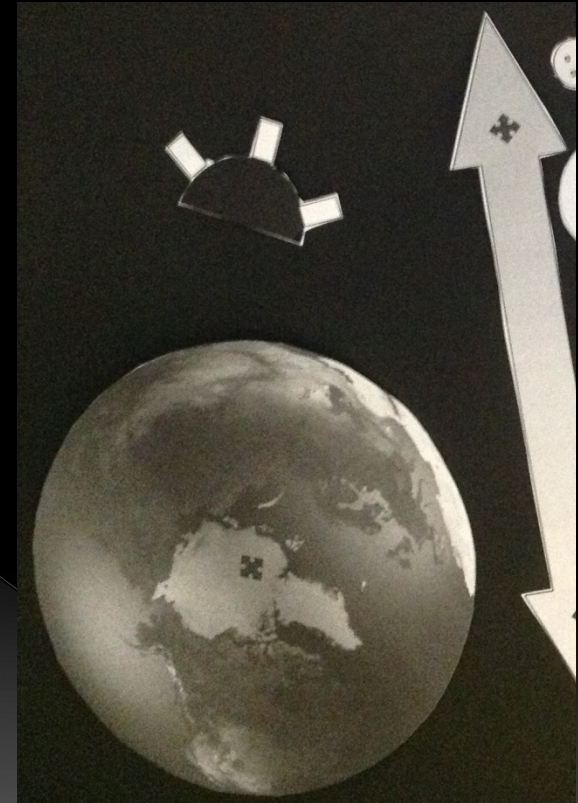
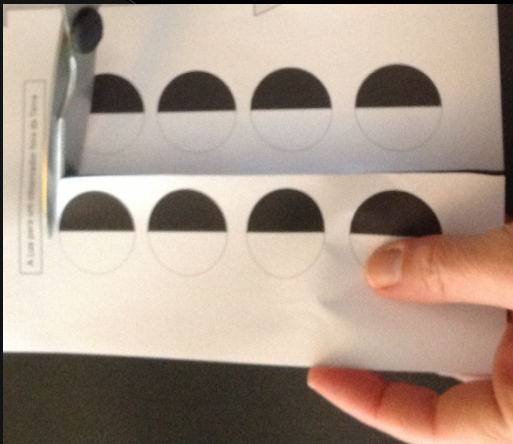


Moon Phases

GOALS:

- ★ Understand Moon phases.
- ★ Understand why the Moon always shows the same face to Earth.
- ★ Recognise the importance of the usage of models in the study of astronomy.

Moon Phases



While you cut all pieces,
take a look at the video
“Full Moon Silhouettes”

