



# SPACE<sup>☆</sup> awareness

## TIME AND SPACE AROUND ME

Learn to measure the Sun's path in the sky  
Grom D. Matthies, Nuclio



**Curriculumonderwerp**  
Constellations, stars

**Grote idee van wetenschap**

**Trefwoorden**  
Islamic Heritage

**Leeftijdsgroep**  
12 - 16

**Onderwijsniveau**  
Middle School, Secondary School

**Tijd**  
1 day

**Groepsgrootte**  
None

**Toezicht voor de veiligheid**  
Supervised

**Kosten**  
Low (< ~5 EUR)

**Locatie**  
Outdoors

**Kernvaardigheden**  
Asking questions, Planning and carrying out investigations, Using mathematics and computational thinking

**Type leeractiviteit**  
Partial enquiry

## KORTE BESCHRIJVING

This is an outdoor activity, complemented indoors for better results. Students will use the 90° angle scale on top of their astrolabe to measure the altitude of the Sun and any landscape features just below the Sun several times throughout their day at school. These measures will then be plotted graphically to create a skyline with the path of the Sun above.

Depending on the time of year, this exercise may not work too well or at all for locations far beyond 55° latitude on either hemisphere. Therefore it is advisable that the teacher first simulates the outcome for the desired day and times before exercising with students.

The exercise is carried out by measuring for several minutes at a time throughout a day, either at school and/or at home.

## DOELEN

The primary goal of this activity is to learn taking measures with an angled scale and subsequently plot a graph in order to learn about the apparent path of the Sun in the sky over the course of one day. From the resulting arch one can deduce the true local midday and true South (depends on hemisphere). The difference between official time and true local time is also introduced. Creative drawing and special awareness skills are also put to use.

## LEERDOELEN

After this exercise, the students will be able to:

- take precise angular measurements.
- interpolate data points derived from time dependent angular measurements.

- describe the apparent diurnal path of the Sun in the sky.

## EVALUATIE

- The precision of the measurements can be assessed by comparing results from all the students. Using the Sun's path is sufficient for this purpose.
- Before connecting the data points representing the Sun's altitude at various points in time, ask the students how the missing data can be inferred. What is the main assumption for interpolating? (smooth increase and decrease of altitudes)
- Let the students describe the path of the Sun. Are the points of sunrise and sunset symmetric with regard to local midday? How long was the Sun above the horizon? When did the Sun indicate local noon? What would change if the measurement were taken at a different day during the year?

## MATERIAAL

- Astrolabe
- The time vs. altitude template
- Pencil (optional: one type B, one type H1), ruler, (optional) French curve (curve ruler)
- Notepad to write down measures and sketch (part of) the landscape
- A clock or watch (or other device to track time)

## ACHTERGRONDINFORMATIE

As the Earth rotates, the Sun appears to describe an arched path in the sky over the course of a day. In summer this path crosses much higher in the sky than in winter. When the Sun passes its highest point of the daily arch, it is said to *transit* or *culminate*. When this happens, the Sun is always directly south (or north in southern hemisphere). The moment of transit is *true local noon* (midday), which, most likely, is very different from what the clock indicates at that time. True local time is a very unpractical measure of time to use when traveling over long distances in eastern or western direction, which is the reason why each country adopts an *official* or *legal* time, which tends to be the same for all countries on the same longitude. This is the base for the implementation of *time zones*.

## VOLLEDIGE BESCHRIJVING VAN DE ACTIVITEIT

You should measure the altitude and position of the Sun at many times between sunrise and sunset: during every school break, between classes and - if needed - continue at home. If done several times per year, one can compare the different results.

**Preparation** You need a place where you are able to see the Sun for most of the day. Ask your teacher to point you to a good observation point or choose a position yourself on for example the schoolyard. Remember to always measure from this exact spot.

**Exercise REMEMBER: NEVER LOOK DIRECTLY INTO THE SUN!** Hold the astrolabe by the string and aim it at the Sun in such a way that you can see the leading sight on the alidade cast a shadow. Rotate the alidade until its shadow passes the astrolabe's centre and points to the second (lower) sight on the alidade.

Position yourself on your observation point with your astrolabe, a notepad, and a pen or pencil.

Write down the current time.

Read the angle of the Sun's altitude and write this value down.

