TEACHING TRAINING COURSE ON ASTRONOMY, ASTROPHYSICS, ASTROBIOLOGY AND ASTRO-CULTURE

- **Lectures Topics**
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  - 2 – Cosmology
  - 3 – History of Astronomy
  - 4 – Solar System
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  - 2 – Stellar, solar and lunar demonstrators
  - 3 – Earth-moon-sun system: phases and eclipses
  - 4 – Young astronomer briefcase
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  - 9 – Planets and exoplanets
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- **Working Groups**
  - 1 – Preparing Observations
  - 2 - Astronomy in the city

WS1: Local Horizon and Sundials

Summary

The study of the horizon is crucial to facilitate the students' first observations in an educational center. A simple model that has to be made in each center allows us to make the study and the comprehension of the first astronomical rudiments easier. The model is also presented as a simple model of an equatorial clock and from it; we can make other models (horizontal and vertical).

Goals

- Understand the diurnal and annual movement of the Sun.
- Understand the celestial vault movement.
- Understand the construction of an elemental Sundial.

List of Materials.

Activity 1:

- 4-sphere model
- 1 Bulb,
- 1 Support for the light bulb,
- 2 meters of electric cable and a plug
- 4 balls of porexpan or icopor of 8 cm
- 4 sticks with 4 supports (2 of equal height, 1 lower, 1 higher as explained in the WS1 text)
- 1 circular mat that is used as a base for cakes or pies
- 1 a card with a cut angle of 23º

Activity 2: Model of the parallel Earth

- 1 terrestrial sphere that can be removed from your support. About 30 cm in diameter
- 1 bowl that serves to put the terrestrial sphere on it
- 1 compass
- 1 rope of 2 meters in length
- 1 box of chopsticks
- 1 package of play dough for children

Activity 3: Horizon model.

- a photo strip of the local horizon (taken as explained in the workshop)
- 1 Photo of stellar traces of the cardinal point east or west
- 1 Photo of sunrise at 2 or 3 minutes intervals (approx) made on the day of the equinox
- 3 photos of the sunrise (or sunset) on the first day of the solstices and an equinox
- 1 photo of the Orion belt area with about 15 or 20 minutes of exposure time
- 1 Wood sheet (cardboard or cork does not work because it is soft) of 40x 40
- 2 meters galvanized wire, cut into three sections, (simulation of the apparent path of the sun at solstices and equinoxes and to simulate the rotation axis of the Earth)
- 1 Flashlight (with the light jet inside a cardboard tube so that it focuses well on the jet)

- 1 compass

Activity 4: Equatorial Sundial
- 1 compass
- 1 wooden rod for the gnomon of the solar clock.
- Scissors and tail (for setting the sundial)

Activity 5: Reading Time
- Without equipment

WS2: Stellar, solar, and lunar demonstrators

Summary
This worksheet presents a simple method to explain how the apparent motions of stars, the Sun, and the Moon are observed from different places on Earth. The procedure consists of building a simple model that allows us to demonstrate how these movements are observed from different latitudes.

Goals
- Understand the apparent motions of stars as seen from different latitudes.
- Understand the apparent motions of the Sun as seen from different latitudes.
- Understand the Moon's movement and shapes as seen from different latitudes.

List of Materials

Activity 1: Stellar Simulator
- Extended photocopied material for the instructor, so it looks better.
- Scissors.
- Cutter, carving or scalpel
- Glue to paste.

Activity 2: Solar simulator
- Extended photocopied material for the instructor, so it looks better.
- Scissors.
- Cutter, carving or scalpel
- Glue to paste.
- 1 clip (to secure the Sun). You have to draw a sun and stick it on one end of the clip

Activity 3: Parallel Earth Simulator
- Extended photocopied material.
- Scissors.
- Cutter, carving or scalpel
- Glue to paste.
- 1 ping pong ball
- 1 piece of elastic band.
- 1 mobile flashlight.

Activity 4: Lunar Simulator

- Extended photocopied material for the instructor, so it looks better.
- Scissors.
- Cutter, carving or scalpel
- Glue to paste.
- 1 clip (to secure the Moon). You have to draw a half moon and stick it on one end of the clip with the diameter of the half-moon perpendicular to the clip

WS3: Earth-moon-sun system: Phases and eclipses

Summary

The following work deals with moon phases, solar eclipses, and lunar eclipses. These eclipses are also used to find distances and diameters in the Earth-Moon-Sun system.

Goals

- To understand why the moon has phases.
- To understand the cause of lunar eclipses.
- To understand why solar eclipses occur.
- To determine distances and diameters of the Earth-Moon-Sun system.
- To understand the origin of the tides.

List of Materials

Activity 1: Model of the hidden face of the Moon

- 1 mask (cut out on white card) to simulate the visible face of the Moon

Activity 2: Model of the phases of the Moon

- 4 masks (cut out on white card) to simulate the 4 phases of the Moon
- 1 projector of the ones used to project the ppt (you have to leave it blank using a blank Word page for example)

Activity 3: Tierra Luna model to scale

- 1 4cm sphere and 1 wait of 1cm in diameter
- 1 rigid wood or plastic rod 1.3 m
- 2 nails for driving the two spheres into the rod at a distance of 1.2 m

Activity 4: Illustration Errors

- Without equipment

Activity 5: Lunar Eclipsis

- The same equipment of Activity 3

Activity 6: Solar Eclipsis

- The same equipment of Activity 3

Activity 7: Sol Luna model at scale

- 1 savannah where to paint a Sun of 220 cm in diameter

• 1 Moon 6 mm in diameter (can be a pellet of play dough for children) punctured on a toothpick

Activity 8: Finger Cinema
- 1 notebook with spiral
- a series of photos of a Moon or Sun eclipse
- 1 tube of glue or glue

Activity 9: Measure the diameter of the Sun
- 1 plastic tube at least 1 meter long and 8cm in diameter (camera obscured)
- 1 hour of translucent paper (vegetable, butter, tracing paper)
- 1 piece of aluminum foil
- 1 calculator
- 1 clip to undo and puncture with the aluminum foil

Activity 10: Aristarchus' Experiment
- Without equipment

Activity 11: Eratosthenes' Experiment
- Without equipment

WS4: Young Astronomer Briefcase

Summary
To further observation it is necessary that students have a set of simple tools. It is proposed that they construct some of them and then use them in observing the sky from the school itself.
Students should understand in a basic way how various instruments have been introduced over the centuries, how they have developed, and have become necessary. It is an important part of astronomy, noting the great ability to build them and the skill to use them to do readings of the observations. These requirements are not easy to develop with students and for that reason here we propose very simple instruments.

Goals
- Understand the importance of making careful observations.
- Understand the use of various instruments thanks to the fact that students do the construction by themselves.

List of Materials

Scissors, cutter and glue or tail are required for the different activities

Activity 1: rule to measure angles
- 1 piece of cardboard of 20x3 cm
- 1 piece of string of 65 cm
- Paste the photocopy of the rule

Activity 2: simplified quadrant
- 1 piece of cardboard of 20x12 cm

- 1 piece of string of 25 cm
- 1 lead (can be anything heavy that can be knotted with the string
- Paste to the photocopy of the quadrant
- 2 pieces of cardboard 4x4 cm where the hole is made to measure the height of the sun

Activity 3: Simplified horizontal goniometer
- 1 piece of porexspan, isopor or quite thick cardboard of 25x20 cm
- Paste the photocopy of the semicircle
- 3 pins or needles with colored heads

Activity 4: Planisphere
- Cut out photocopies
- Glue
- Scissors

Activity 5: Equatorial Coordinates
- No materials

Activity 6: Moon map
- Prepare various lunar maps

Activity 7: Spectroscope
- 1 matchbox
- 1 piece of CD (1/8 of CD is enough). The CD can be used
- 1 black marker

Activity 8: Equatorial Sundial
- 1 compass
- 1 wooden rod for the gnomon of the solar clock.
- Scissors and tail (for setting the sundial)

Activity 9: Red light torch and other materials
- 1 flashlight,
- 1 piece of red cellophane paper to stick on the lantern
- 1 compass
- 1 notebook
- 1 pencil or pen
- 1 camera
- glasses to see eclipses
- 1 mobile

Activity 10: Build the briefcase
- 1 bag type folder
- 1 piece of rope a little thick to make the handle

WS5: Solar Spectrum and Sunspots

Summary
This workshop includes a theoretical approach to the spectrum of sunlight that can be used in high school. The activities are appropriate for primary and secondary levels.
The Sun is the main source of almost all wavelengths of radiation. However, our atmosphere has high absorption of several non-visible wavelengths so we will only consider experiments related to the visible spectrum, which is the part of the spectrum that is present in the daily lives of students. For the activities in non-visible wavelengths, see the corresponding workshop.
First we will present the theoretical background followed by experimental demonstrations of all the concepts developed. These activities are simple experiments that teachers can reproduce in the classroom, introducing topics such as polarization, extinction, blackbody radiation, the continuous spectrum, the emission spectrum, the absorption spectrum (eg sunlight) and Fraunhofer lines.
We also discuss differences between the areas of regular solar output and the emission of sunspots. Additionally, we mention the evidence of solar rotation and how this concept can be used for school projects.

Goals
- To understand what the Sun's spectrum is.
- Understand the spectrum of sunlight.
- Understand what sunspots are.
- Understand the historical significance of sunspots and of Galileo's work on the rotation of the Sun.
- Understand some characteristics of the light such as polarization, dispersion, etc.

List of Materials

Activity 1: Solar Spectrum: Polarization
- 2 polarizing filters (can be parts of glasses)
- polarized glasses

Activity 2: Ligh polarization
- 1 plastic CD cover or piece of glass
- Transparent tape

Activity 3: Solar Structure.
- cuttable
- scissors
- bookbinder

Activity 4: Sunspots and Sun rotation.
- Binoculars (demonstration of how the Sun is observed)
- Real photos of the Sun, acquired over 7 days (Soho)
- Paper, pencil, ruler, calculator, angle protractor, compass

Activity 5: Solar Luminosity
- 2 incandescent lamps, one of 100W and another of 40W
- 2 lampholders
- Plug
- Any kind of rule of one meter

• Transparent oil drops
• Print paper sheet
• Pen, calculator

Activity 6: Opacity
• 1 candle, or tinderbox or lighter or lighter
• Bright light source (retro projector or multimedia projector or LED bulb)
• Screen (can be a cleat wall)

Activity 7: Dispersion of light
• 1 flashlight of cellular
• 1 translucent straight glass cups, with no drawings on the body or base
• milk drops (can be prepared with milk powder)
• a dropper or equivalent
• ½ liter of water

Activity 8: Light scattering in silicone

✓ 1 silicone stick for hot melt glue gun.
✓ 1 flashlight of cellular

WS6: Stellar Lives

Summary
To understand the life of the stars it is necessary to understand what they are, how we can find out how far away they are, how they evolve and what are the differences between them. Through simple experiments, it is possible to explain to students the work done by scientists to study the composition of the stars, and also build some simple models.

Goals
This workshop complements the stellar evolution NASE course, presenting various activities and demonstrations centered on understanding stellar evolution. The main goals are to:
-Understand the difference between apparent magnitude and absolute magnitude.
-Understand the Hertzsprung-Russell diagram by making a color-magnitude diagram.
-Understand concepts such as supernova, neutron star, pulsar, and black hole.

List of Materials

Activity 1: Parallax (distances)
• Attendees' fingers
• Background with reference elements
• pencil, paper, calculator

Activity 2: Law of the inverse square of distance (magnitudes)
• 2 squares glued on cardboard of 15cm x 15 cm minimum, in one of them cut out the central square
• Rule

• Flash light

Activity 3: Colors of stars (temperatures)

• 3 flashlights (preferably not LED)
• 3 filters R, G and B, stuck on the flash lights (transparent red, green, blue paper)
• 3 white paper cones to produce the spot light (this is not mandatory)

Activity 4: HR diagram (cumulus ages)

• 1 photo of an open cluster (the kappa Crucis workshop is provided in the workshop)
• 1 grid (is provided) to relate temperature to magnitude.
• Rule, pencil
• Special rule with magnitude and color scales (provided with the cluster image)
• Comparative chart of HR diagrams of clusters of different ages (provided)

Activity 5: Supernova explosion simulation (star death)

• 1 basketball ball
• 1 tennis ball

Activity 6: Pulsars (star death)

• 1 flashlight
• 1 rope of at least 1 meter

Activity 7: Black hole simulation (star death)

• 1 piece of fabric or elastic mesh (lycra or similar) of at least 1.5 x 1.5 meters
• 1 tennis ball
• 1 heavy weight spherical object (can be constructed with a balloon full of water)

WS7: Astronomy beyond the visible

Summary

Celestial objects radiate in many wavelengths of the electromagnetic spectrum, but the human eye only distinguishes a very small part: the visible region.
There are ways to demonstrate the existence of these forms of electromagnetic radiation that we do not see through simple experiments. In this presentation, you will be introduced to observations beyond what is observable with a telescope that can be used in a primary or secondary school.