<http://vimeo.com/58385453>

NUCLIO
NÚCLEO INTERACTIVO DE ASTRONOMIA



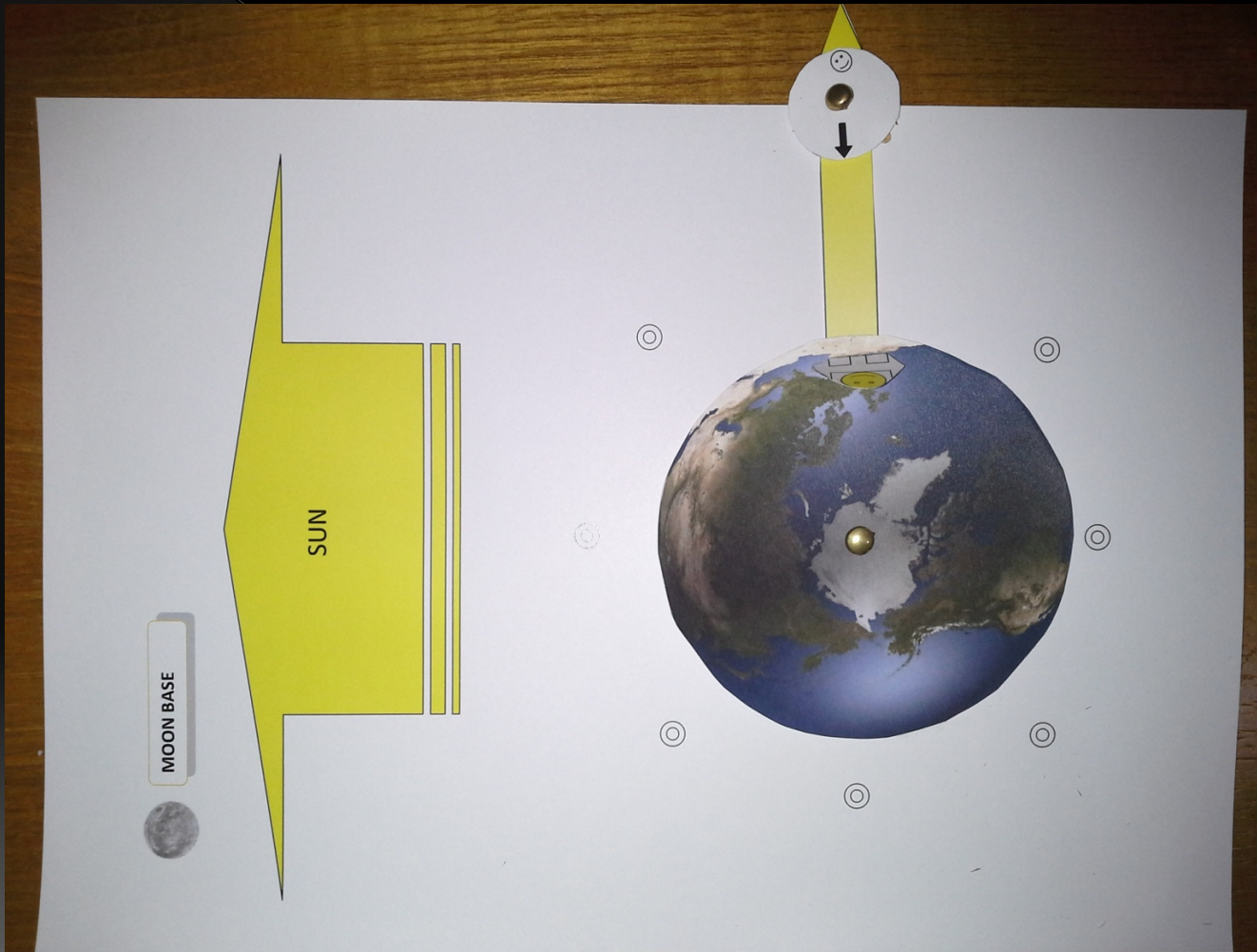
Some statements about the video for your consideration

- ❖ The video was made in Cascais.
- ❖ The Moon will show the same phase again, in one week.
- ❖ The movement of the Moon results of its motion around the Earth.

