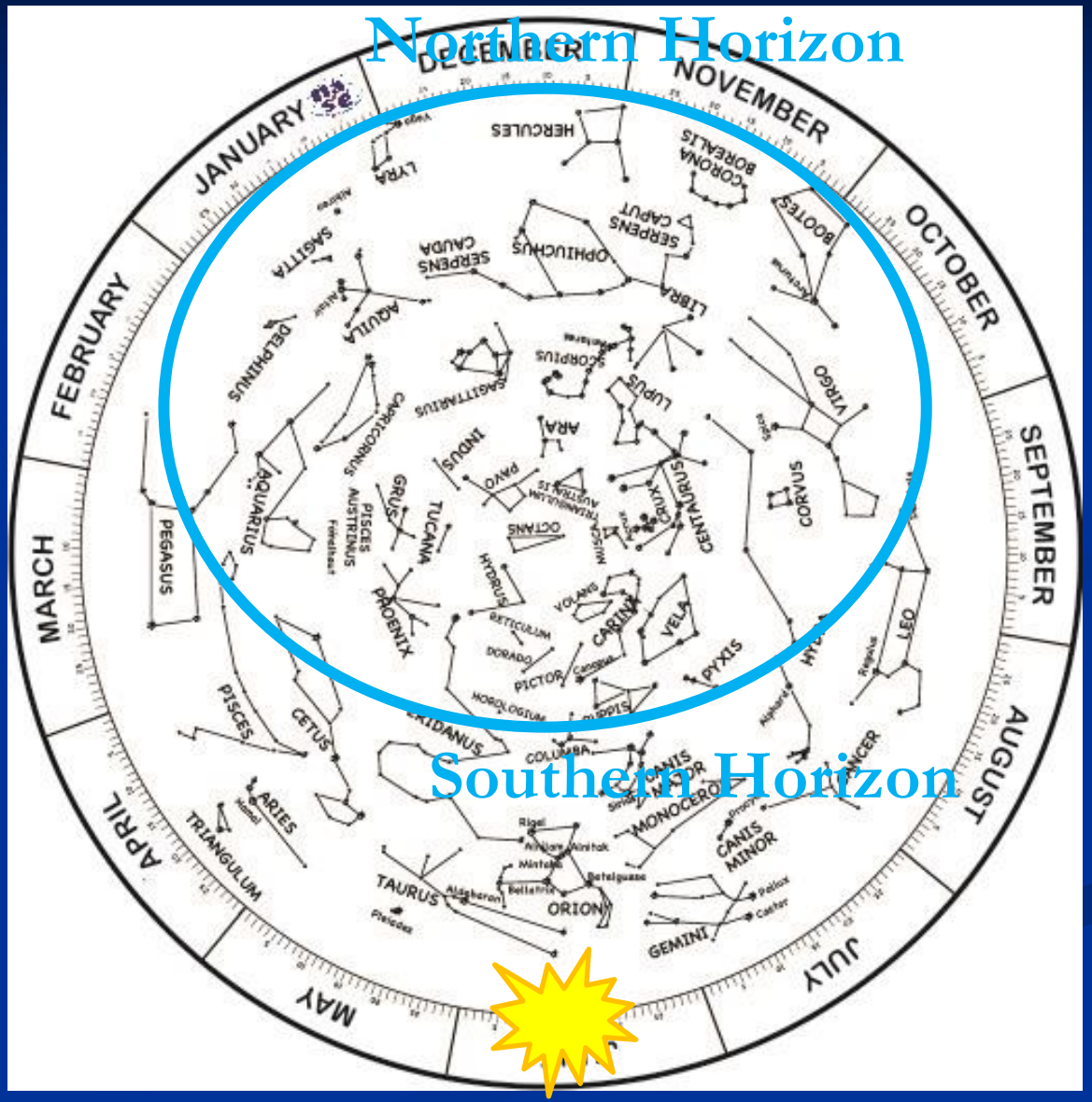
Activity 2: Celestial Dome Umbrella

Southern Hemisphere

Winter

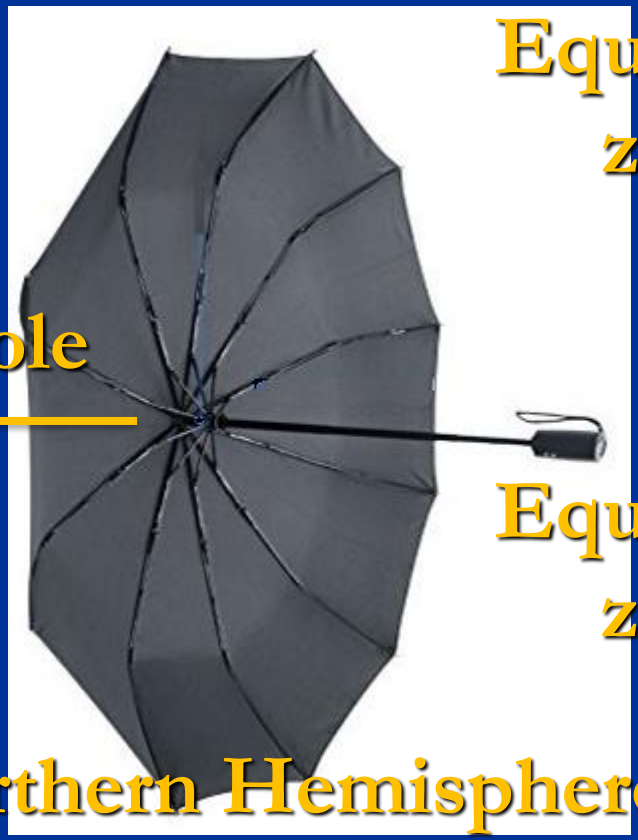
Southern Horizon

Local midnight



Activity 2: 2 Umbrellas of the Equatorial Zone

We use 2 umbrellas with the handle parallel to the Horizon



Equatorial zone

North pole

Equatorial zona

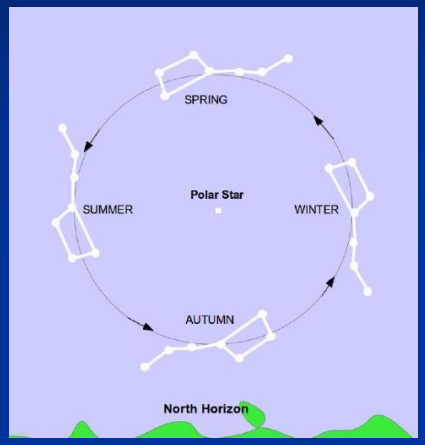
South Pole

Northern Hemisphere

Southern Hemisphere

Activity 2: 2 Umbrellas of the Equatorial Zone

Northern Horizon



Local midnight

- MARCH: Spring with Leo in the equatorial zone
- JUNE: Summer with Swan in the equatorial zone
- SEPTEMBER: Autumn with Pegasus in eq. z.
- DECEMBER: Winter with Orion equatorial zone

Southern Horizon

Local midnight

- MARCH: Autumn with Leo in the equatorial zone
- JUNE: Winter in Scorpio in equatorial zone
- SEPTEMBER: Spring with Aquarius in the eq. z.
- DECEMBER: Summer with Orion in the eq. z.