Goals

This activity aims to show certain phenomena beyond what may be observable with amateur telescopes, such as the existence of:
-Celestial bodies that emit electromagnetic energy that our eye cannot detect. Astronomers are interested in these other wavelengths because visible radiation alone does not offer a complete picture of the Universe.
-Visible emissions in the regions of radio waves, infrared, ultraviolet, microwave and X-rays.

List of Materials

Activity 1: Construction of a spectrograph (spectra)
- Template to make the spectrograph (provided)
- 1 CD out of use (or a DVD)
- Packing tape (wide adhesive tape, with resistant glue)
- Common adhesive or paper tape.
- Strong scissor
- Tack (cutter, stylet, scalpel) for fine cutting.
- Glue to be glued (preferably in a bar)

Activity 2: Natural decomposition of light (rainbow)
- 1 hose
- a patio or garden

Activity 3: Infrared detection (Herschel)
- 1 large cardboard box (type of sheets for photocopier)
- 1 prism
- 4 laboratory thermometers.
- Common adhesive tape
- clock
- paper, pencil

Activity 4: IR detection with the mobile
- 1 or more remotes with IR LED
- CCD camera of cellular phone (also serves the digital camera)

Activity 5: IR detection through interstellar medium
- 1 flashlight (or a bulb)
- a piece of cloth
- mobile phone camera

Activity 6: Constellation with LEDs
- IR LEDs
- base for installing LEDs
- wire and resistance

Activity 7: Constellations with remote controls
- Several remote controls (depends on the constellation you want to play)

Activity 8: Detection of radio waves.
- 1 9V battery
- 2 wires with peeled tips, 20 cm long
- a radio receiver.

Activity 9: Uses of UV (Black light)
- 1 black light bulb (365nm recommended)
- false bills and not or cards

Activity 10: Filter UV radiation (Black light)

- 1 black light bulb (365nm recommended)
- fluorescent material
- piece of glass or glass goggles
- plastic or organic glasses, tickets

WS8: Expansion of the Universe

Summary

This workshop contains several simple activities to do in which we are going to work with the key concepts of the expanding universe. In the first activity we build a spectroscope to observe spectra of gases. In the second, third, and fourth we experiment qualitatively with the expansion of a rubber band, a balloon, and a surface of points, respectively. In the fifth activity we work quantitatively with the expansion of a surface and even calculate the Hubble constant for this case. In the sixth activity we detect the microwave background radiation.

Goals

- Understand the expansion of the universe.
- Understand that there is not a center of the universe.
- Understand Hubble's Law.
- Understand the meaning of the dark matter and simulate gravitational lens

List of Materials

Activity 1: Doppler effect (redshift)

- 1 rope clock with uniform sound
- 1 cloth bag with handle of at least 50 cm (or a string to attach the clock)

Activity 2: Stretching the photons (microwave background)

- 1 resistive wire of at least one meter

Activity 3: The Universe in a rubber (expansion)

- pieces of 20 cm of elastic of at least 2 cm wide (one piece per 2 students)
- rule of at least 40 cm
- pencil, paper

Activity 4: The Universe in a balloon (expansion)

- birthday balloons (one per student)
- telgopor, isopor (or the appropriate local name) in small spheres (no larger than 5mm in diameter). You can undo a sheet of the same material
- Rubber to paste of any type

Activity 5: Calculation of the Hubble constable (expansion)

• Template with galaxies in a universe before and after the expansion (provided)
• Table to collect data (provided)
• pencil, ruler, calculator

Activity 6: There is no expansion center
• 2 films with points (the image is provided), one copied at 100% and another at 105% and put the 2 sheets on a very well illuminated wall will be enough

Activity 7: Detection of microwave background radiation
• an analog B & W TV

Activity 8 and 9: Simulation of the deformation of space (dark matter)
• 1 glass cup of the type used for cognac or water (body bulging in the center) without drawings on the body or base.
• 1 cup foot
• 1 glass of white wine
• 1 glass of red wine
• graph paper or graph paper
• 1 flashlight

WS9: Planets and exoplanets

Summary

This workshop provides a series of activities to compare the many observed properties (such as size, distances, orbital speeds and escape velocities) of the planets in our Solar System. Each section provides context to various planetary data tables by providing demonstrations or calculations to contrast the properties of the planets, giving the students a concrete sense for what the data mean.

At present, several methods are used to find exoplanets, more or less indirectly. It has been possible to detect nearly 4000 planets, and about 500 systems with multiple planets.

Goals

- Understand what the numerical values in the Solar System summary data table mean.
- Understand the main characteristics of extrasolar planetary systems by comparing their properties to the orbital system of Jupiter and its Galilean satellites.

List of Materials

Activity 1: Scale of distances to the Sun
• 1 piece of calculating machine paper of just over 4.5 meters
• 1 roll of toilet paper of more than 30 units

Activity 2: Diameter model
• 1 piece of yellow paper or yellow cloth to cut a circle of 1.39 m in diameter
• Paintings to draw the planets or paper with different colors to cut the disks of different sizes

Activity 3: Model of distances and diameters

- 1 basketball ball
- 2 pins of 1 mm head
- 2 pins of 2 mm head
- 1 ping pong ball
- 1 golf ball
- 2 glass marbles

Activity 4: Model in the city
- 1 map of the city
- 1 calculator

Activity 5: Model of times
- 1 calculator

Activity 6: Sun from the planets
- 1 circles template

Activity 7: Density model
- 3 similar fragments of pyrite
- 3 similar fragments of sulfur
- 1 fragment of clay
- 1 fragment of pine wood
- 1 fragment of blende

Activity 8: Flattening Model
- Cardboard
- 1 stick 50cm long and 1cm in diameter

"NOTE: the wine can be replaced by must or other transparent juice, or coca cola."

Activity 9: Rotational model
- 1 a meter string
- 1 lead or something that weighs a little and can be easily tied

Activity 10: Model of superficial gravities
- 1 mechanical bath scale (other than electronic) for each planet
- 1 pliers to open the scale
- 1 card
- 1 marker

Activity 11: Model of craters
- 1 pack of 1 kilo of flour
- 1 pack of 400 gr of cocoa powder. Those that are difficult to dissolve are better, those that are difficult to dissolve in the milk
- 1 fine sieve
- 1 old newspaper
- 1 soup spoon

Activity 12: Escape velocity model

• 1 tube of pills or medicines whose lid has no thread but is under pressure. It also serves a tube of food for fish, a capsule of photographic film
• Water and an effervescent pill
• Bicarbonate and vinegar
• Coca cola and mentos

Activity 13: Doppler Effect
• 1 transparent plastic box
• 1 stopper with chair
• Flash of 1 mobile

Activity 14: Transit simulation
• 1 large ball about 10 cm
• 1 small ball about 2 cm

Activity 15: Simulation of micro lenses
• 2 wine glass feet
• 1 small ball about 1 cm

Activity 16: Model of solar system and exoplanets
• 1 extensible meter
• 1 little ball of 0.2 cm
• 1 little ball of 0.3 cm
• 2 little ball of 0.6 cm
• 2 balls of 2.5 cm
• 1 ball of 6 cm
• 1 ball of 7 cm
• 1 paper lamp of 35 cm
• 1 ball of 5.5 cm
• 1 ball of 7 cm
• 1 ball of 9 cm
• 1 ball of 10 cm
• 1 paper lamp of 45 cm
• 1 little ball of 0.8 cm
• 1 little ball of 1.1 cm
• 1 little ball of 1.6 cm
• 1 ball of 10 cm
• 1 little ball of 0.7 cm
• 1 little ball of 1.7 cm
• 1 little ball of 1.8 cm
• 1 ball of 2 cm
• 1 ball of 2.4 cm
• 1 paper lamp of 22 cm
• 2 little ball of 1.0 cm
• 1 little ball of 1.2 cm
• 1 little ball of 1.3 cm
• 2 little ball of 1.4 cm
• 1 little ball of 1.5 cm
• 1 ball of 4 cm

WS10: Astrobiology

Summary

This workshop is essentially divided into two parts. The necessary chemical elements for life, a simple study of the periodic table corresponding to the objectives of this work and some concepts of astrobiology are introduced.

Goals

- Understand where from or how the different elements of the periodic table arise
- Understand the main characteristics of extra-solar planetary systems.
- Understand the habitability conditions necessary for the development of life
- Study the minimum guidelines of life outside the Earth.

List of Materials

Activity 1: Formation of the planetary system from gas and dust

- no material

Activity 2: Periodic table classification

- 3 basket (blue, yellow, red)
- 1 golden ring
- 1 drill bit coated with titanium
- a child's balloon with helium inside
- 1 pan scourers of nickel
- 1 mobile/button battery
- 1 car spark plugs
- 1 electric cooper wire
- 1 iodine solution
- 1 water bottle
- 1 old cooking pan
- 1 black pencil lead
- 1 sulfur for agriculture
- 1 can of soft drink
- 1 wrist watch of titanium
- 1 silver medal
- 1 pipe lead
- 1 zinc pencil sharpener
- 1 thermometer
- 1 matchbox

Activity 3: Children of the stars

- no materials

Activity 4: Liquid water on Mars?

- 1 disposable syringe of 10 ml
- Hot water close to boiling

Activity 5: Oxygen production by photosynthesis

- 1 punch
- 2 sheets of spinach
- 25g of sodium bicarbonate
- 1 disposable syringe of 10 ml
- 1 disposable syringe of 20 ml
- 1 foil of red cellophane paper
- 1 foil of blue cellophane paper
- 2 light bulb (not less than 70W) better led
- 2 lamps to put both light bulbs
- 1 tablespoon of yeats (to make bread)
- 10 tablespoon of sugar
- 1 glass of warm water (between 22º-27º)
- 6 zip bags
- 1 tablespoon of sodium bicarbonate
- 1 tablespoon of sodium chloride (common salt)
- 1 tablespoon of vinegar or lemon
- 4 or 5 ice's rocs
- 1 UV lamp (used to grow up vegetables)

Activity 6: Life in extreme conditions.

- 1 small packet of yeast to make bread (1 tablespoon is enough)
- 1 glass of warm water (between 22º and 27º)
- 10 tablespoon of sugar that will be consumed by microorganisms
- 1 disposable syringe of 20 ml.
- 6 zipper bags
- 1 tablespoon baking soda
- 1 tablespoon of sodium chloride (common salt)
- 1 tablespoon vinegar or lemon juice
- 10 or 12 pieces of ice
- 1 UV lamp (used to grow vegetables)

Activity 7: DNA extraction.

- ½ glass of water
- 1 tablespoon of salt
- 3 tablespoons of baking soda
- dishwasher jet
- 1 ripe tomato
- 1 spoon
- 1 fork
- 1 strainer
- 2 glasses
- 1 shot of alcohol

Activity 8: Looking for a second Earth

- no materials

WG1: Preparing for Observing

<u>Summary</u>

A star party can be a way to learn and have fun, especially if you do it with a friend or with a group of friends. You have to prepare for it, especially if you plan to use some instruments. But don't neglect the simple joy of watching the sky with the unaided eye or binoculars.
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<u>Goals</u>

- Explain how to choose the correct place, time, and date, what equipment you will take and how to plan the event.
- Recognize the Light Pollution problem.
- Learn to use the program Stellarium.

<u>List of materials</u>

Activity 1: Umbrellas of the Celestial Vault

- ✓ 1 black umbrella.
- ✓ 1 Liquid corrector used in order to correct written text on a piece of white paper
- ✓ 1 beamer for projection the North Hemisphere (or the Sothern Hemisphere) on the umbrella and paint the constellations with the corrector.

Activity 2: Light Pollution

- ✓ 1 shoe cardboard box or similar.
- ✓ 1 punch or compass point.
- ✓ 2 ping-pong balls with a hole in one of its poles to introduce a flashlight
- ✓ 2 flashlight which can be introduced in the hole of each ball.

General: 1 netbook for Internet access (recognition of heavens-above) and demonstration of the use of the Stellarium.

WG2: Astronomy in the city

Summary

The potential of archaeoastronomy in the teaching of astronomy is that it can inspire the hearts and consciousness of young apprentices to see their own culture reflected in the way of understanding the cosmos of their ancestors. In this sense, archaeoastronomy can provide a direct connection to their immediate environment as opposed to the apparent remoteness of the sky and the universe in general. If this is true, it would be interesting to conduct research on the pedagogical effects of either archaeoastronomy or ethnoastronomy or even a combination of both.

These approaches open up opportunities for students to stimulate dialogue with elders to learn traditional knowledge of the sky, particularly if they are located near or in agricultural or hunter-gatherer societies. In modern urban societies knowledge is transmitted more formally through schools and the media.

On the other hand, it is almost certain that in the immediate environment of the young astronomy apprentice, wherever he or she is located, there will be a series of buildings that could have a marked symbolic character and which already have a religious or secular function. Those buildings, or urban spatial planning, are potential objects of archaeoastronomical experimentation. Therefore, cultural astronomy can become an effective and valuable approach that can bring astronomy to the general public, and especially to young people.