Look at the landscape right below the Sun, where the sky touches the ground. This can be a building, a tree, a hill... Make a very simple drawing of the outline of that small part of the landscape. Use the astrolabe to measure the angle of the highest parts of that object.

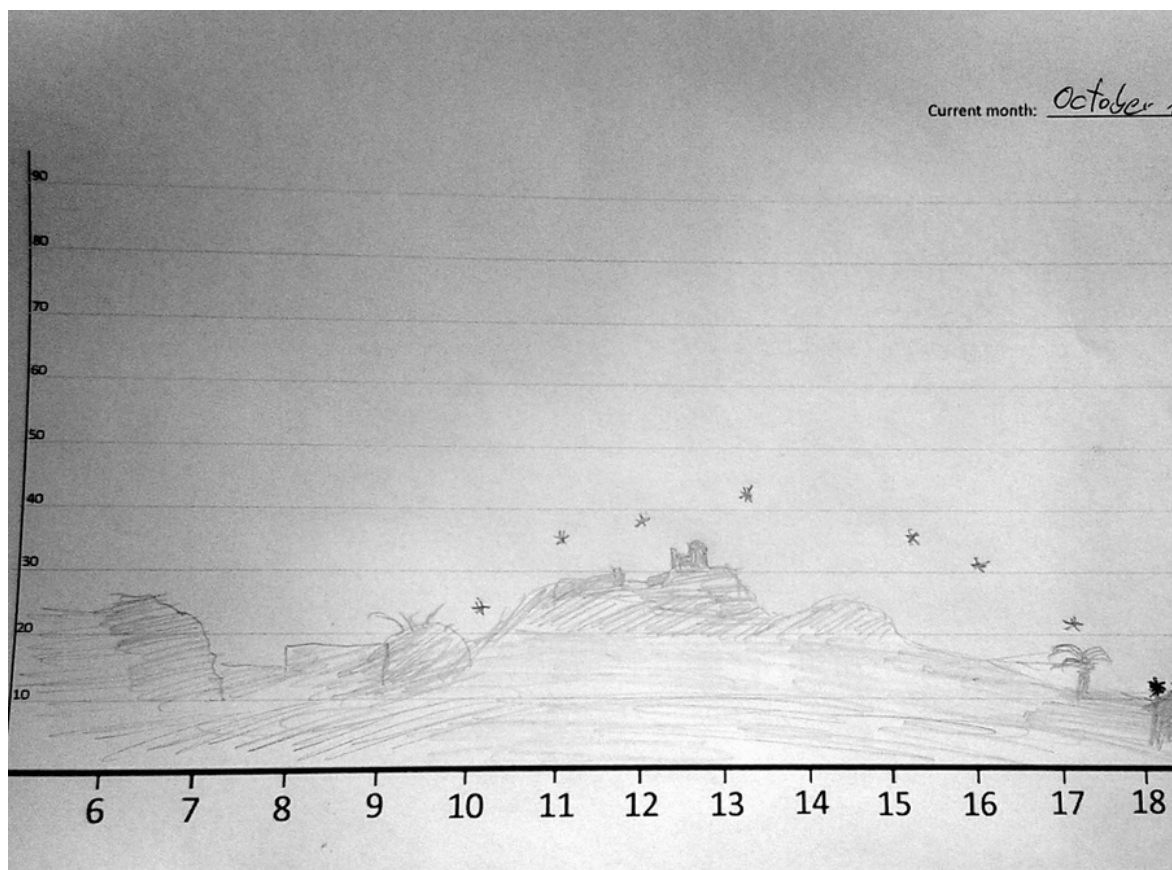


Fig. 32 Measuring the height an position of the Sun in the sky (Credits: Scroza)

Return to your main drawing (Time vs. altitude), find - on the horizontal Time axis the position for the time you wrote down. From this position, use a ruler and find - on the vertical altitude axis - the position that corresponds best to the altitude of the Sun at that time. Mark this position with a small star to represent the Sun. Do the same with the part of the landscape you measured underneath the Sun.