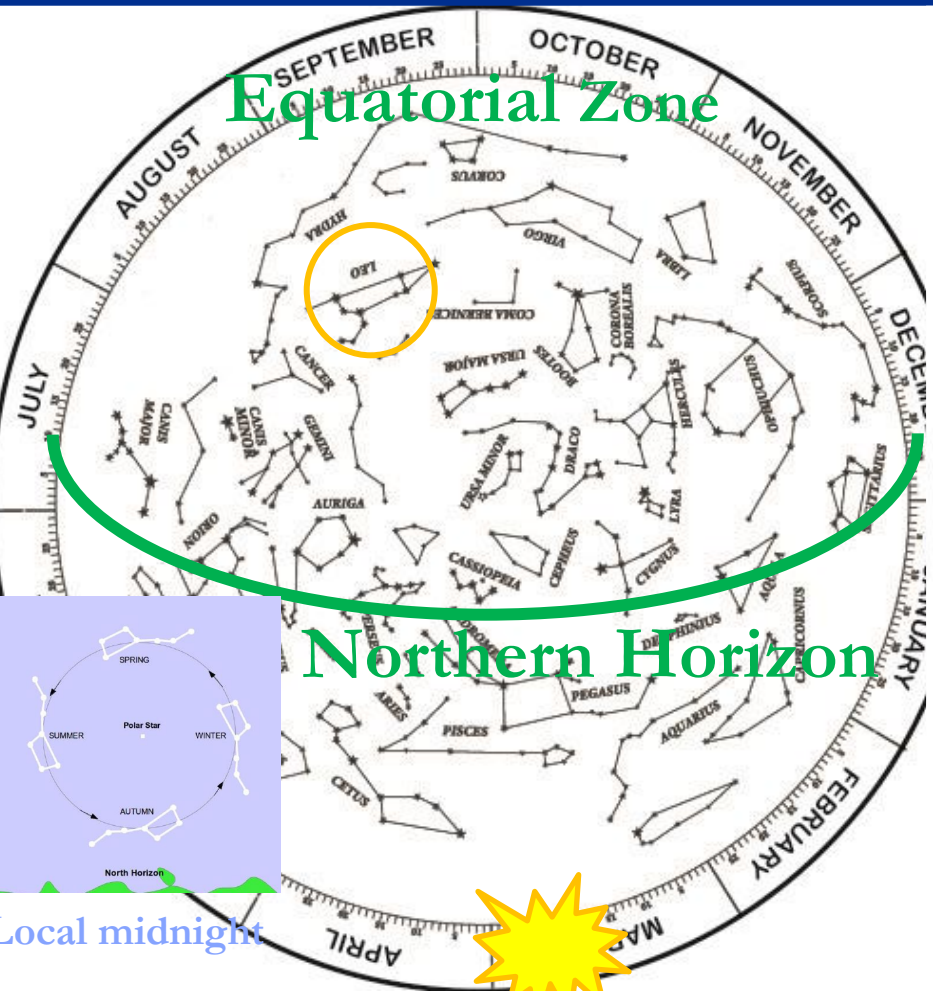
Activity 2: 2 Umbrellas of the Equatorial Zone