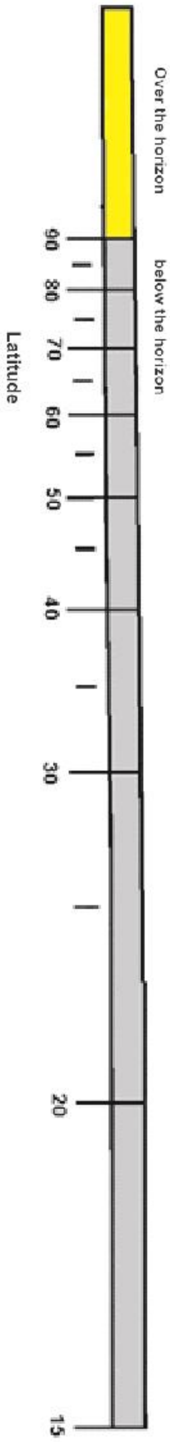
Goals

We quote some examples:

- Churches in a Christian environment.
- Mosques in a Muslim environment.
- Temples in a Hindu environment, Buddhist or Shinto (pagodas or gopurams included)
- Urban plans, especially those with a clear organized orthogonal frame (very common around the world).
- Sanctuaries of indigenous societies (Polynesia or America)
- Other places of worship in tribal societies.
- Ancient monuments if there were any.

List of materials

It is only necessary to have the planisphere made in working group 1 and the two demonstrators completed in workshop 2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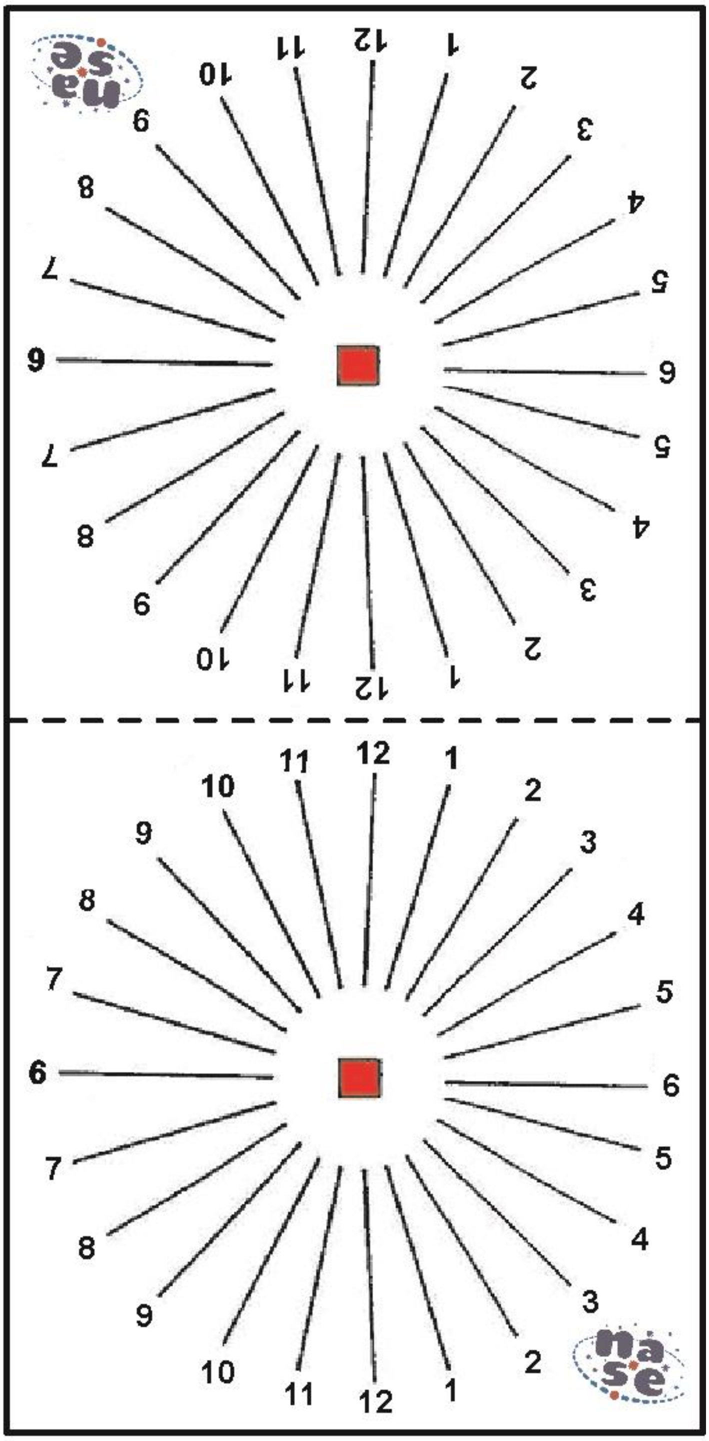
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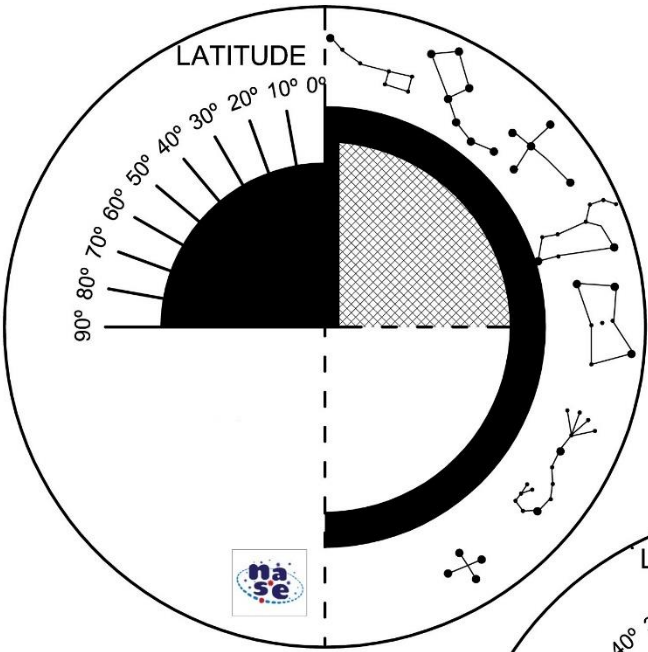
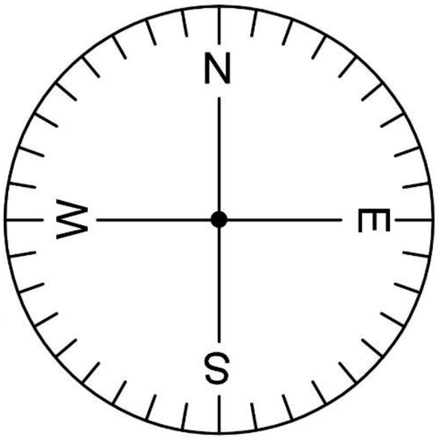
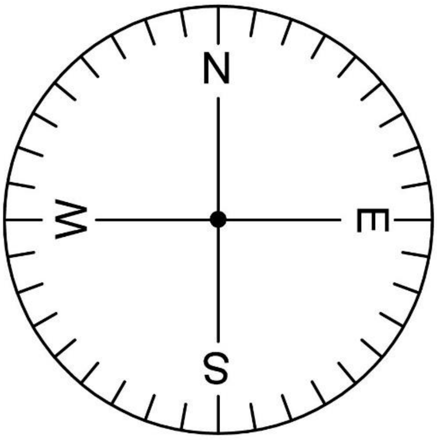
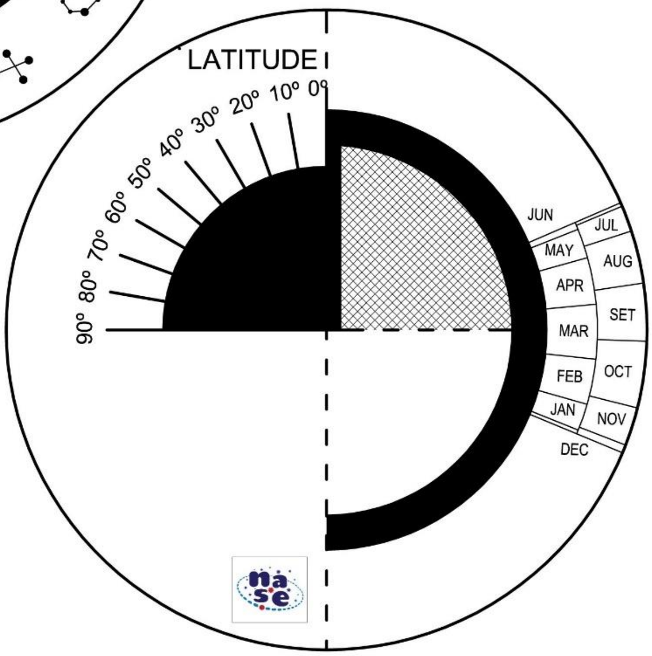
WORKSHOP 2 NORTE