Investigation with Stellarium or real observation

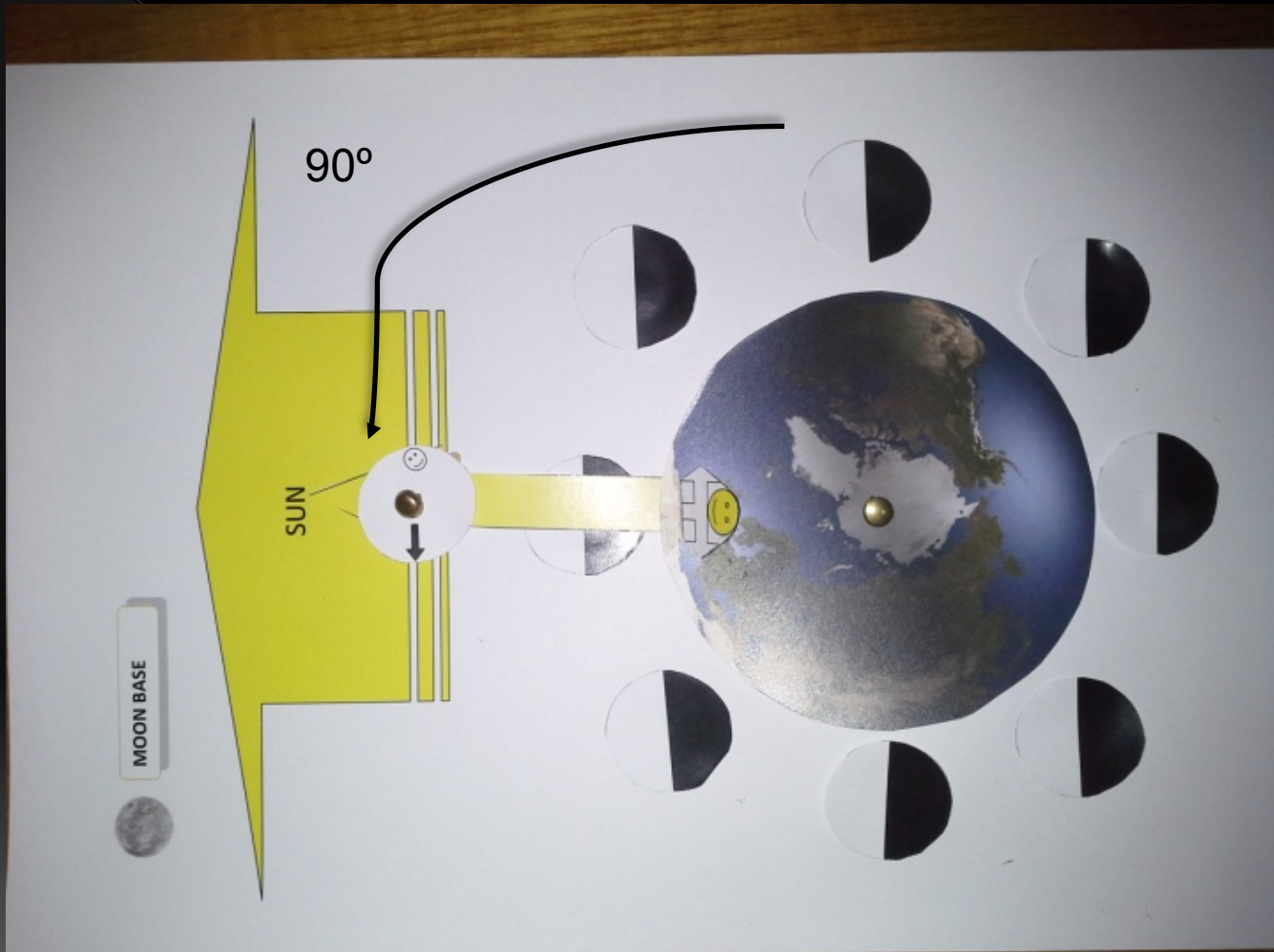
- ❖ Look for the Moon and advance the days to find how many days are necessary in order to repeat the same Moon phase.
- ❖ Look the features on the Moon seen from different places on Earth.
- ❖ Find how much the position of the Moon changes in one day.

