TASTE

Teaching Astronomy at Educational Level

Understanding the apparent motions of the Sun and the stars

A Teachers' Guide to the resources of the project TASTE (Teaching Astronomy at Educational Level)

Understanding the apparent motions of the Sun and the stars in the sky is fundamental for understanding our place in the cosmos. These motions link our direct experience – observing the Sun by day, the stars at night – with the basic geometry and motions of our home planet, both Earth's rotation and its orbital motion within the solar system. In consequence, these motions are a staple of teaching about astronomy in both primary and secondary schools. This document presents resources and insights related to this topic from the project TASTE ("Teaching Astronomy at Educational Level"), an EU-funded project involving schools and science centers from Italy, Greece, Belgium and Germany. TASTE combined educational research with development, and we believe the results should be of interest both to experienced teachers and to those who are just starting to teach astronomy.

Compared with other astronomical topics taught in schools, understanding apparent motions has a relatively high level of difficulty. To begin with, the set-up that needs to be understood is truly three-dimensional, and cannot be reduced to two-dimensional diagrams. Stellar and solar motion have similarities, but also key differences. Understanding what is going on requires students to develop adequate mental models – and as the research part of TASTE shows, quite a number of students have difficulties with this requirement.

The following is meant to provide an overview of insights and resources developed within the TASTE project that you as a teacher might find helpful in the classroom:

- Interested in knowing more about typical mistakes students make when learning this topic? Our research section 2 has more information.
- Interested in basic tools and resources you can use for teaching about apparent motion? You will find examples, with links to more thorough descriptions, in section 3.
- There is a planetarium near you, and you are wondering how to partner with them in teaching this topic? Section 4 has some resources for just that situation.

But before we go there, we should make sure we are on the same page: in section 1, we establish common ground with a summary of the basic concepts and phenomena relevant for our topic.

Please cite as:

TASTE Collaboration (2023): "Understanding the apparent motions of the Sun and the stars. A teacher's guide to the resources of the project TASTE." Zenodo, doi 10.5281/zenodo.8306479.

1 Apparent celestial motion – summary of basic concepts and phenomena

Attentive observation of the Sun over the course of a day, or the stars over the course of one night, shows a systematic pattern of apparent motions of these celestial objects in the sky. In order to describe these motions, we introduce a number of concepts anchored to our experiences: We do not perceive the arrangement of the stars as three-dimensional, nor do we have any perception of the three-dimensional positioning of the Sun. All of these celestial objects are much too far away for any depth perception – both for our own spatial vision and for the much more powerful method of us changing location and observing how these changes in position change our perspective ("parallax effect"). In consequence, our perception of the sky is that of a gigantic sphere to which the celestial objects are "attached." We call this imaginary sphere the *celestial sphere*. (Mathematically speaking, what we observe are the various directions from our observing location to the various celestial objects, and the set of all possible directions is isomorphic to the unit sphere.)

While we know that the Earth is, to very good approximation, a globe, our local impression, as human-size observers on Earth's surface, is that the fraction of Earth's surface we can survey with our own eyes is flat – as if we were standing on a flat plane. That imagined plane is called the *horizon plane* – it is the plane touching Earth's idealized globe in exactly one point, namely in our observing location. The horizon plane separates what we can see from our location on Earth from what we cannot see. In most situations, there will be obstacles – such as buildings, or mountains – further restricting our view, and looking out over a large body of water is the closest we can come to the idealized set-up. Ships moving off into the distance will appear to "sink" below the horizon, their hulls moving out of sight first, their upper structure next, with tall masts remaining visible a bit longer. Observations of this kind were an early indication of the Earth's spherical shape.