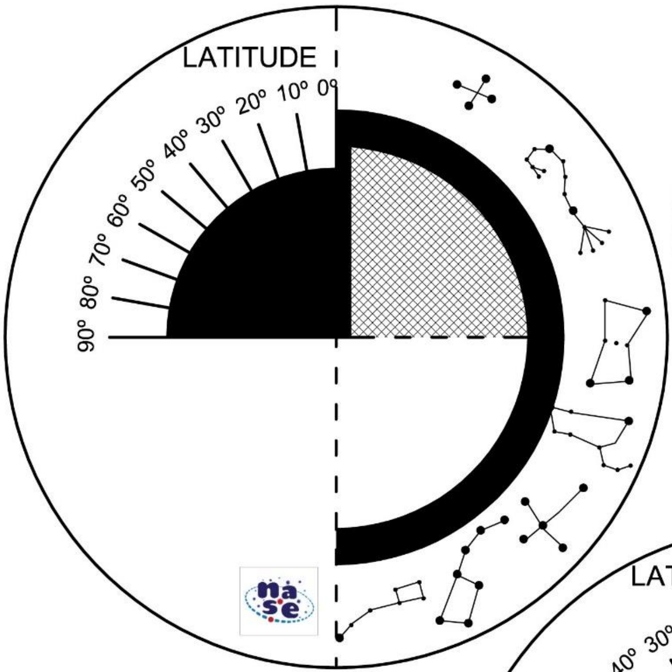


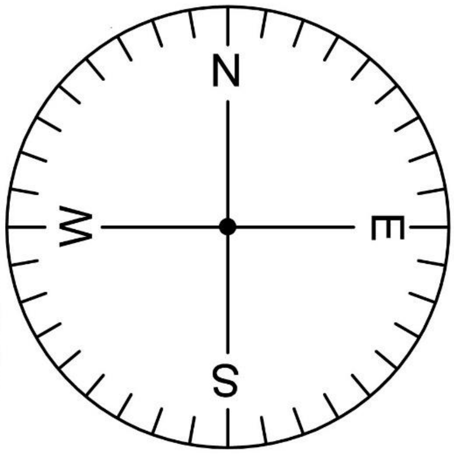


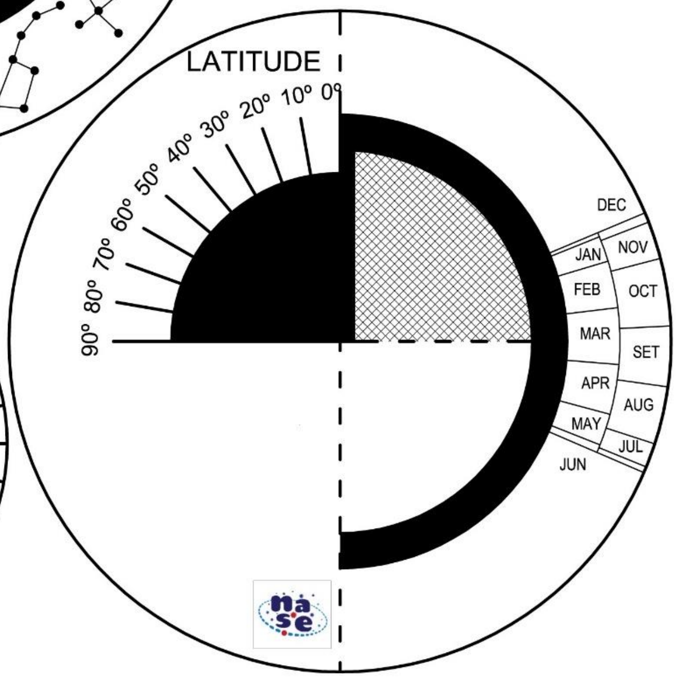


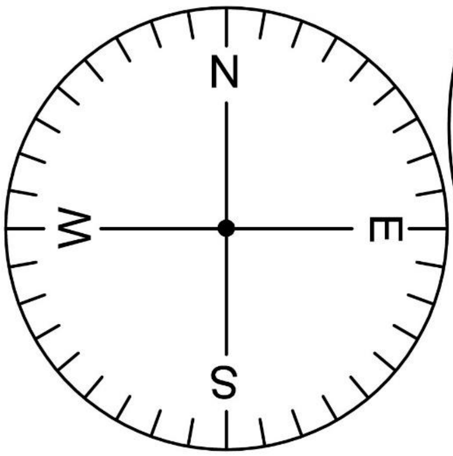


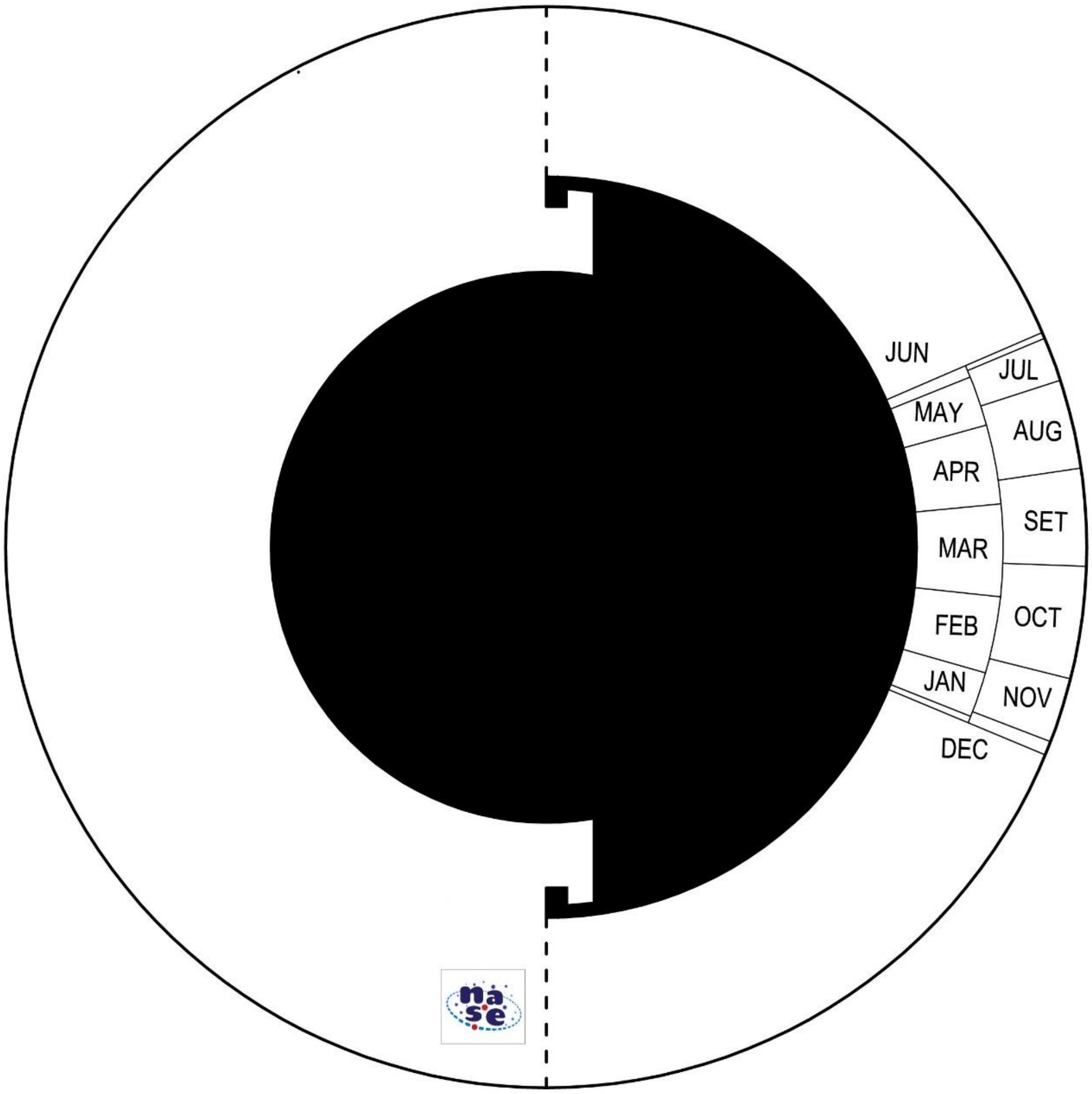
WORKSHOP 2 SUR





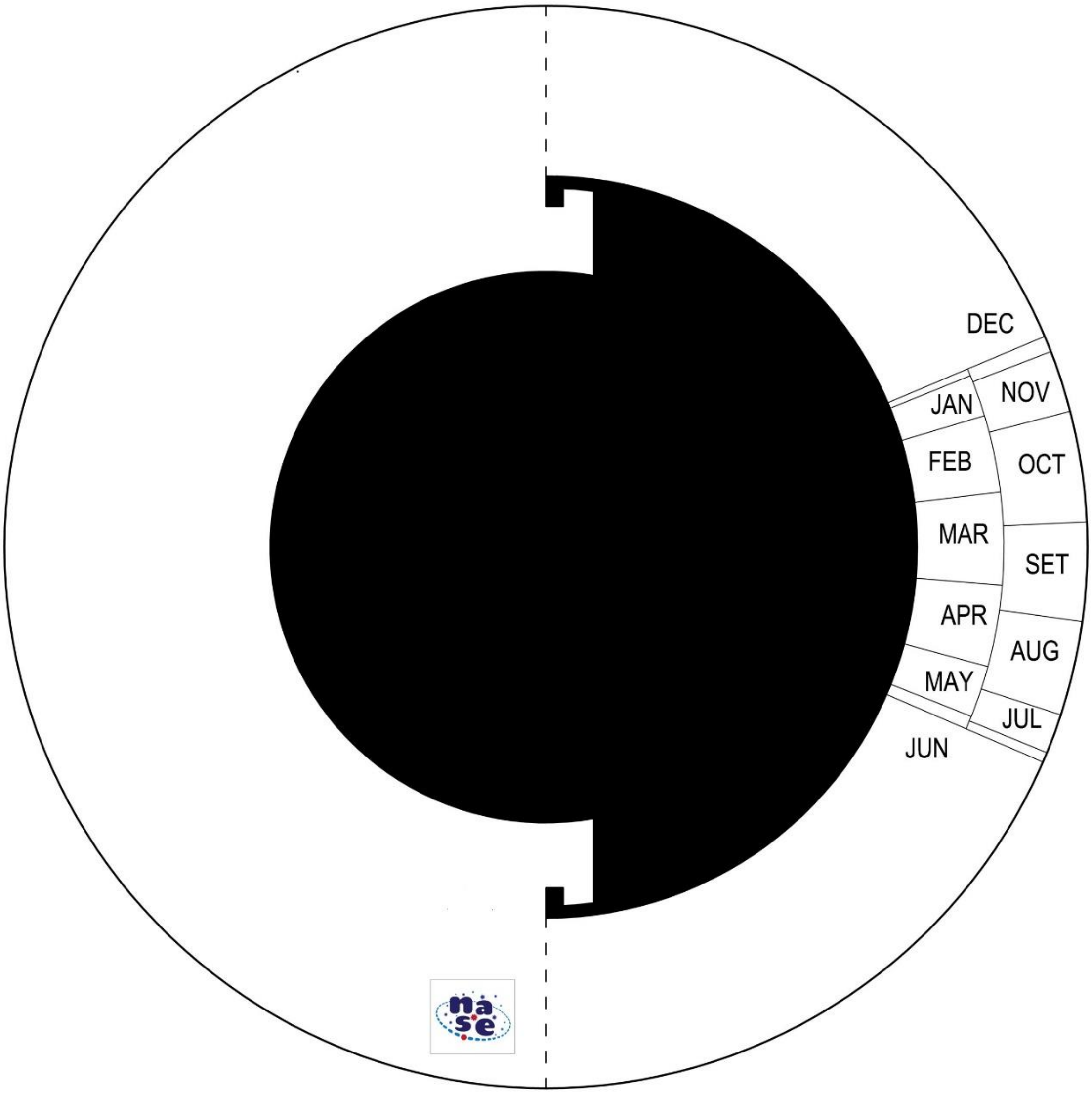


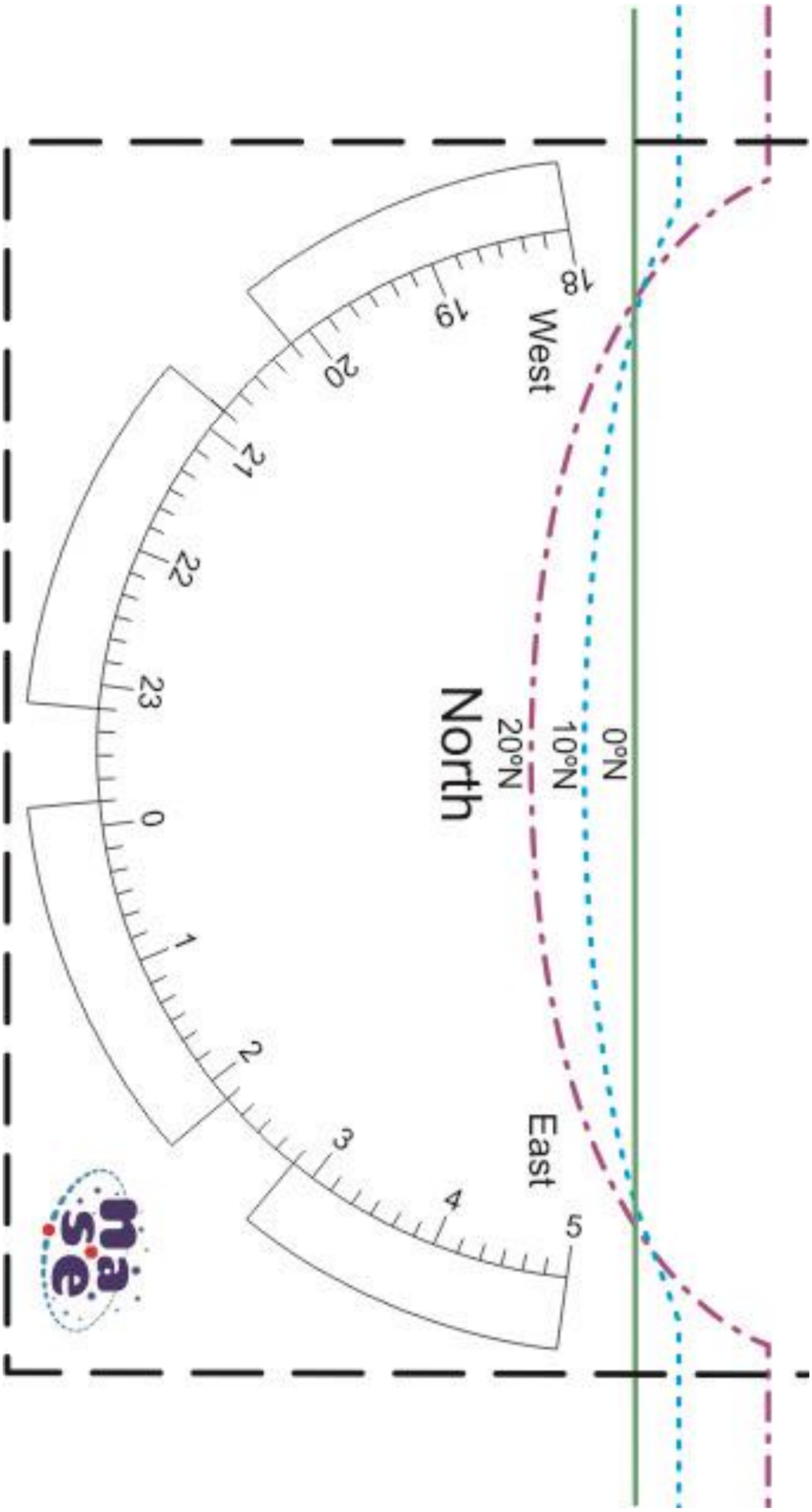




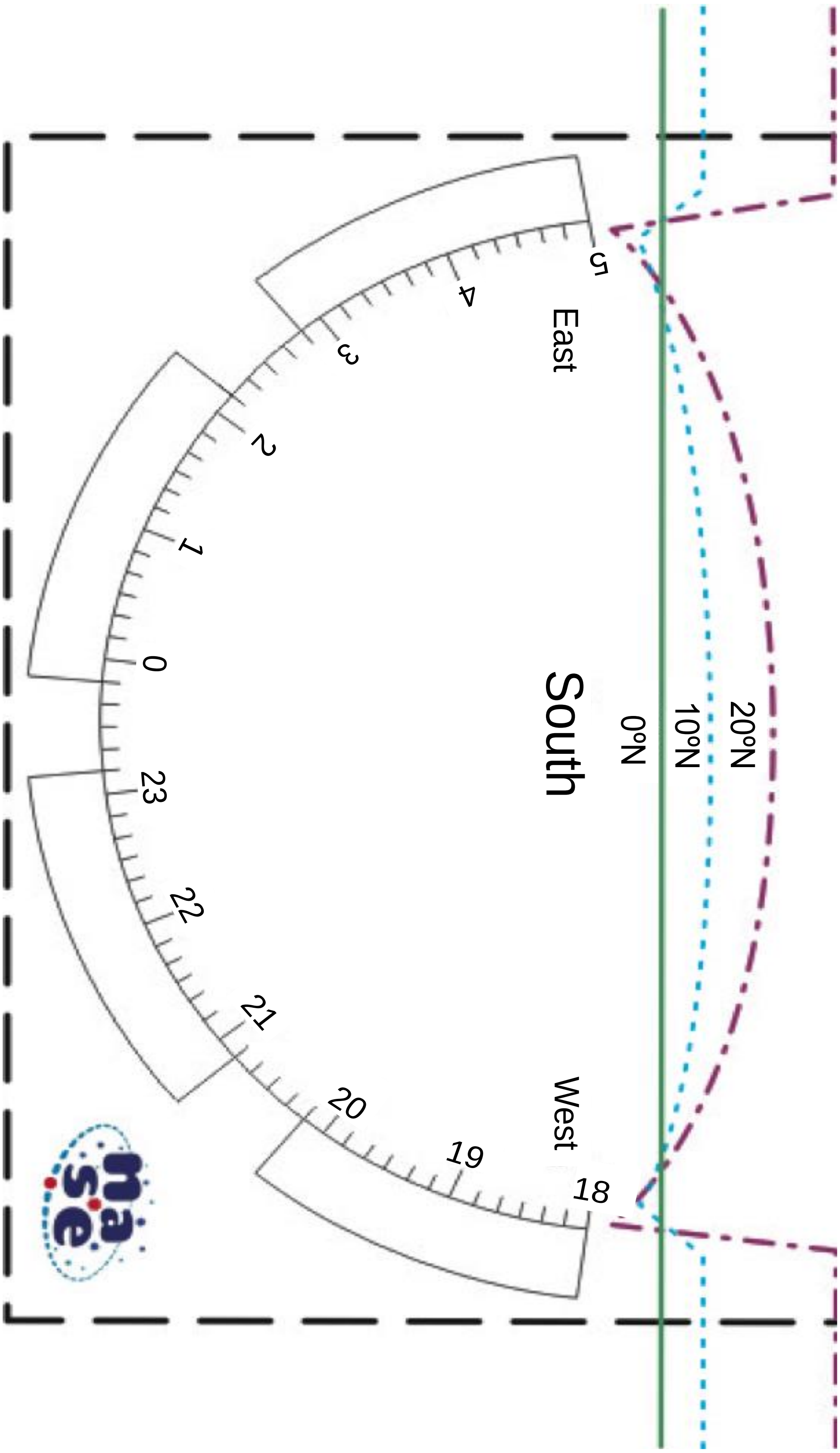