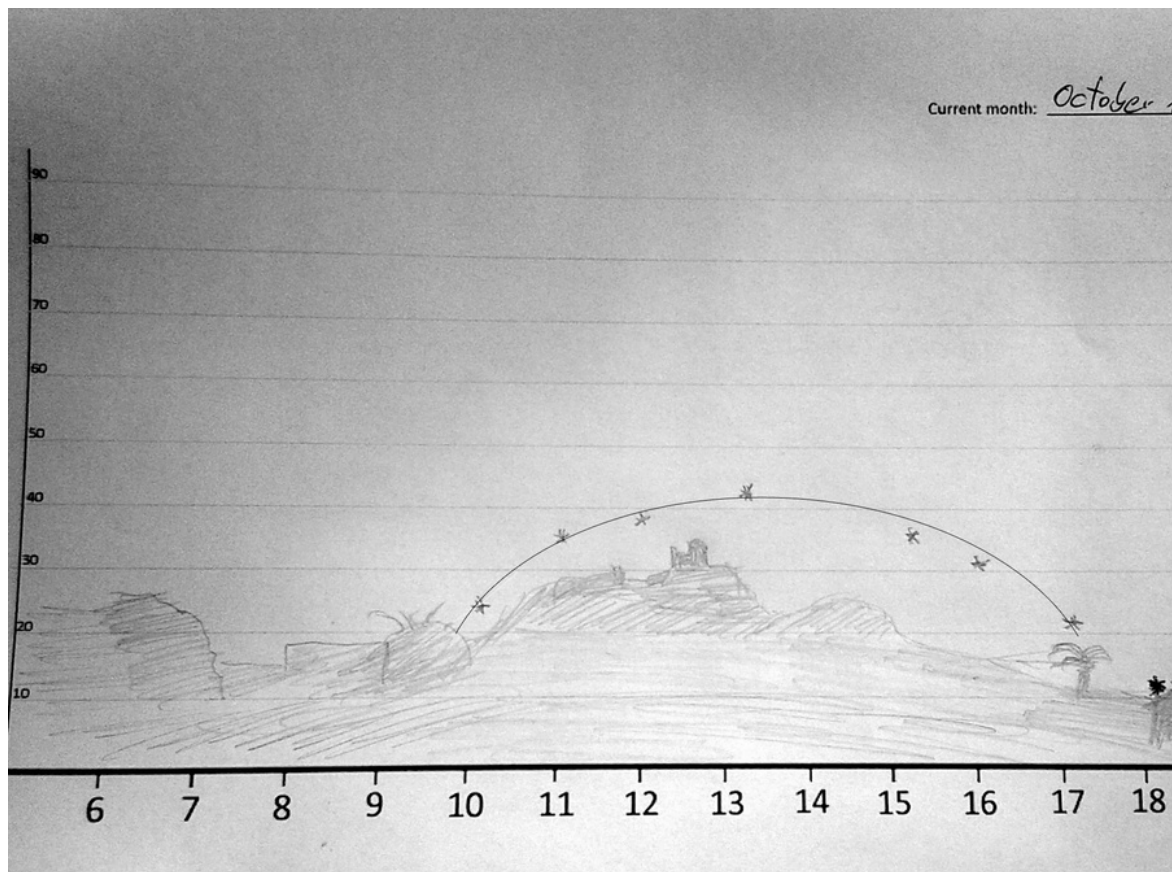
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Repeat these measurements every time you have a break or as often as possible. Measure the height of the Sun, sketch and measure whatever is directly underneath the Sun at that moment. If you have a short day at school, you may continue the measures of the altitude of the Sun from home.

**Analysis** Once you have finished marking as many positions as possible during the course of a day, you will be able to trace the path the Sun takes in the sky. If available use a French curve to connect the dots (stars) you marked.

At some point on this path, the Sun will be in its highest position. The Sun is supposed to have the highest daily point in the sky at the exact *middle of the day*: midday, which intuitively you would say is 12 o'clock. But our clocks and your drawing probably don't reflect that. The moment when the Sun is at the highest point in your sky is called the **true local noon** and at that moment, the Sun is exactly in the south (north in the southern hemisphere).



## CURRICULUM

### Space Awareness curricula topics (EU and South Africa)

The journey of ideas, Constellations, stars

## CONCLUSIE

This activity simulates an astronomical application of the astrolabe. In this way, the students work like scientists from ancient or medieval times, trying to investigate the apparent path of the Sun in the sky. The activity fosters observational and measuring skills. The more precise the students work, the better the result will be. Comparing between students will reveal with how much precision they have worked.



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