NH March

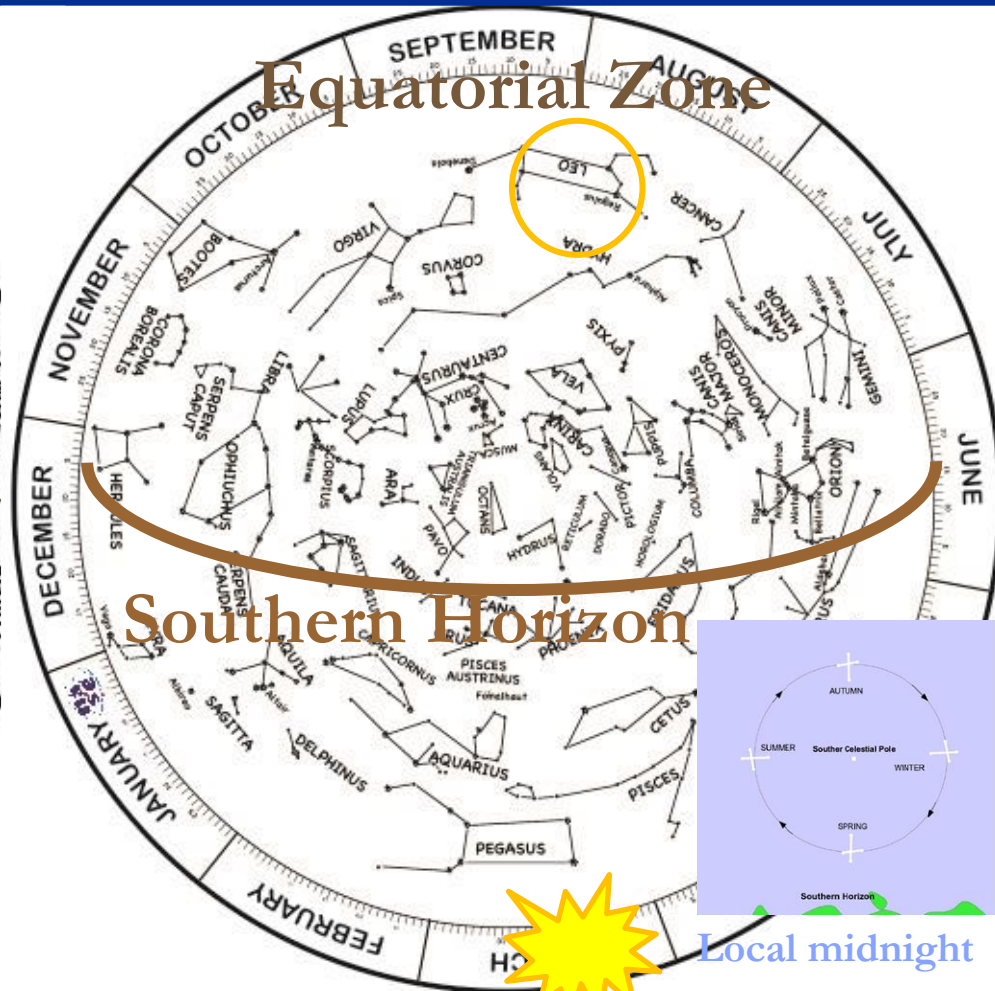
(Spring)

SH March

(Autumn)