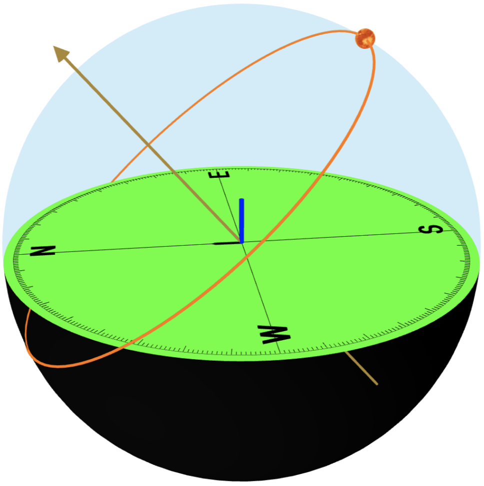

Figure 1 Sketch of the horizon system, with the horizon plane, cardinal points, daily solar path, and direction to north star marked. Image source: Snapshot from TASTE app, cf. section 3.10

On the horizon plane, we can define *cardinal directions* relative to our own position. The direction we would need to move in to head directly towards Earth's North pole, is North, and the other cardinal directions East, South and West are arranged in the usual clockwise fashion, as seen in a top-down view of the horizon plane. For arbitrarily fine subdivisions, we can measure the angle between a given direction in the horizon plane and the North direction. That angle is conventionally also measured clockwise, as seen from an observer above the horizon plane, and is called the *azimuthal angle* or *azimuth*. At any given time, we can assign to a celestial object that is visible in the sky an "angle above the horizon plane," which is called that object's *altitude angle* or *altitude*. In practice, when we face a particular object and point to it, the angle between our pointing arm and the horizon plane is the object's altitude (in other words, the altitude is the angle by which we would need to lower our pointing arm to the horizontal). If we start out facing North, the angle we need to turn clockwise in order to face the object is the object's azimuth. In this way, we can assign two coordinate values to any object that is visible to us in the sky.

When we as observers in the Northern hemisphere track either the Sun or the stars over the course of one day or one night, observation shows that these objects reach their maximum altitude when they are directly in the South. An object that is directly in the South, at maximum altitude, is said to be in *(upper) culmination*.

The Sun, as well as those stars that rise above the horizon over the course of the night, rise along the horizon's eastern half (the semi-circle linking north and south point via the west point), and those objects that move out of sight below the horizon set along the horizon's western half.

The apparent motion of the stars is comparatively simple. One can imagine the stars as being fixed on the celestial sphere, and the celestial sphere as a whole rotating around a fixed axis, at constant angular velocity. This part of the apparent motion is an effect of the Earth's rotation on its own axis, and can be given structure by reference to the Earth itself: If we imagine the Earth as a whole inside the celestial sphere, then if we prolong Earth's axis of rotation above the north pole, its intersection with the celestial sphere is the *celestial north pole*. In the night sky, the pole star ("Polaris") is close to the celestial north pole, and can be used to find the northern direction. By doing the same above Earth's south pole, we find the *celestial south pole*, although that point in the sky is not directly marked by a star. Half-way between, corresponding to the intersection between Earth's equatorial plane and the celestial sphere, is the *celestial equator*.

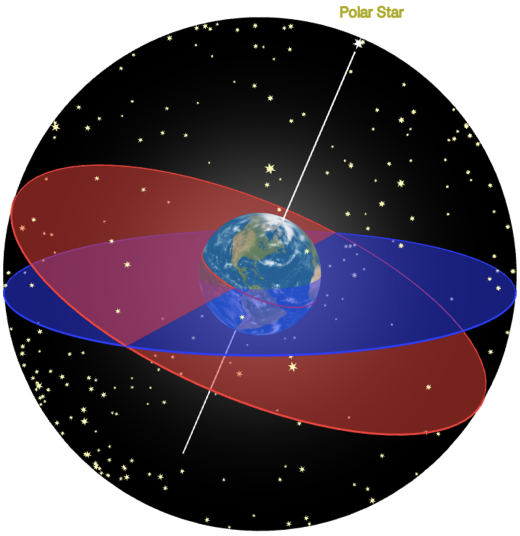

Figure 2 Sketch of celestial sphere with equatorial plane (red), ecliptic plane (blue) and Earth's axis marked. Image source: Snapshot from TASTE app, cf. section 3.10

A consequence of this simple pattern of motion is that, at least for an observer at a fixed location on Earth, stars that rise and set will always rise at the same point (at the same azimuth value) on the eastern horizon and set at the same point (azimuth) on the western horizon. Their altitude at culmination will also be the same.