WORKSHOP 2

WORKSHOP 2





WORKSHOP 4 NORTE 0-20N



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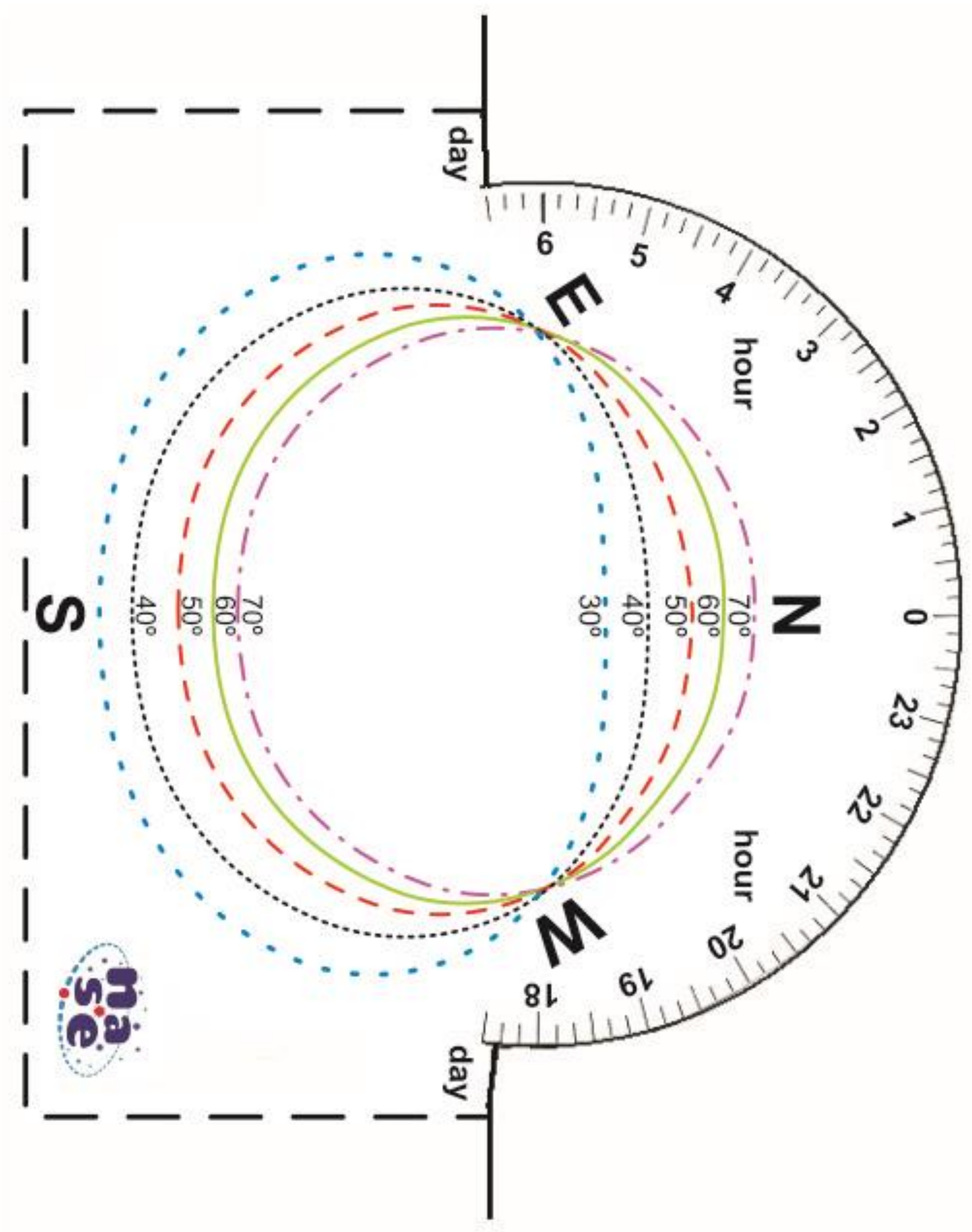
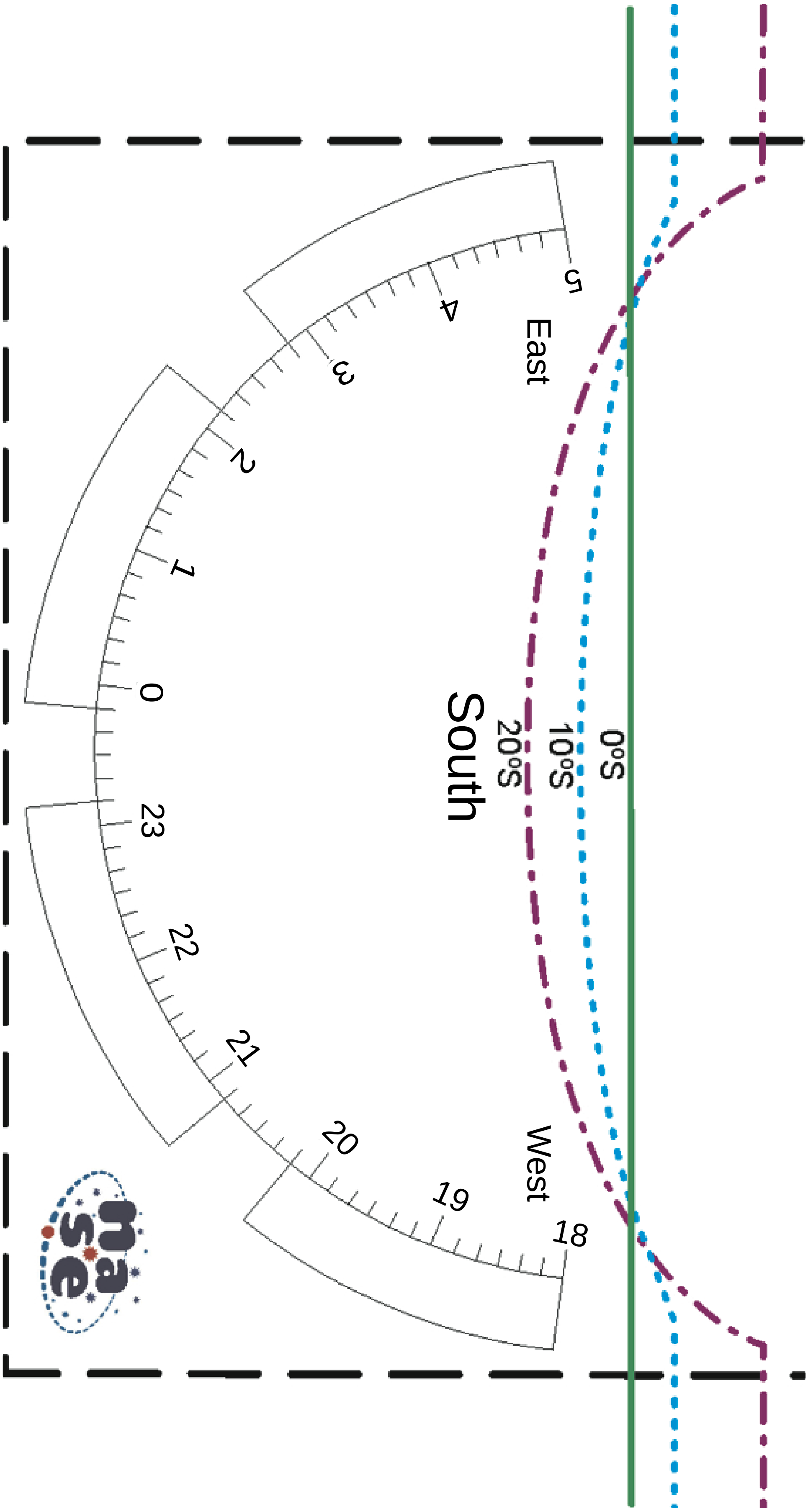


WORKSHOP 4 NORTE 30-70N

WORKSHOP 4 SUR 0-20S



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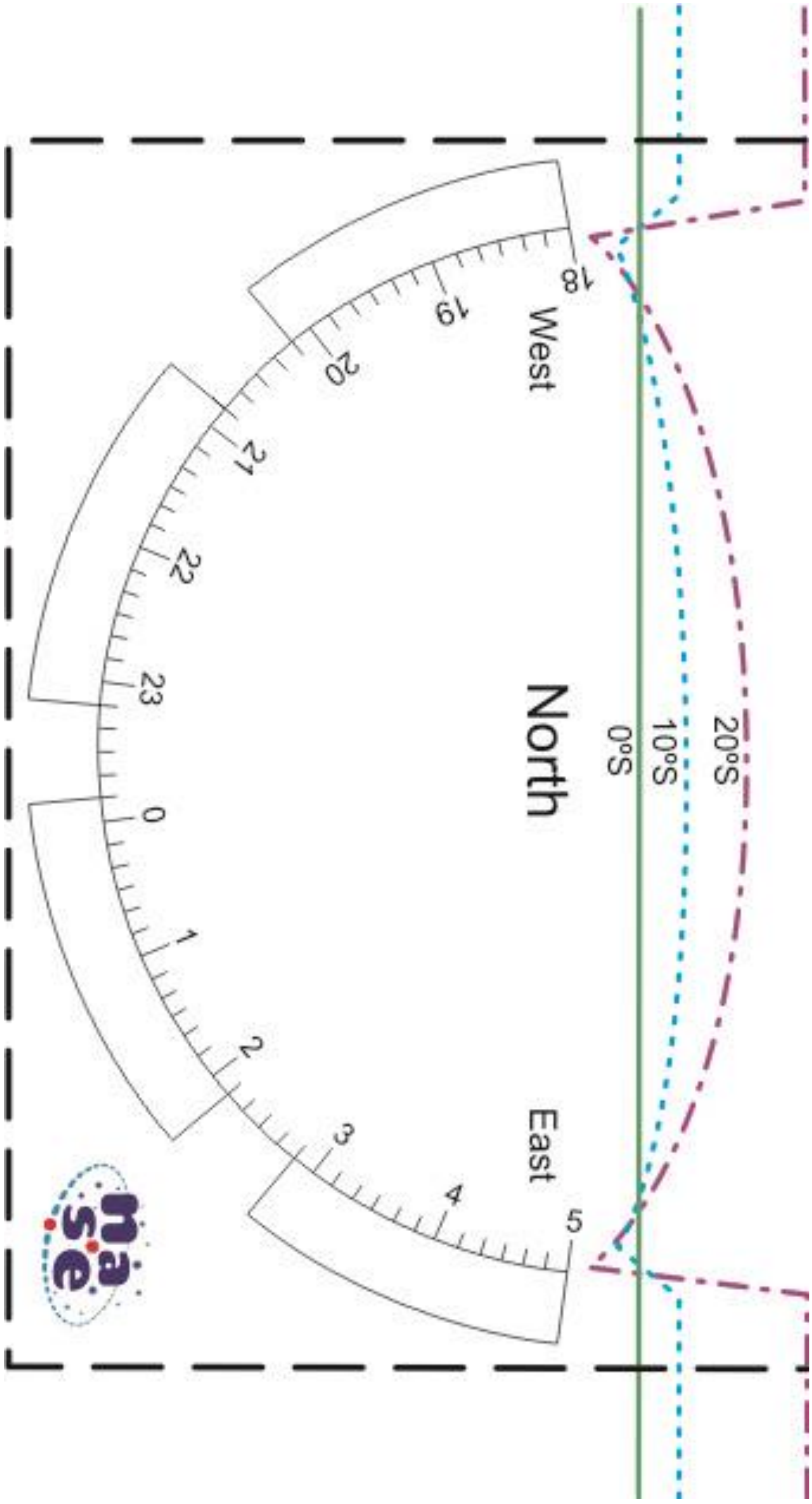