Local midnight



Local midnight

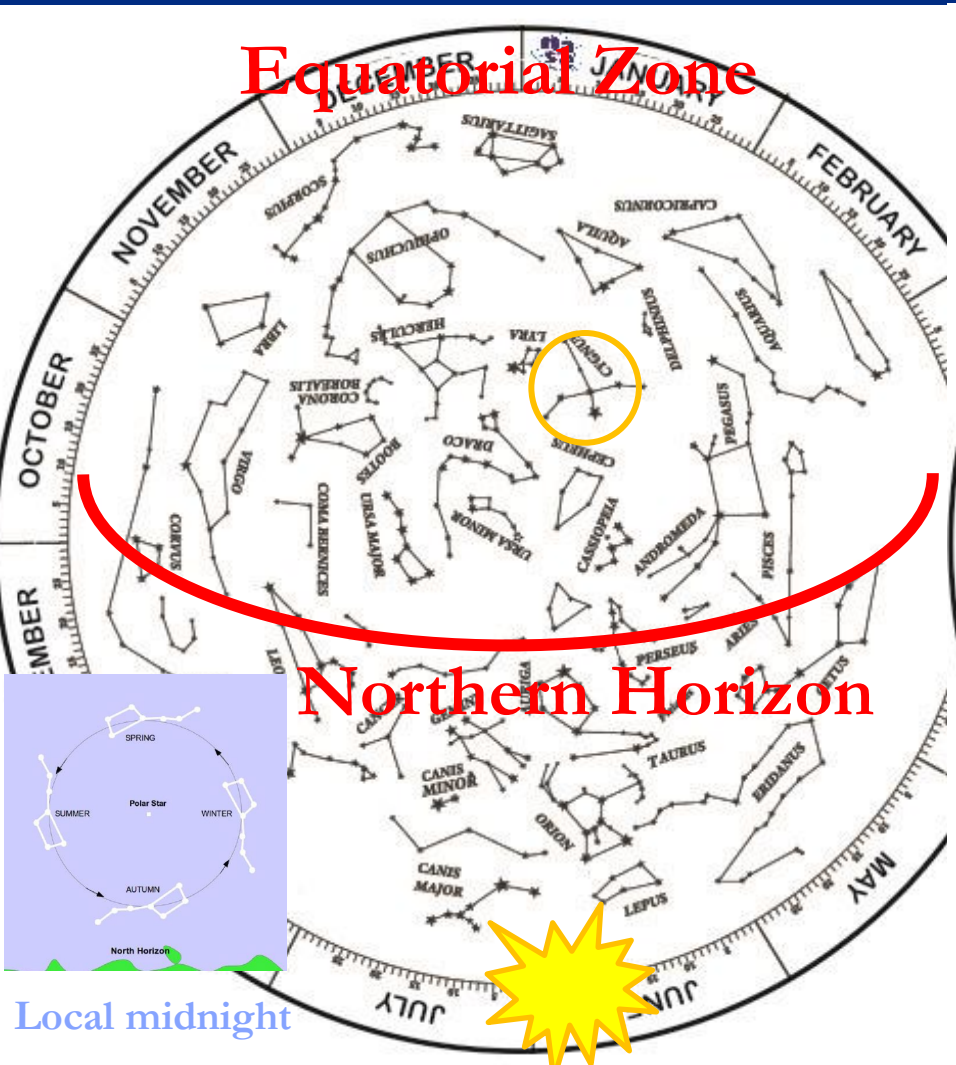
Activity 2: 2 Umbrellas of the Equatorial Zone