The situation is more complicated for the Sun. As Earth orbits the Sun over the course of one year, the Sun's position as seen from Earth changes relative to the pattern of fixed stars. The great circle in the sky along which the Sun appears to move for an observer on Earth is called the *ecliptic*. The Sun's apparent motion as seen from Earth is a combination of its motion along the ecliptic on the one hand, and the apparent motion of the celestial sphere on the other. As a result, for an observer at a fixed position on Earth, the Sun's altitude at culmination changes, as do the points on the horizon (characterized by their azimuth values) at which the Sun rises or sets. The fraction of the Sun's path that is above the horizon will also vary: For Northern-hemisphere observers, the day is longest at the *summer solstice* when the Sun's altitude at culmination is highest, and the day is shortest at the *winter solstice* corresponding to the lowest culmination altitude. At the *vernal equinox* and *autumnal equinox*, day and night are exactly the same length. At those two times the Sun’s projection on the celestial sphere is where the ecliptic crosses the celestial equator. The change in solar altitude over one year is also the major factor for the seasons that can be experienced in the middle latitudes (between the polar regions and the tropical [equatorial] regions): sunlight becomes more intense when the Sun is higher in the sky, with the same amount of light falling onto a smaller surface area on Earth.

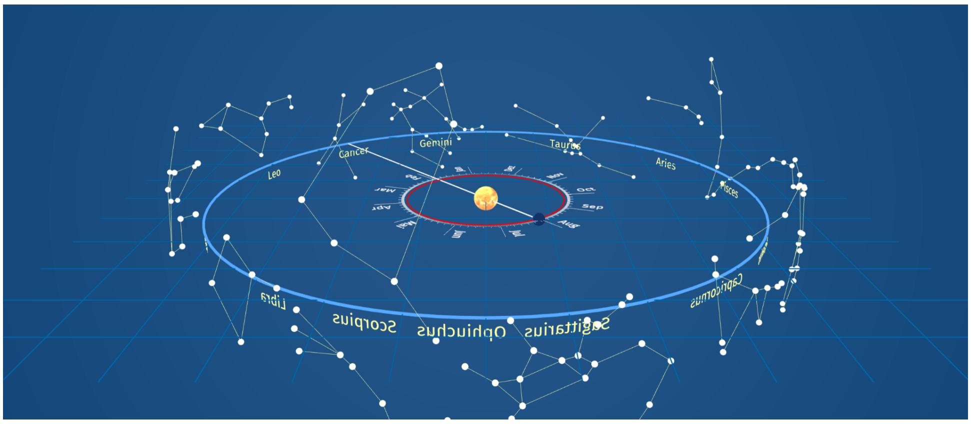

Figure 3 Projected position of the Sun onto the constellations in the ecliptic plane. Image source: Snapshot from TASTE app, cf. section 3.10

What an observer sees will also depend on their location, with geographic latitude as the key parameter. It is instructive to first look at edge cases: For an observer at the North pole (geographic latitude 90°), the apparent motions of stars and Sun happen along horizontal circles, with the pole star directly overhead. For an observer at the equator (latitude 0°), the Sun and each star describe daily circles that are orthogonal to the horizon plane, with the pole star directly on the horizon. For latitudes in between, the pole star can be seen at an altitude angle that corresponds to the location's geographic latitude, and there are different groups of stars. *Circumpolar stars* that are always above the horizon. Stars that are not circumpolar are either always below the horizon for a given observer, or else they rise and set.

For stars that rise and set, there is an additional effect. As the Sun moves along the ecliptic over the course of one year, stars that are too close to the Sun's current position cannot be observed at all – when they are above the observer's horizon, the Sun is visible as well, outshining the stars: As sunlight is scattered by the air molecules, our atmosphere takes on a blue color of its own, hiding the stars from sight. Except for observers at the poles, this leads to a yearly pattern of stars, or alternatively constellations, that an observer can see at night (when they are sufficiently far from the region where the Sun is on that date).

Similar to the Sun's motion along the ecliptic, one can also track the motion of the different planets; that, however, was beyond the scope of the TASTE project.

As this summary shows, there are quite a number of properties and relationships involved in understanding the apparent motions of the Sun and stars. In consequence, there are numerous ways of testing whether or not students understand what is going on, many of them of the form: how will a given situation change over the course of an hour, a month, or another period of time? That brings us to the next part: the education research that was undertaken as part of the TASTE project in order to probe student understanding of apparent motions.