Moon Phases



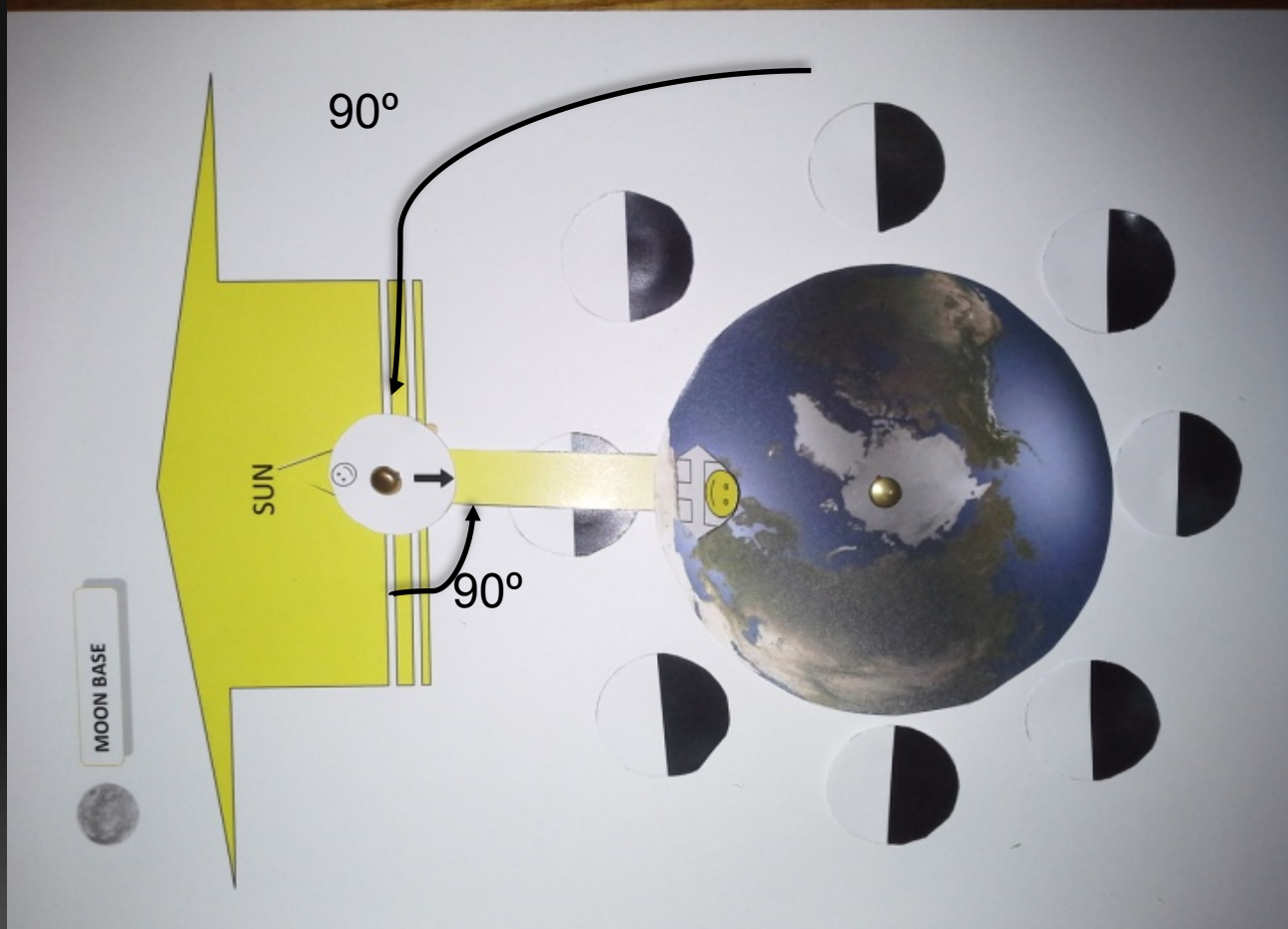
- ❖ Assemble the Earth, the circle with a smile and an the arrow on the base as shown in the picture
- ❖ Place the black/white circles around the Earth representing the illuminated face of the Moon