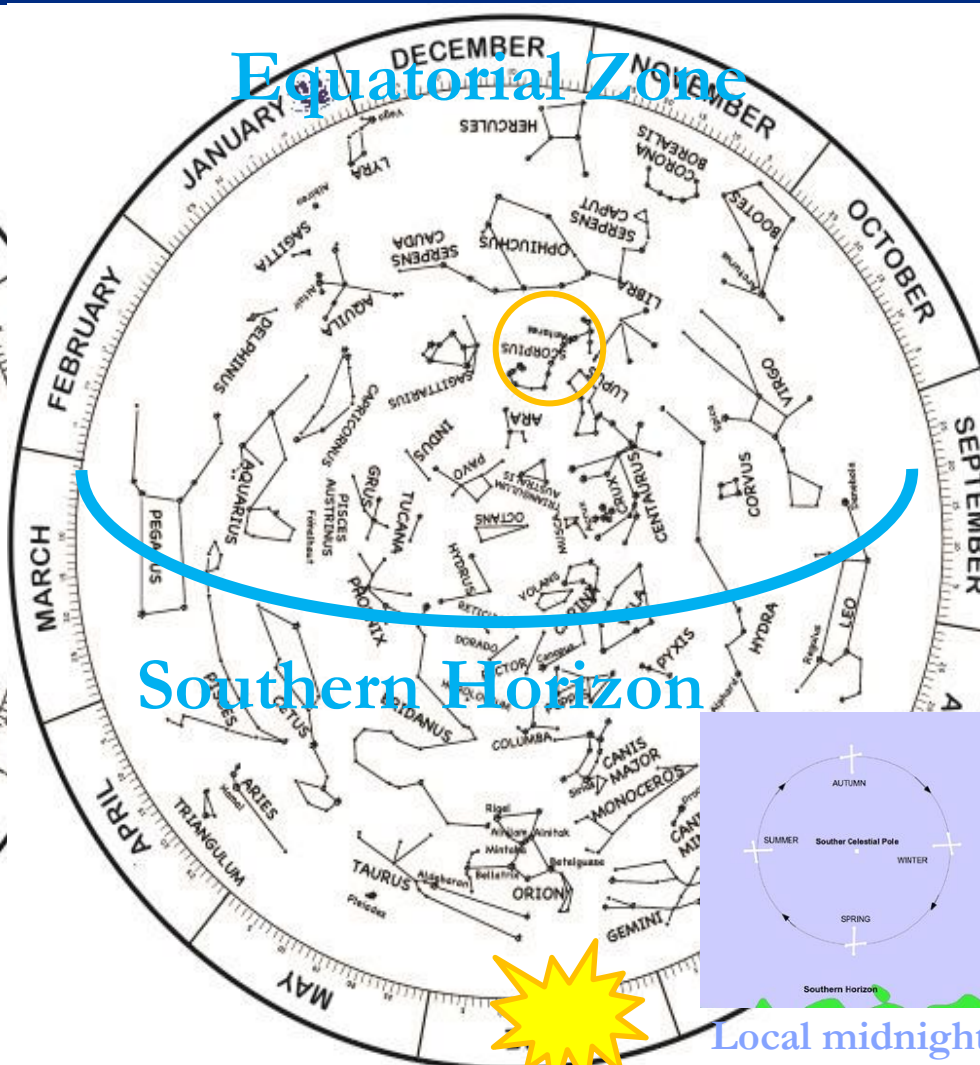
NH June

(Summer)

SH June

(Winter)