2 Probing student understanding with the AMoSS test instrument

So how well do students understand these basic concepts of apparent motions to begin with – and how can we improve their understanding? To answer these questions, the TASTE project made use of the AMoSS (Apparent Motion of Sun and Stars) test instrument that had been developed, validated and published by Hans Bekaert, Mieke De Cock and colleagues previously.

2.1 The AMoSS test

The AMoSS test in the version used by TASTE consists of 12 multiple-choice questions aimed at testing basic understanding of the apparent motion of the Sun and the stars over the course of a day, a year, and for different observer locations on Earth. The test was deliberately kept short (testing time no more than 30 minutes), so as to allow testing e.g. during a school lesson or planetarium visit. The possible answers to its multiple-choice questions were chosen in a way so as to probe common (incorrect) alternative conceptions students may have. Background information about the AMoSS test can be found in the following publication:

> H. Bekaert et al.: "Design and validation of an instrument to test students' understanding of the apparent motion of the Sun and stars." In: Phys. Rev. Phys. Educ. Res. 16, 020135.
> doi 10.1003/PhysRevPhysEducRes.16.020135

The twelve AMoSS questions cover the following topics:

I. Apparent motion of the Sun	**II. Apparent motion of a star**
I.A Daily sun position changes: Sun's path	II.A Nightly star position changes: star trail
I.B Sun culmination changes during a year	II.B Star culmination: no change during a year
I.C Sunrise/sunset positions change during a year	II.C Star-rise/-set positions: no change during a year
I.D Sun culmination depends on observer position	II.D Star culmination depends on observer position
I.E Sunrise/sunset position depend on location	II.E Star-rise/-set position depend on location
III. Seasons and Earth's orbital motion	**IV. Sky map changes due to Earth's orbital motion**

We believe that there are at least two ways in which these results can be of interest to teachers. For one, the AMoSS test might prove helpful for formative assessment – providing information about your students' pre-existing notions about apparent motions or, with the test given once before and once after your teaching unit, providing feedback on the effectiveness of your teaching unit. Make sure, though, that you do not use AMoSS questions separately in your teaching, as this would skew the result!

If you want to make use of the AMoSS test, we offer the TASTE version of the test for download in four different languages. Versions a and b only differ by the order in which the questions are presented to the student – a measure taken in order to reduce any bias that might arise from the order of the questions:

AMoSS English, Dutch and Greek versions (PDF). doi 10.5281/zenodo.8305504
AMoSS Italian version (PDF). doi 10.5281/zenodo.8304473
AMoSS German version (PDF). doi 10.5281/zenodo.8304812

2.2 AMoSS-based research in the TASTE project

In the TASTE project itself, the AMoSS in two different ways. At the beginning of the project, one key aim was to find out about student understanding of apparent motions, and in particular about the mental models on which students' answers were based. To this end, the AMoSS test was administered to a total of 348 students, 13 to 17 years in age, in the four participating countries. For each question, beyond the multiple-choice answer, students were asked "Explain your choice," with a blank box allowing them to write down their reasoning in words and/or in the form of little sketches. As part of the study, the explanations were evaluated in detail. In all countries, the students demonstrated only a somewhat rudimentary understanding, and in all countries, the level of knowledge about the Sun's apparent motion was higher than for the stars. In a number of cases, several explanations by the same student were inconsistent with each other, indicating that the student did not have a coherent mental model for understanding apparent motions.

The results from this first study were used to develop a number of resources for teaching about apparent motions – which will be described in the following two sections. A selection of those resources was used to create an intervention, specifically: a combination of exercises to be completed over 80 minutes in school, plus activities and a planetarium show to be completed during a half-day visit to a planetarium or science center. The efficacy of that intervention was then examined for 262 participating students in a treatment study with a pretest–post-test design: The students took the AMoSS test (just the multiple-choice questions, no explanations asked for) before the intervention, and then again after the intervention. For the Belgian students, the planetarium visit with its planetarium presentation and hands-on workshops was replaced by in-school exercises with a three-dimensional model of the celestial sphere.