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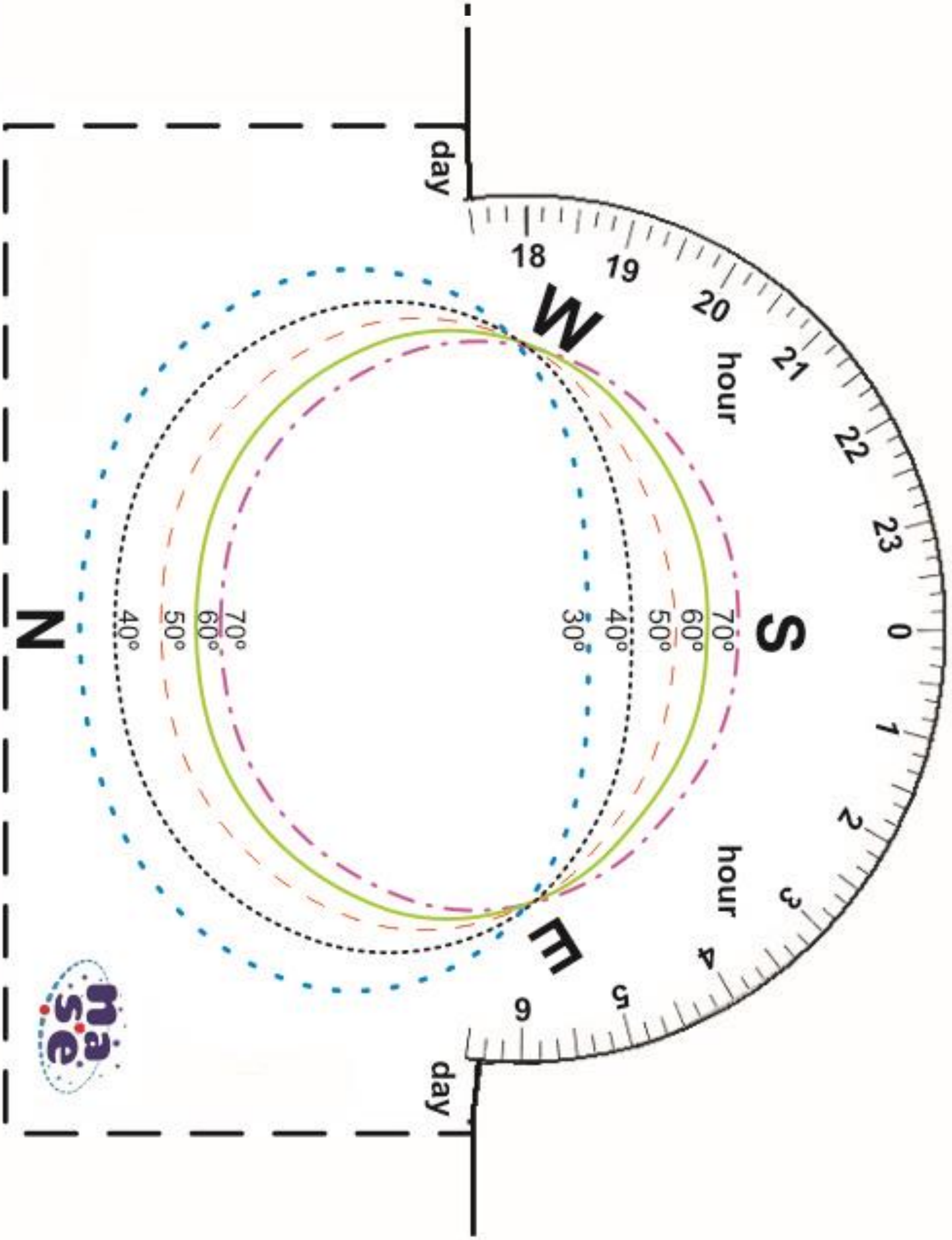

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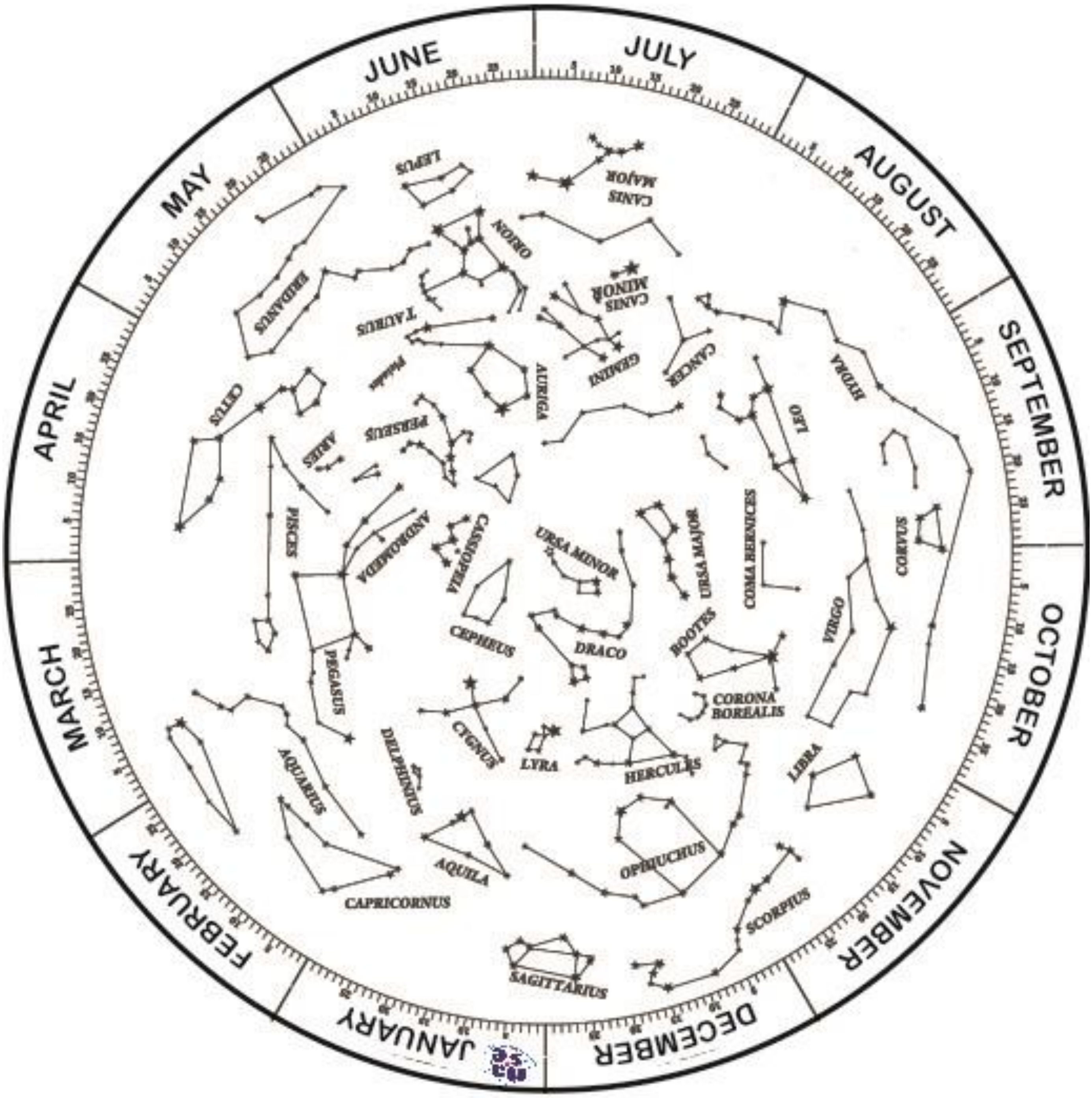
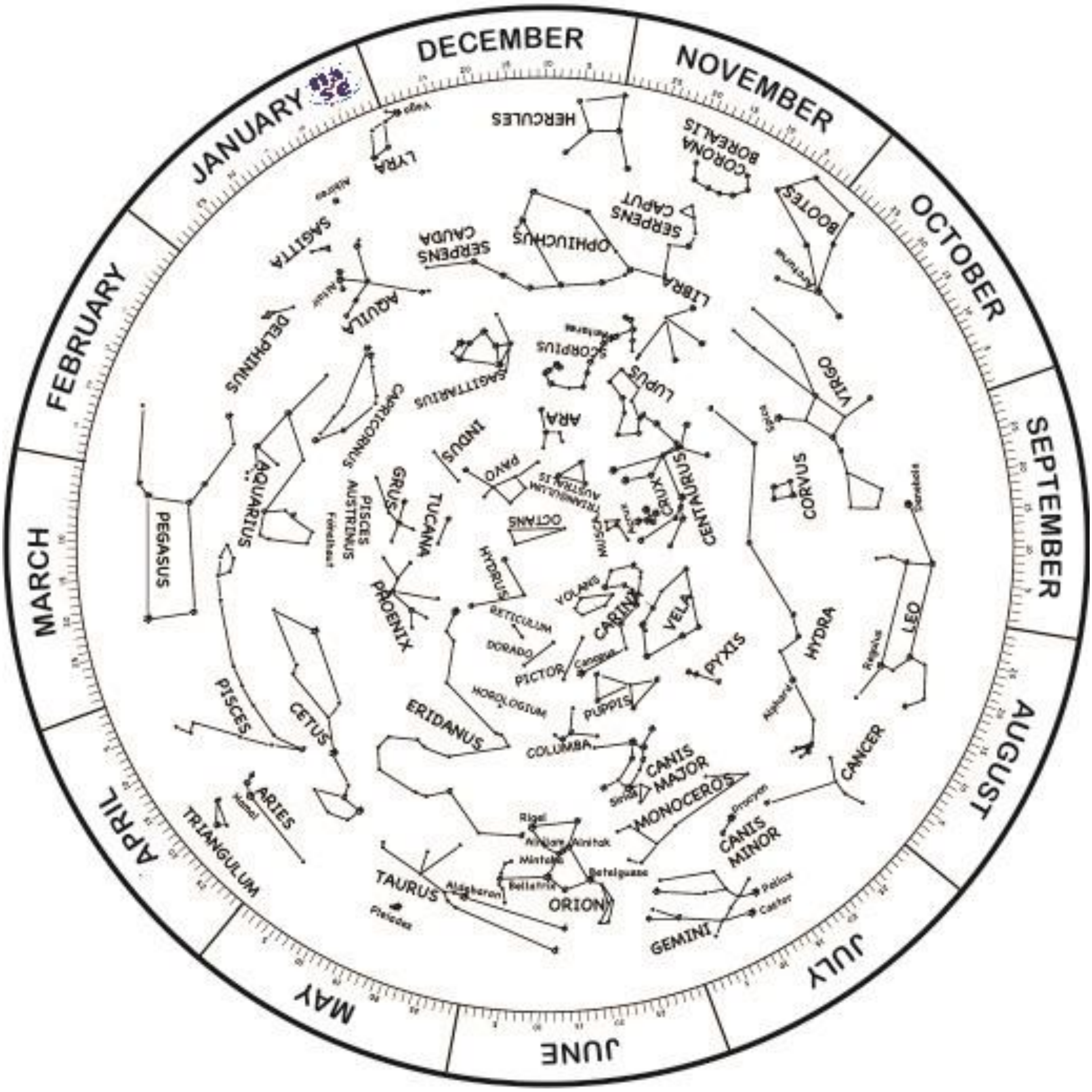
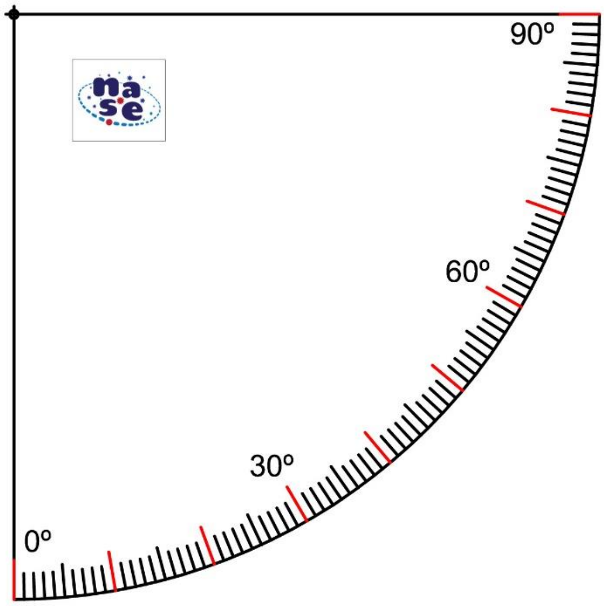
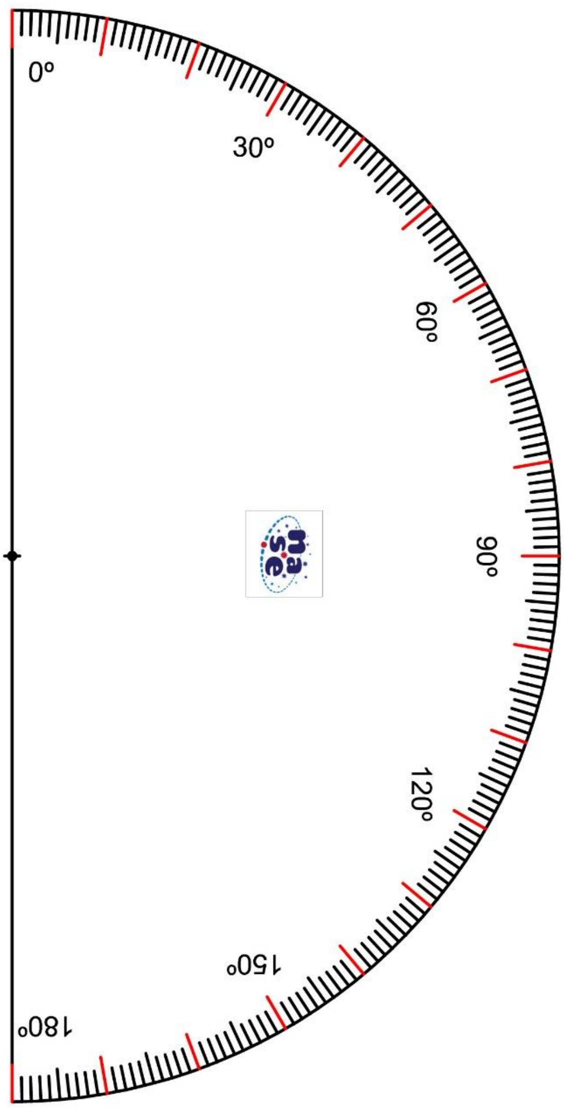