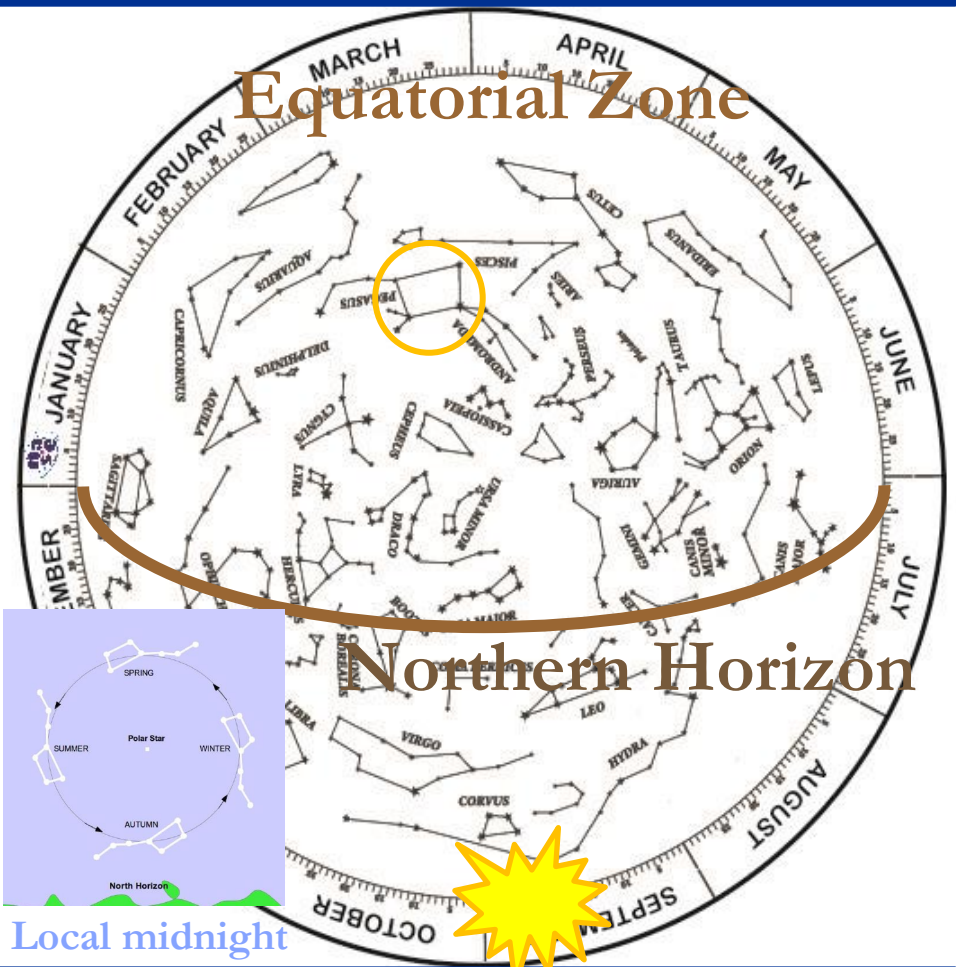


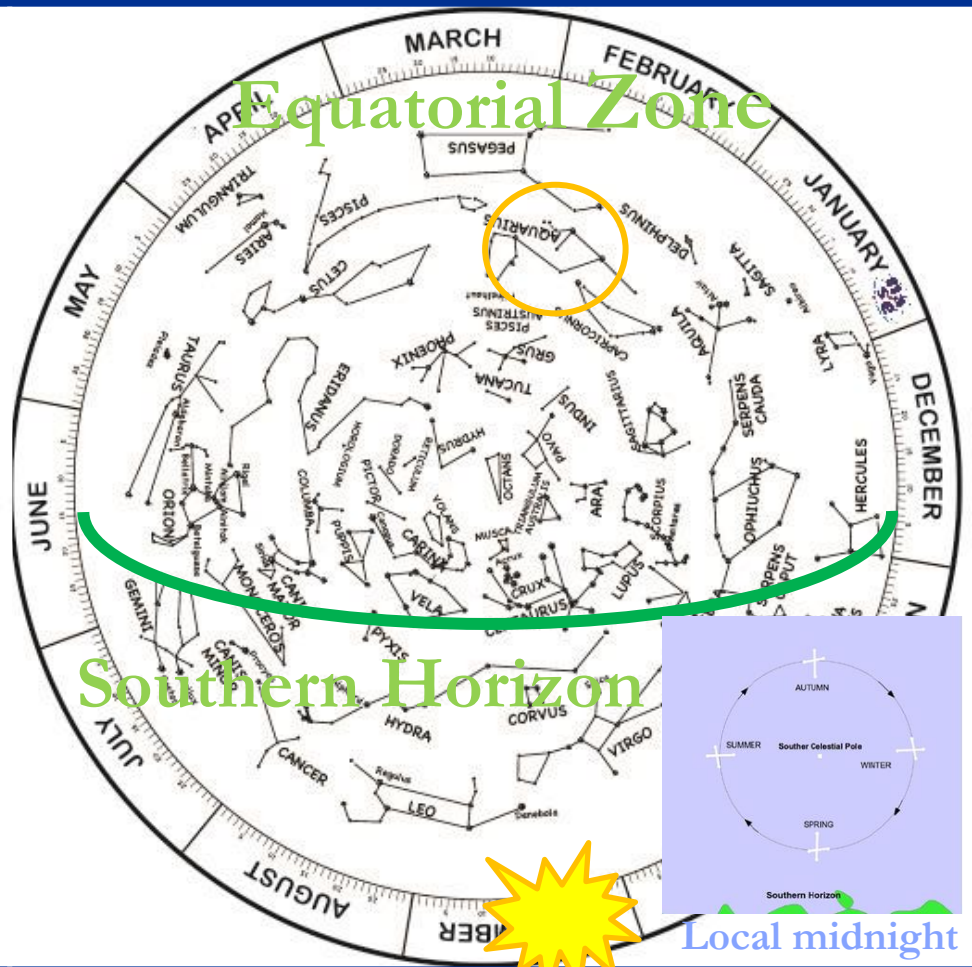


Activity 2: 2 Umbrellas of the Equatorial Zone

NH September
(Autumn)

SH September
(Spring)