Moon Phases



If the Moon doesn't rotate around its axes we will see the "smile"!

Moon Phases



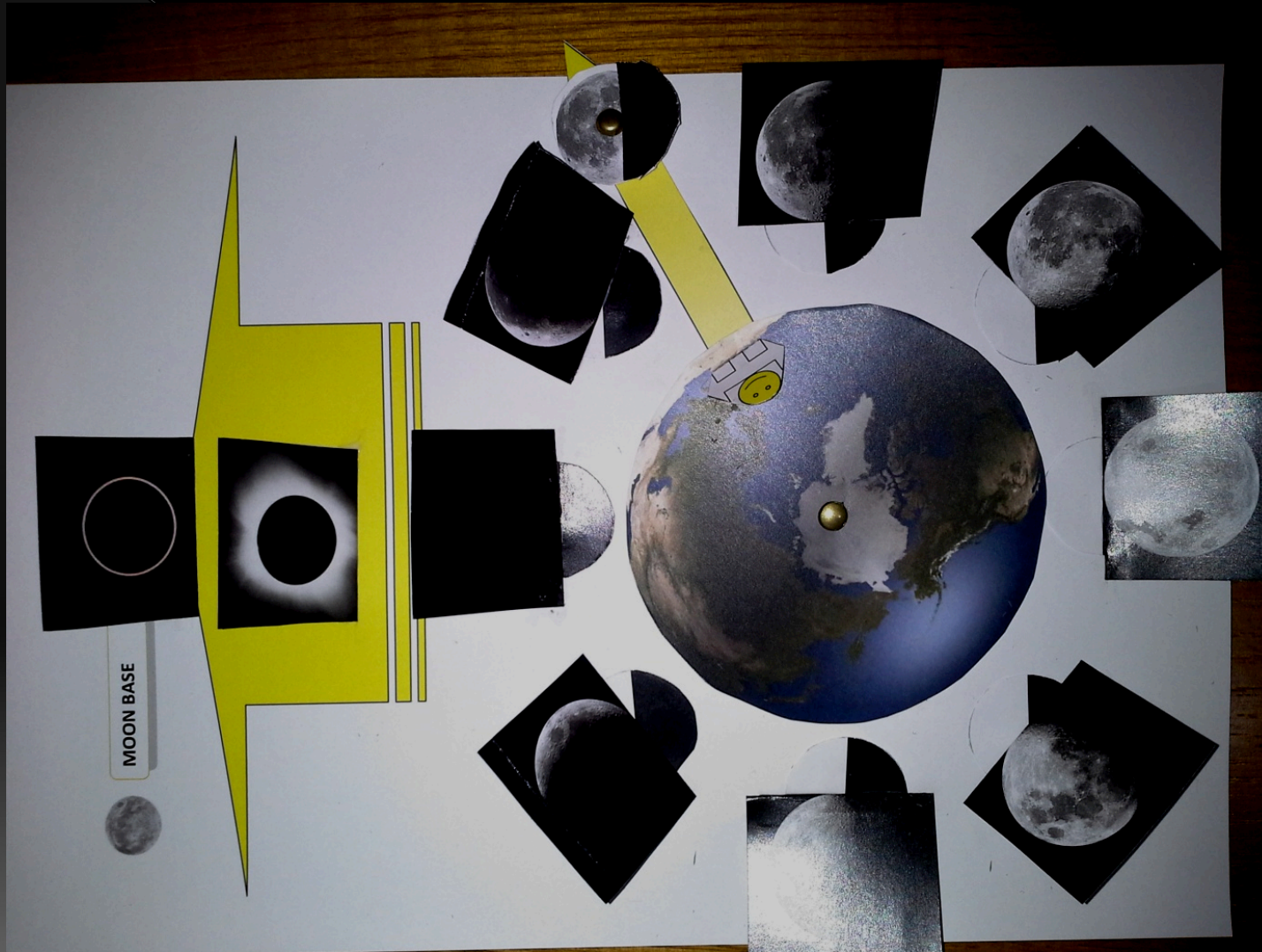
If the rotational and revolution periods of the Moon are the same, we will see always the same face.