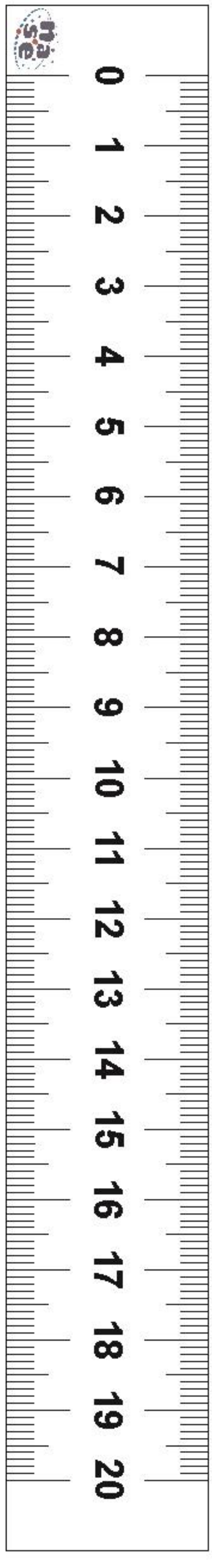
WORKSHOP 4   SUR



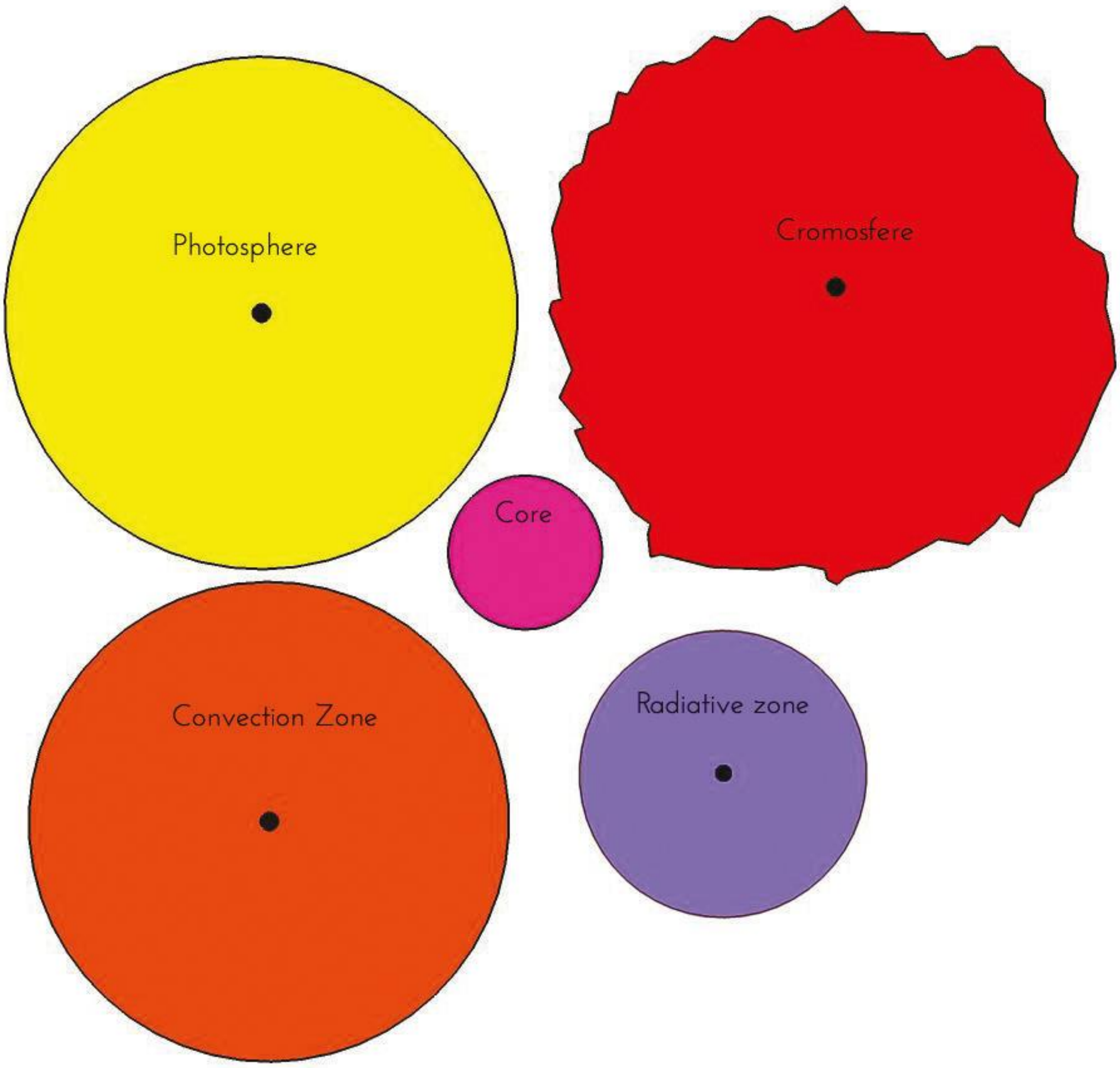

90º
60º
30º
0º


0º
30º
60º
90º
120º
150º
180º

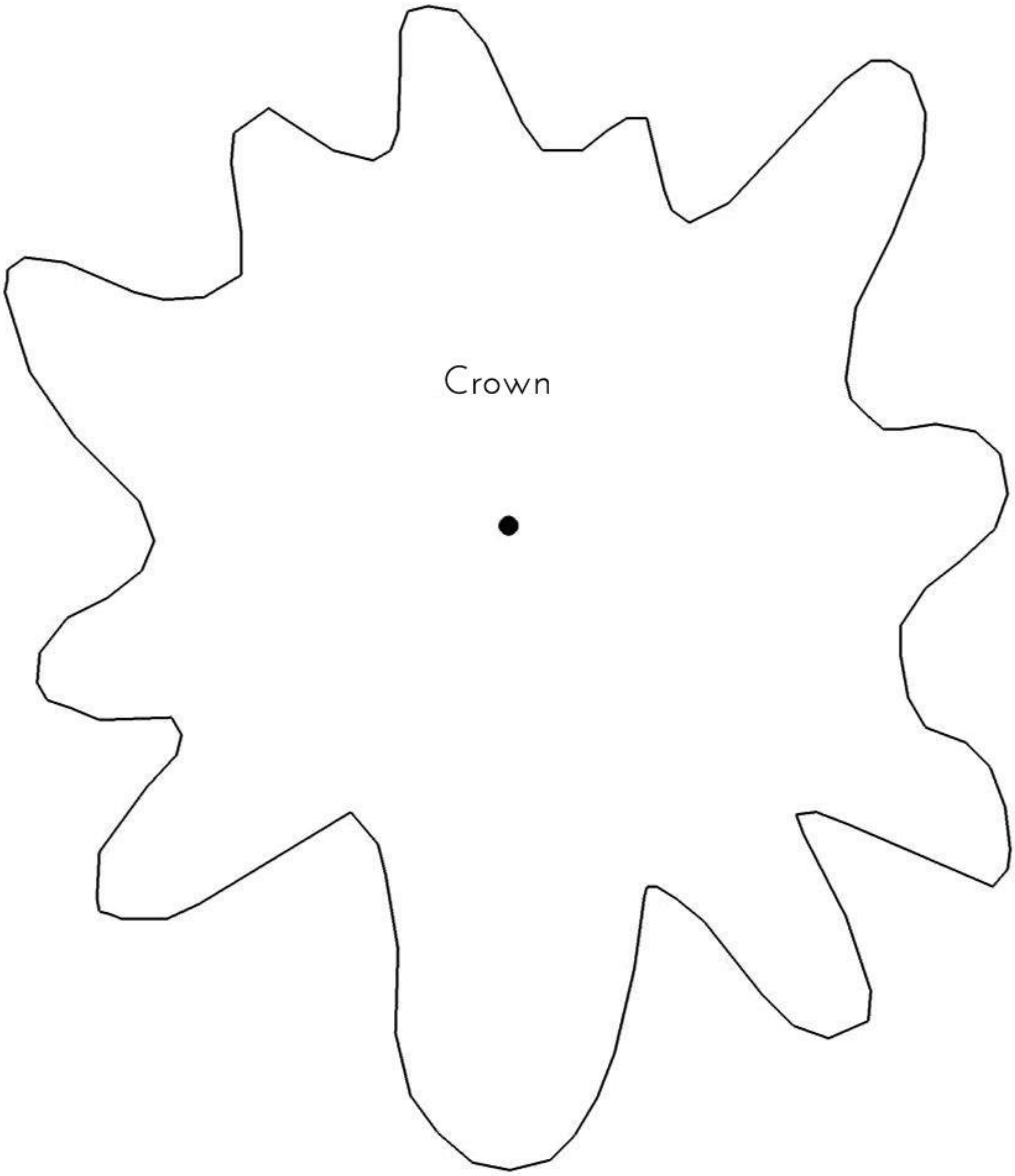
WORKSHOP 4


0
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20

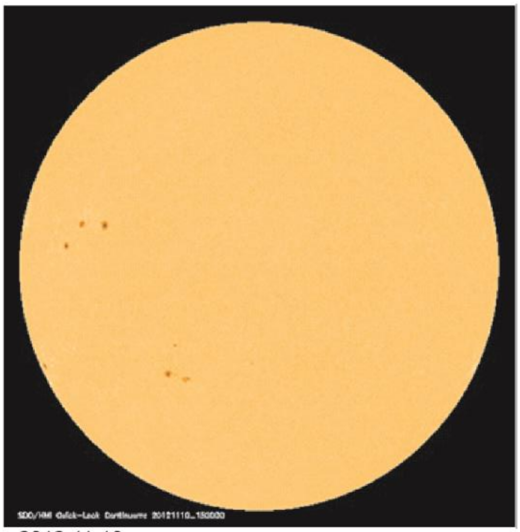
WORKSHOP 5


Photosphere
Cromosfere
Core
Convection Zone
Radiative zone

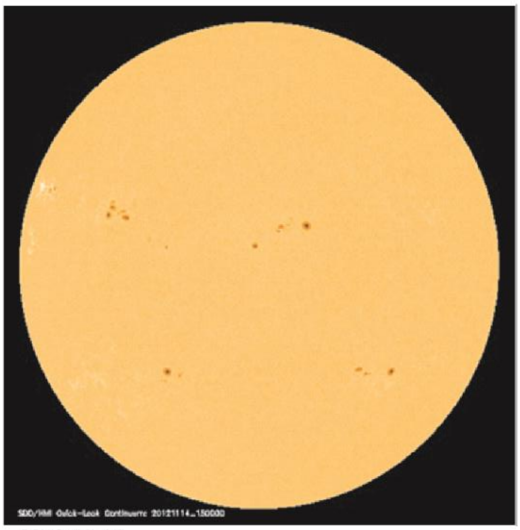
WORKSHOP 5



WORKSHOP 5


2012-11-10


2012-11-12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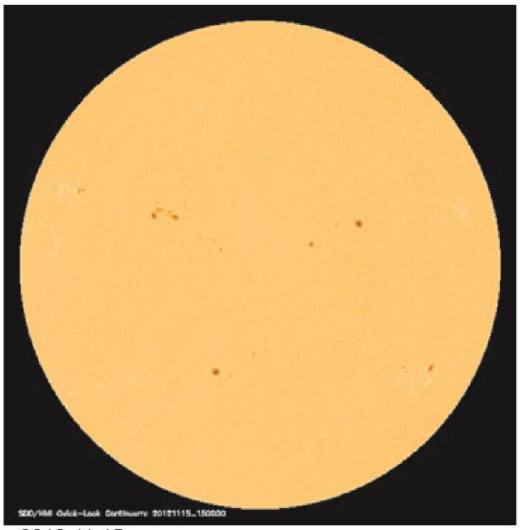
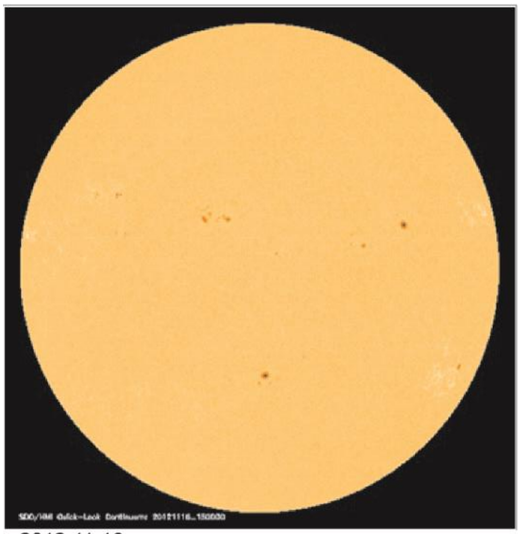