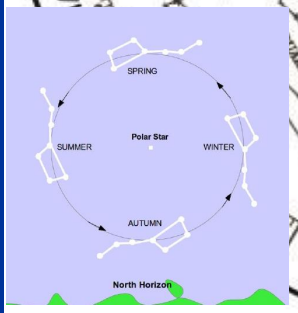
Activity 2: 2 Umbrellas of the Equatorial Zone

NH December

(Winter)

Equatorial Zone

Northern Horizon



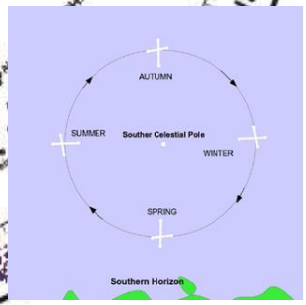
Local midnight

SH December

(Summer)

Equatorial Zone

Southern Horizon



Local midnight

The previous schemes are those that we consider in the umbrella according to the season. The only difference is that the umbrella is represented in a simplified way and allows an easier understanding.

Dark skies and light pollution

- We need a dark sky to see more stars
- This is only possible if we move away from the built-up areas
- We have forgotten how the night sky looks since we cannot see it clearly from the cities
- Light pollution is one of the least recognised forms of pollution. It prevents us from seeing the stars, affects the nocturnal ecosystem, human health and represents a waste of energy.

Forms of light pollution

There are three types of light pollution:

a) Glow: Associated with public lighting projected toward the sky. It looks like a bubble of light above the city.
b) Trespass: The external light that spreads in all directions and into houses and gardens.
c) Glare: Related to the illuminated signs or vehicles that affects the eye directly and also by surprise.

Activity 3: Light pollution - Glow

Objectives:

- **Show the polluting effect of unshielded lighting.**
- **Recognize the beneficial effect of a well-chosen lamp.**
- **Recognize the possibility of improving the night sky observations, even then there is some artificial light.**

Activity 3: Light pollution - Glow

Procedure

Preparing the black box

Activity 3: Light pollution - Glare

Test the streetlights with and without shielding, special for controlling the glare

Activity 3: Light pollution - Glow

Proof: Pictures are taken inside the box

Appearance of the sky with lantern unshielded

Appearance of the sky with lantern shielded

The Stellarium Program

www.stellarium.org

Stellarium Resource Guide

Help Window		F1	Show the help window, which lists key bindings and other useful information
Configuration Window		F2	Show the display of the configuration window
Search Window		F3 or CTRL+f	Show the display of the object search window
View Window		F4	Show the view window
Time Window		F5	Show the display of the help window
Location Window		F6	Show the observer location window (map)

Stellarium Resource Guide

Table below describes the operations of buttons on the main tool-bar and the side tool-bar, and gives their keyboard shortcuts.

Feature	Tool-bar button	Key	Description
Constellations		c	Draws the constellation lines
Constellation Names		v	Draws the name of the constellations
Constellation Art		r	Superimposes artistic representations of the constellations over the stars
Equatorial Grid		e	Draws grid lines for the RA/Dec coordinate system
Azimuth Grid		z	Draws grid lines for the Alt/Azi coordinate system
Toggle Ground		g	Toggles drawing of the ground. Turn this off to see objects that are below the horizon
Toggle Cardinal Points		q	Toggles marking of the North, South, East and West points on the horizon
Toggle Atmosphere		a	Toggles atmospheric effects. Most notably makes the stars visible in the daytime
Nebulae & Galaxies		n	Toggles marking the positions of Nebulae and Galaxies when the FOV is too wide to see them
Planet Hints		p	Toggles indicators to show the position of planets
Coordinate System		Enter	Toggles between Alt/Azi & RA/Dec coordinate systems
Goto		Space	Centres the view on the selected object
Night Mode		[none]	Toggle "night mode", which changes the coloring of same display elements to be easier on the dark-adapted eye.

Thank you for
your attention!