The results of this second study were more complex. On the plus side, there were significant moderate improvements in all countries, with the score (1 for a correct, 0 for an incorrect multiple-choice answer) increasing between 10% and 15%. Interestingly, when it came to improvements, there was no striking difference between the Belgian students and those students who had taken part in the planetarium workshops. Once again, the students were grouped into different classes according to the pattern of correct and incorrect answers (e.g. "Students who answered all questions correctly" or "Students who believe the stars behave in the same way as the Sun"), and changes before vs. after between those classes were documented. Overall, the intervention mainly improved students' understanding of the Sun's apparent motion, but was less effective for the stars – in fact, the class of students who assumed there was no difference between the Sun and the stars when it comes to apparent motion increased after the intervention!

Beyond the statistical analyses, the second TASTE study was a good example for the usefulness of this kind of before-and-after comparison for teaching practice. Each AMoSS question covers a separate aspect of the subject of apparent motions, so looking at the trend for each question (is the correct answer given more often after the intervention? is there a shift to a specific wrong answer?) can give helpful pointers on how to adapt the intervention and make it more effective, and which areas might not have been given enough attention and require revision. TASTE itself included one iteration of this kind (the initial study, the development of the intervention, and the before-and-after study); given the results, additional iterations are clearly called for.

Information about the research part of TASTE can be found in the following documents:

"A TASTE of Research" – TASTE research summary for teachers by M. De Cock (PDF).
doi 10.5281/zenodo.8305547

Bekaert et al. 2022: "Comparing students' knowledge of the apparent motion of the Sun and stars across four European countries" in *Astronomy Education Journal* 2(1). doi 10.32374/AEJ.2022.2.1.038ra

Bekaert et al. 2023: "Teaching the apparent motion of Sun and stars across four European countries," *Astronomy Education Journal*, submitted.

Complete Student's Handbook used for the 2023 study: doi 10.5281/zenodo.8288616

3 Tools and resources for teaching about apparent motions

Following the initial survey of student understanding of apparent motions and the exploration of students' mental models, the TASTE collaborators developed a set of tools and resources that allow for hands-on and exploration-based teaching about the subject. Some of these tools were used in the intervention (cf. section 2) – for these, there are worked-out exercises for using these tools as part of a workshop. Almost all of our tools are easy to produce DIY-style, and we provide how-to texts for each of them.

3.1 Exercises about daily motion

This module provides exercises for introducing the daily apparent motion of the Sun and the nightly apparent motion of the stars. The exercises facilitate the understanding of the basic concepts and the basic geometry involved.

Lesson module "The daily apparent motion of the Sun and stars" consisting of student worksheet (PDF), student worksheet with solutions, background information for teachers. doi 10.5281/zenodo.8280116

3.2 Sky in a bottle

The "sky in a bottle" is a simple, haptic model that allows students to explore the daily apparent motions of the Sun and stars as well as the annual motion of the Sun. The main element of the model is a large round-bottom flask (which you might find in the chemistry department of your school) whose spherical lower part is half filled with water. The spherical part represents the celestial sphere, the neck of the flask represents the northern direction, and the water represents the horizon plane. Changing the inclination of the neck corresponds to the transition to a different observer latitude.

Student worksheet "Sky in a bottle", student worksheet with solutions, background information for teachers (PDF). doi: 10.5281/zenodo.8304674

“How to” document, technical specs (PDF). doi: 10.5281/zenodo.8299610

3.3 Exploring apparent motions with Stellarium

The freely available planetarium software Stellarium is available in stand-alone versions for Linux, Windows and MacOS and in a browser-based version. Stellarium brings (part of) a planetarium perspective to your computer screen, and comes with numerous options for setting up specific dates and times, and for displaying specific celestial objects. The exercises presented here allow students to familiarize themselves with the program and to explore the daily motions of the Sun, stars and the Moon, using Stellarium.

Student worksheet "Exploring the sky with the computer program Stellarium", worksheet with solution, background information for teachers (PDF). doi: 10.5281/zenodo.8304532

3.4 The parallel globe

The parallel globe is a globe – either a large, elaborate version for demonstration purposes or a simple styrofoam sphere students can work with individually – that can be positioned so as to correspond to the students' real position.