Moon Phases



Place the Moon phase correctly distributed around the Earth.

Moon Phases



Place in the right position the pictures of the total and the annular solar eclipse.

(Pay attention to the difference on the distance Moon/Earth in both cases)



Moon Phases

More information:
leonor.cabral@nuclio.net

Link to materials

Moon Phases

<http://portal.discoverthecosmos.eu/en/node/195740>

Fases da Lua

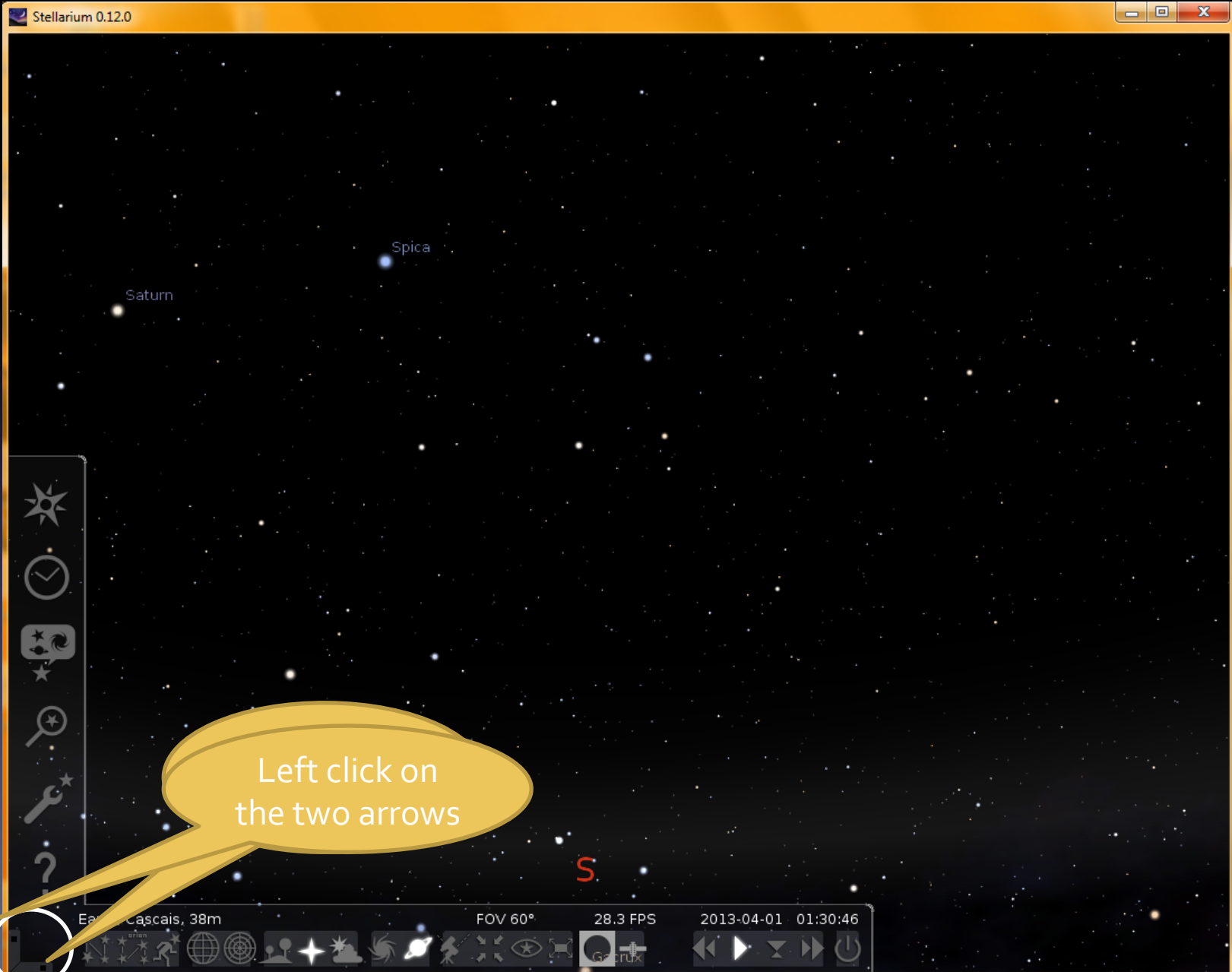
<http://portal.discoverthecosmos.eu/en/node/192795>