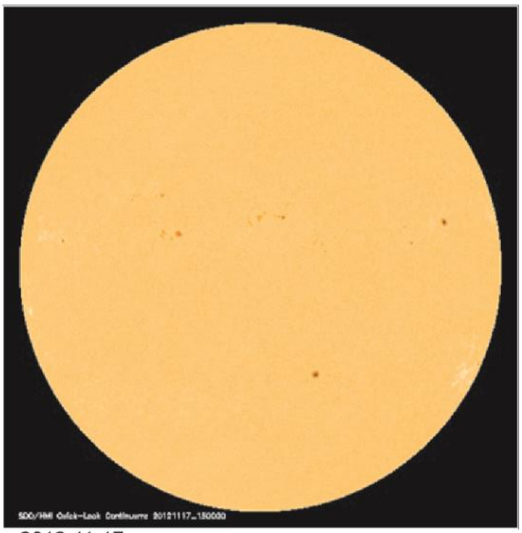
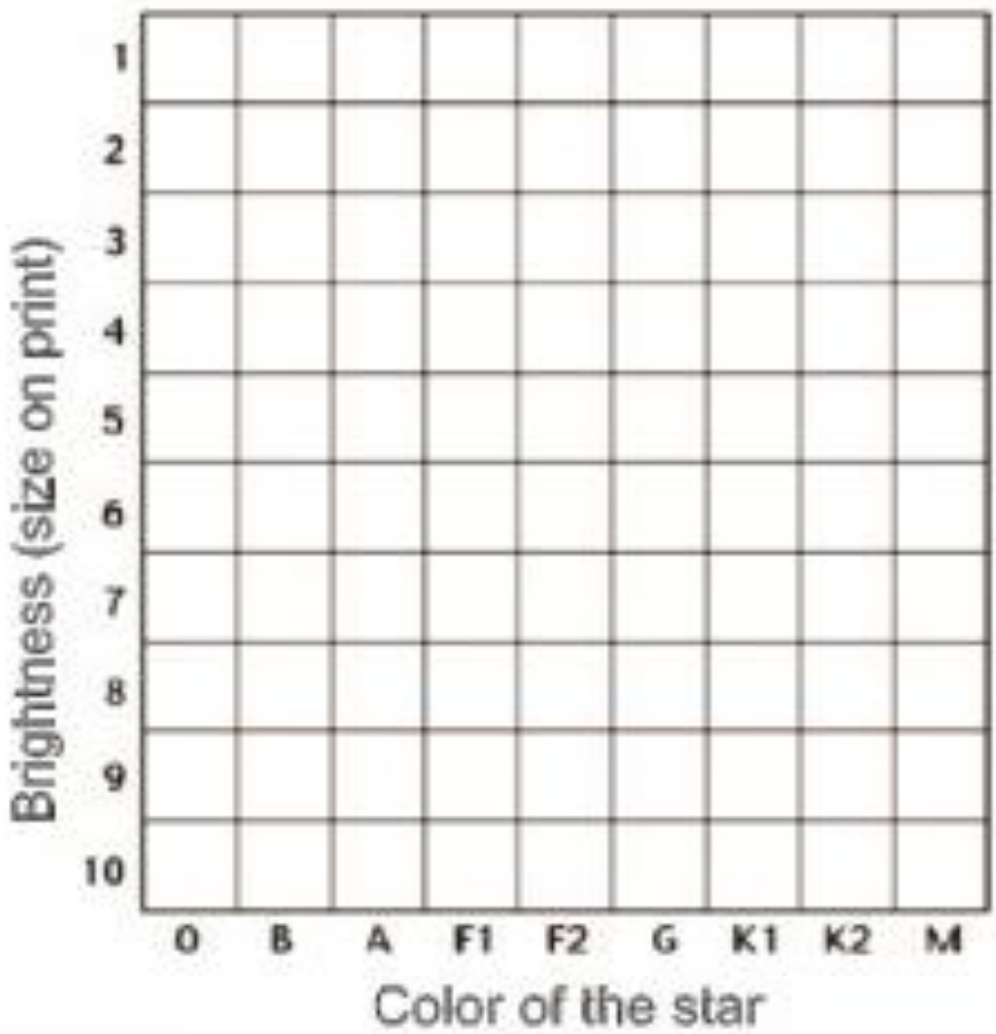

2012-11-15


2012-11-16


2012-11-17

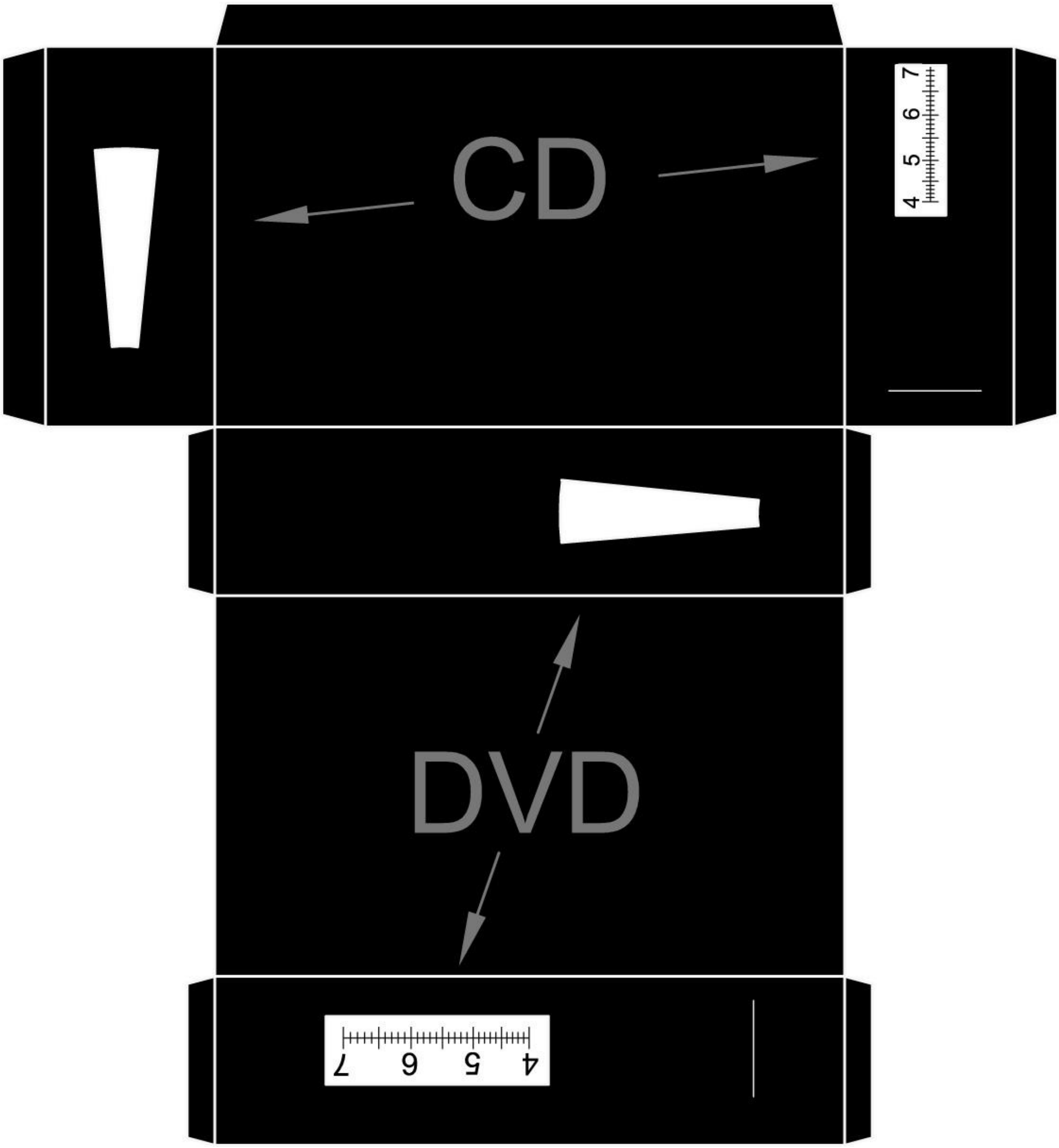
WORKSHOP 6

WORKSHOP 6



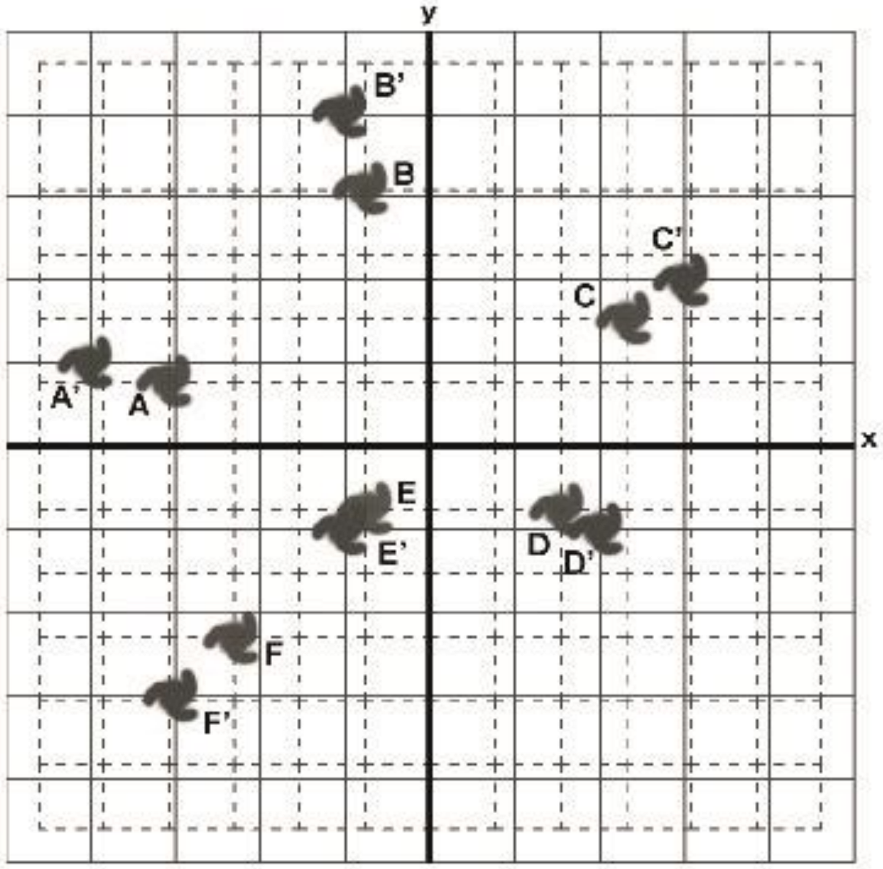
Brightness (size on print)
1
2
3
4
5
6
7
8
9
10
O
B
A
F1
F2
G
K1
K2
M
Color of the star

WORKSHOP 7



WORKSHOP 8

Expansion of the Universe.
Hubble constant determination.



GALAXY	COORDINATES X,Y	D=DISTANCE TO THE ORIGIN	ΔD	$v = \frac{\Delta d}{\Delta t}$	$H = \frac{v}{d}$
A					
A'					
B					
B'					
C					
C'					
D					
D'					
E					
E'					
F					
F'					

WORKSHOP 8