In the proper position, the (flat) horizon plane attached to the globe is parallel to the students' real horizon plane, with the cardinal directions coinciding with their real-world counterparts as well. In this situation, the actual Sun can be used to illuminate "observers" in different locations on the globe, their shadows demonstrating how the altitude of the Sun depends on observer position.

A description of the parallel globe and how to work with it can be found as part of the teacher’s guide to 3D activities at the planetarium (PDF). doi 10.5281/zenodo.8288635

Parallel globe “How to” document and technical specs (PDF). doi 10.5281/zenodo.8299495

3.5 Celestial coordinate activities

The concepts of altitude and azimuth introduced for describing the position of the Sun or stars in the sky naturally lead to the observer-specific horizontal-system, or alt-azimuth, coordinates used in astronomy. These exercises introduce the horizontal-system coordinates, centered around the two topics of angles as a proxy for lengths, and angles as a measure of position, respectively. A key role is played by a physical realization in the shape of a "coordinate-measurement device" (in effect, a simple DIY theodolite), and apply the new knowledge to determining the positions of stars in the virtual planetarium Stellarium.

Lesson “Drawing the sky: the position of celestial bodies – Celestial coordinates” with students’ book, students’ book with solutions and background information for teachers (PDF).
doi 10.5281/zenodo.8298790.

“How-to” for the manual coordinate-measurement device (PDF). doi 10.5281/zenodo.8299572

3.6 Planisphere

The planisphere is a classical tool for observing the night-sky. The lower layer represents the fixed stars on the night sky, while the upper, partially transparent layer, can be rotated so as to indicate which stars are above the horizon at a given date and time.

The TASTE model of the planisphere is different from the usual layout in that it clearly separates the northern and southern hemisphere of the celestial sphere, showing one hemisphere on the one side, the other on the flipside. This orthogonal projection makes for an easier connection between the planisphere design and the location of the observer – less convenient for the practical task of night-time observing, but with added pedagogical value.

Student worksheet "Planisphere", student worksheet with solutions and background information for teachers (PDF). doi 10.5281/zenodo.8304092

“How to” on constructing the planisphere (PDF), technical information and image files. doi 10.5281/zenodo.8299672

3.7 Module: Causes of the Seasons

This exercise sheet provides a standalone unit for students to learn about the causes of the seasons in temperate regions on Earth. Two exercises, one including a classroom activity and a flashlight and the other an online simulator, address the changing inclination of the Sun's rays and the influence of the changing lengths of days over the course of one year, respectively.

Student worksheet "The causes of the seasons", worksheet with solutions, background information for teachers (PDF). doi 10.5281/zenodo.8304761

3.8 Yearly path of the Sun

This standalone unit allows the students to learn about the consequences of the Earth revolving around the Sun throughout the year. It contains exercises using an online simulation as well as the bottle globe (sky-in-a-bottle).

Student worksheet "Yearly path of the Sun" (PDF). doi 10.5281/zenodo.8288565

Student worksheet: version with solutions (PDF). doi 10.5281/zenodo.8288581

Background information for teachers (PDF). doi 10.5281/zenodo.8288587

3.9 Earth's axis

This standalone unit examines the tilt of the Earth’s axis, the constancy of direction of that axis as linked to the physical quantity of angular momentum, and the connection of the tilt to Earth’s seasons.

Student worksheet "Earth's axis " (PDF). doi 10.5281/zenodo.8287483

Student worksheet: version with solutions (PDF). doi 10.5281/zenodo.8287473

Background information for teachers (PDF). doi 10.5281/zenodo.8288522

3.10 Browser-based apps

While illustrations help to understand specific aspects of the apparent motions of the Sun and stars, the three-dimensionality presents a challenge. Humans do not have truly three-dimensional vision – our vision is two-dimensional, and we make use of spatial clues to reconstruct three-dimensional structures. One key technique, that of examining a three-dimensional object from several directions (e.g. by turning the object, changing its orientation), is impossible with static illustrations. That is why, in the course of the TASTE project, we developed three browser-based apps that can serve as "three-dimensional illustrations," but that can also be used by students to interactively explore specific aspects of the topic.