Moon phases

How to see the phases of the Moon with
Stellarium

To lock the toolbars



Left click on
the two arrows



Hide the horizon and the atmosphere

The image shows a screenshot of the Stellarium 0.12.0 software interface. The main window displays a starry sky with labels for 'Saturn' and 'Spica'. A toolbar on the left contains various icons, including a star, a magnifying glass, a wrench, and a question mark. At the bottom, a status bar shows 'Earth, Cascais, 38m', 'FOV 60°', '28.3 FPS', and '2013-04-01 01:30:46'. Two yellow callout boxes are overlaid on the interface. The first callout, pointing to the horizon icon in the toolbar, contains the text 'Left click to hide the horizon'. The second callout, pointing to the atmosphere icon in the toolbar, contains the text 'Left click to hide the atmosphere'. The status bar also features several control icons, including a play button and a power button.

Stellarium 0.12.0

Saturn

Spica

Left click to hide the horizon

Left click to hide the atmosphere

Earth, Cascais, 38m

FOV 60°

28.3 FPS

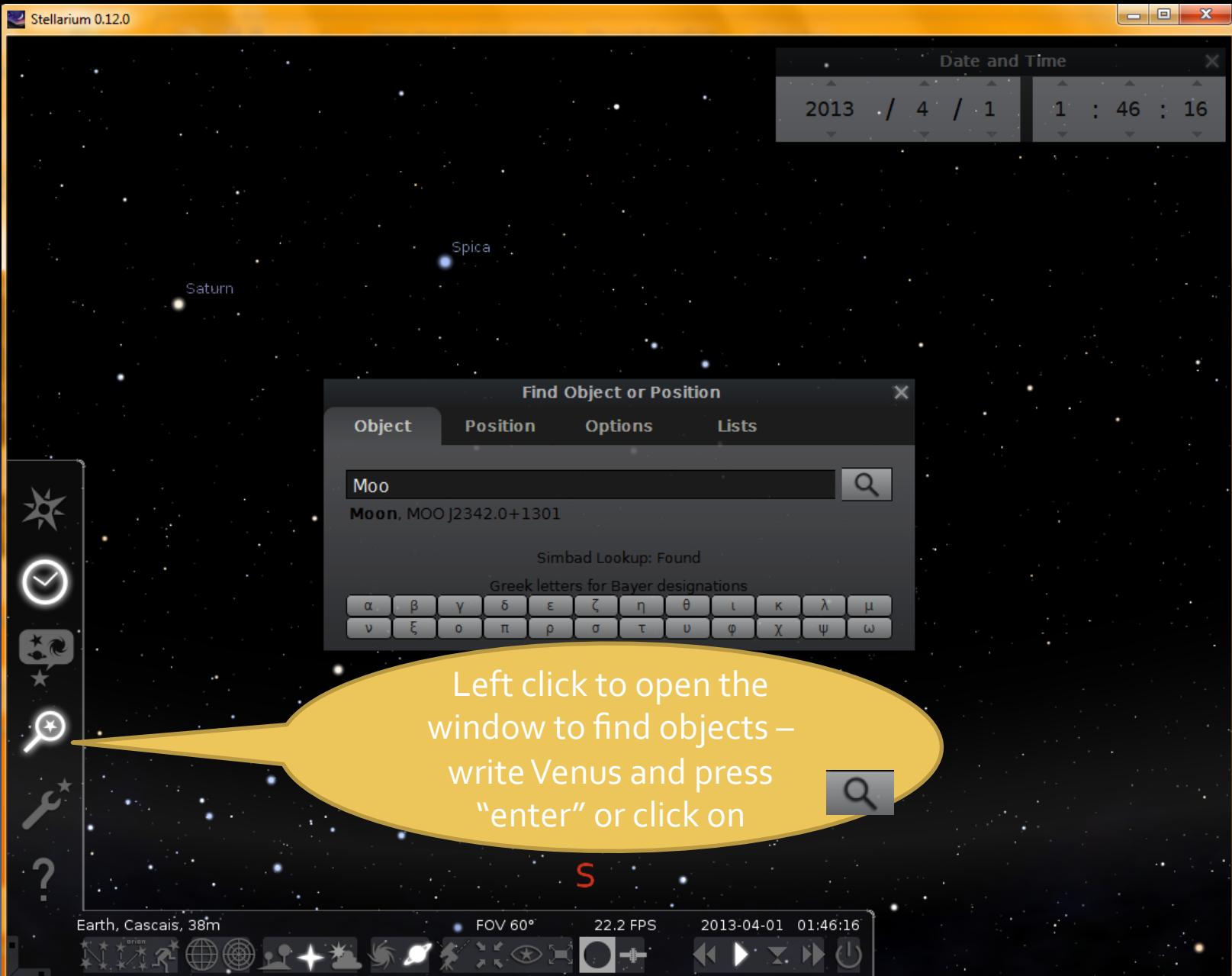
2013-04-01 01:30:46

Open the date and time window



The screenshot shows the Stellarium 0.12.0 application window. In the top right corner, a 'Date and Time' window is open, displaying the date '2013 / 4 / 1' and the time '1 : 41 : 44'. On the left side of the main window, a vertical toolbar contains several icons. The second icon from the top, which is a white checkmark inside a circle, is highlighted with a white glow. A yellow speech bubble points to this icon with the text: 'Left click to open the date/hour window and drag it to the border'. The main window displays a starry sky with a red 'S' in the lower center. At the bottom, a status bar shows 'Earth, Cascais, 38m', 'FOV 60°', '22.6 FPS', and '2013-04-01 01:41:44'. A bottom toolbar contains various navigation and control icons.

Find the Moon



Stellarium 0.12.0

Date and Time
2013 / 4 / 1 1 : 46 : 16

Saturn Spica

Find Object or Position

Object Position Options Lists

Moo

Moon, MOO J2342.0+1301

Simbad Lookup: Found

Greek letters for Bayer designations

α	β	γ	δ	ε	ζ	η	θ	ι	κ	λ	μ
ν	ξ	ο	π	ρ	σ	τ	υ	φ	χ	ψ	ω

Left click to open the window to find objects – write Venus and press “enter” or click on

Earth, Cascais, 38m FOV 60° 22.2 FPS 2013-04-01 01:46:16

Hold and center the Moon



Moon

Type: moon
Magnitude: -11.79
Absolute Magnitude: 32.84
RA/DE (J2000): 16h49m48.2s/-20°49'54.5"
RA/DE (of date): 16h50m35s/-20°51'14"
Galactic longitude/latitude (J2000): -0°30'13.5"/+15°00'11.3"
Hour angle/DE: 20h19m50s/-20°51'14"
Az/Alt: +128°27'06"/+11°05'24"
Ecliptic Topocentric (of date): +253°48'35.5"/+1°36'49.5"
Obliquity (of date, for Earth): +23°26'15.3"
Distance: 0.00245035AU (366568 km)
Apparent diameter: +0°32'35.2"
Sidereal period: 27.32 days (0.075 a)
Sidereal day: 655h43m11.5s
Mean solar day: 680h37m54.2s
Phase Angle: +62°13'28"
Elongation: +117°39'05"
Phase: 0.73
Illuminated: 73.3%