Specifically, the first app is a simplified representation of the horizon system. It allows users to display (and animate) the Sun's daily path for different times of the year. The second app represents the horizon system and the equatorial system on the celestial sphere, and can also be used to introduce the respective celestial coordinates. The third app models Earth's orbit around the Sun over the course of a year, and shows the resulting apparent motion of the Sun relative to the fixed stars.

Documentation Celestial Sphere App (PDF). doi 10.5281/zenodo.8300091

Documentation Celestial Equator App (PDF). doi 10.5281/zenodo.8300075

Documentation Ecliptic and Constellations App (PDF). doi 10.5281/zenodo.8300113

3.11 Sidereal Clock and Nocturnal

For observers at the northern hemisphere, the counter clock rotation of the stars around the pole star (Polaris) can be used as a large nocturnal clock, namely the *sidereal clock*. This clock, however, should not be read as a conventional clock, since sidereal time differs from solar and civil time. This activity allows the students to understand these concepts by looking at the physical phenomena that originate the concept of time.

There is one complication though: In order to correctly read time on the sidereal clock, it is necessary to make a calculation to convert the time indicated by the hand to civil time. The *nocturnal* is an instrument that automates the calculation of civil time (except for the correction for the different longitudes with respect to the central meridian of the time zone) and improves the accuracy of the reading.

Reading the time in stars – booklet with an in-depth description of using the stars for time-keeping, and using the sidereal clock and the nocturnal (PDF). With many examples.
doi: 10.5281/zenodo.8299636

Manual and How-To: Sidereal Clock (PDF). doi 10.5281/zenodo.8299630

Manual and How-To: Nocturnal (PDF). doi 10.5281/zenodo.8299600

4 Planetarium resources

A key element of TASTE was the collaboration between schools and science centers, and specifically planetariums. Both as part of the research intervention (cf. section 2) and to support teaching about the TASTE topics, a number of planetarium resources were developed as part of this project: one for use with classic star-projector planetariums, plus fulldome movies for planetariums with digital projectors.

4.1 Classical planetarium presentation

The classical planetarium is a powerful tool for recreating the apparent motions of the Sun and stars in a controlled environment. Naked-eye observations that would require a long time in real-life can be recreated in the course of minutes – by compressing time, or by jumping from one date to the other. That allows for comparisons in a much more direct fashion than for real-time observations.

For the TASTE project, we developed a scripted program on apparent motions that can be used both in classical (stellar projector) and digital planetariums. This scripted program was part of the before-and-after research described above, in section 2. For teachers who can partner with their regional planetarium, this program can serve to coordinate classroom teaching with a planetarium visit.

Guide for planetarium operators (PDF) and guide for teachers (PDF). doi 10.5281/zenodo.829763

4.2 Fulldome movies

A digital planetarium provides even more possibilities than a classical planetarium. In particular, fulldome movies projected into the dome allow us to change between the geocentric and the allocentric perspectives – presenting the sky as it appears to an observer from Earth, and then "zooming out" to a perspective that shows the Earth, the Sun, and Earth's orbit around the Sun. As part of the TASTE project, five full-dome videos were created, which introduce the concepts of sidereal time, of using the stars and celestial changes to tell the time, the influence of the observer position (latitude in particular) on observations, planetary motions, and last but not least an overview/introductory movie about the apparent motion of the Sun and stars in general.

These fulldome movies, with supporting material, can be downloaded here:

Fulldome movie "Sidereal Time". doi 10.5281/zenodo.8272639
Fulldome movie "Celestial Measures of Time". doi 10.5281/zenodo.8303125
Fulldome movie "How an observer's position influences observations". doi 10.5281/zenodo.8302384
Fulldome movie "The planets' motions and positions". doi 10.5281/zenodo.8304177
Fulldome movie "Apparent motion of Sun and stars". doi 10.5281/zenodo.8303008

Funded by the Erasmus+ Programme of the European Union

TASTE

Teaching Astronomy at Educational Level
(2020-1-IT02-KA201-079528)

These resources were created as part of the project TASTE (Teaching Astronomy at Educational Level), co-funded by the Erasmus+ Programme of the European Union,
Erasmus+ project 2020-1-IT02-KA201-079528.
All the TASTE resources can be found here: https://zenodo.org/communities/taste