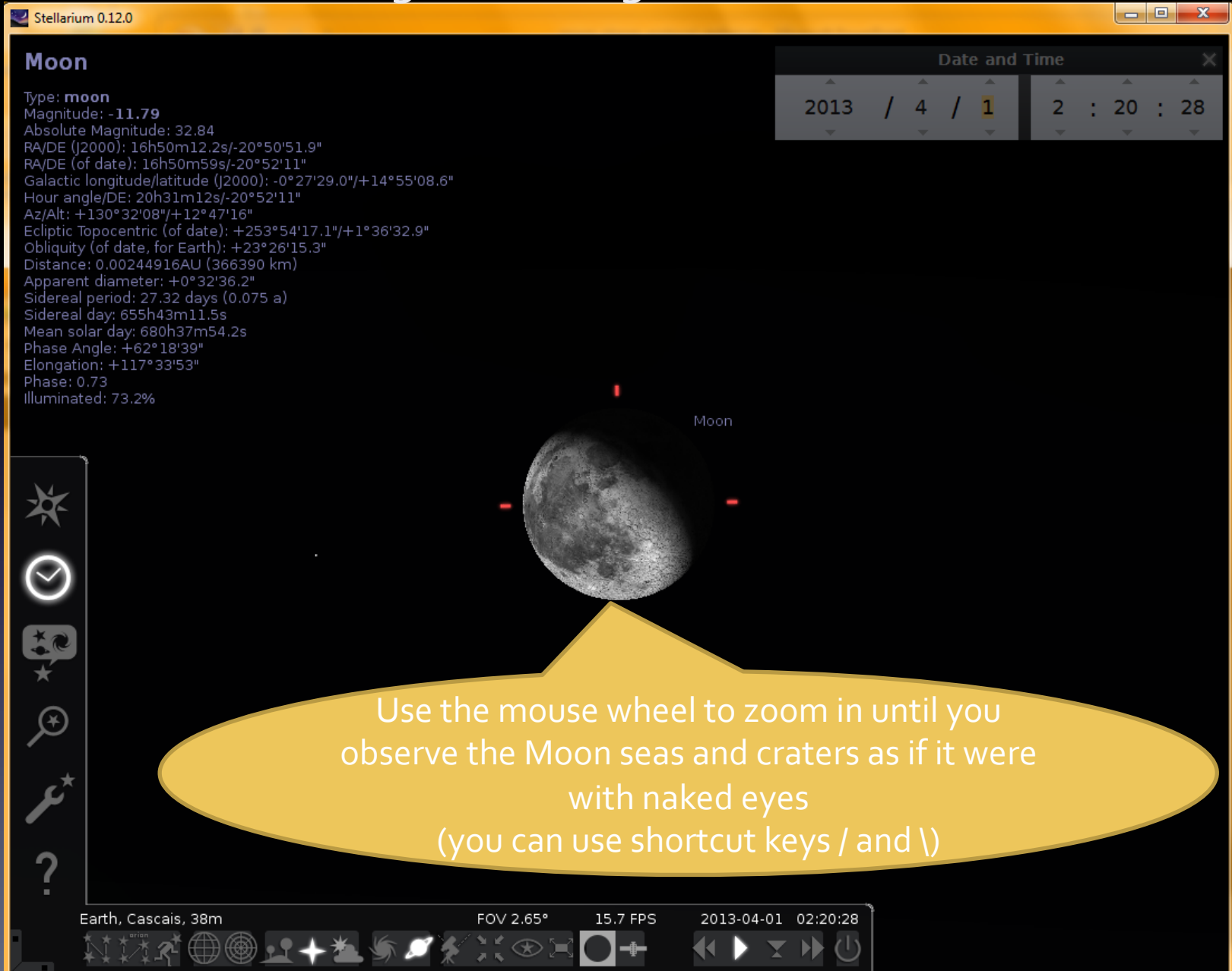
Date and Time: Saturn 2013 / 4 / 1 2 : 8 : 44

Moon Antares

Left click on the Moon to select it and press the space key (the space key center the selected object)

Earth, Cascais, 38m FOV 60° 14.9 FPS 2013-04-01 02:08:44

Enlarge the image of the Moon



The screenshot shows the Stellarium 0.12.0 interface. On the left, a panel titled "Moon" lists various astronomical data. At the top right, a "Date and Time" panel shows the date 2013 / 4 / 1 and time 2 : 20 : 28. The main window displays a 3D view of the Moon in a dark sky, with a yellow callout bubble pointing to it. The callout contains the text: "Use the mouse wheel to zoom in until you observe the Moon seas and craters as if it were with naked eyes (you can use shortcut keys / and \)". At the bottom, a status bar shows "Earth, Cascais, 38m", "FOV 2.65°", "15.7 FPS", and "2013-04-01 02:20:28".

Moon

Type: moon
Magnitude: -11.79
Absolute Magnitude: 32.84
RA/DE (J2000): 16h50m12.2s/-20°50'51.9"
RA/DE (of date): 16h50m59s/-20°52'11"
Galactic longitude/latitude (J2000): -0°27'29.0"/+14°55'08.6"
Hour angle/DE: 20h31m12s/-20°52'11"
Az/Alt: +130°32'08"/+12°47'16"
Ecliptic Topocentric (of date): +253°54'17.1"/+1°36'32.9"
Obliquity (of date, for Earth): +23°26'15.3"
Distance: 0.00244916AU (366390 km)
Apparent diameter: +0°32'36.2"
Sidereal period: 27.32 days (0.075 a)
Sidereal day: 655h43m11.5s
Mean solar day: 680h37m54.2s
Phase Angle: +62°18'39"
Elongation: +117°33'53"
Phase: 0.73
Illuminated: 73.2%

Date and Time
2013 / 4 / 1 2 : 20 : 28

Moon

Use the mouse wheel to zoom in until you observe the Moon seas and craters as if it were with naked eyes (you can use shortcut keys / and \)

Earth, Cascais, 38m FOV 2.65° 15.7 FPS 2013-04-01 02:20:28

Day transition

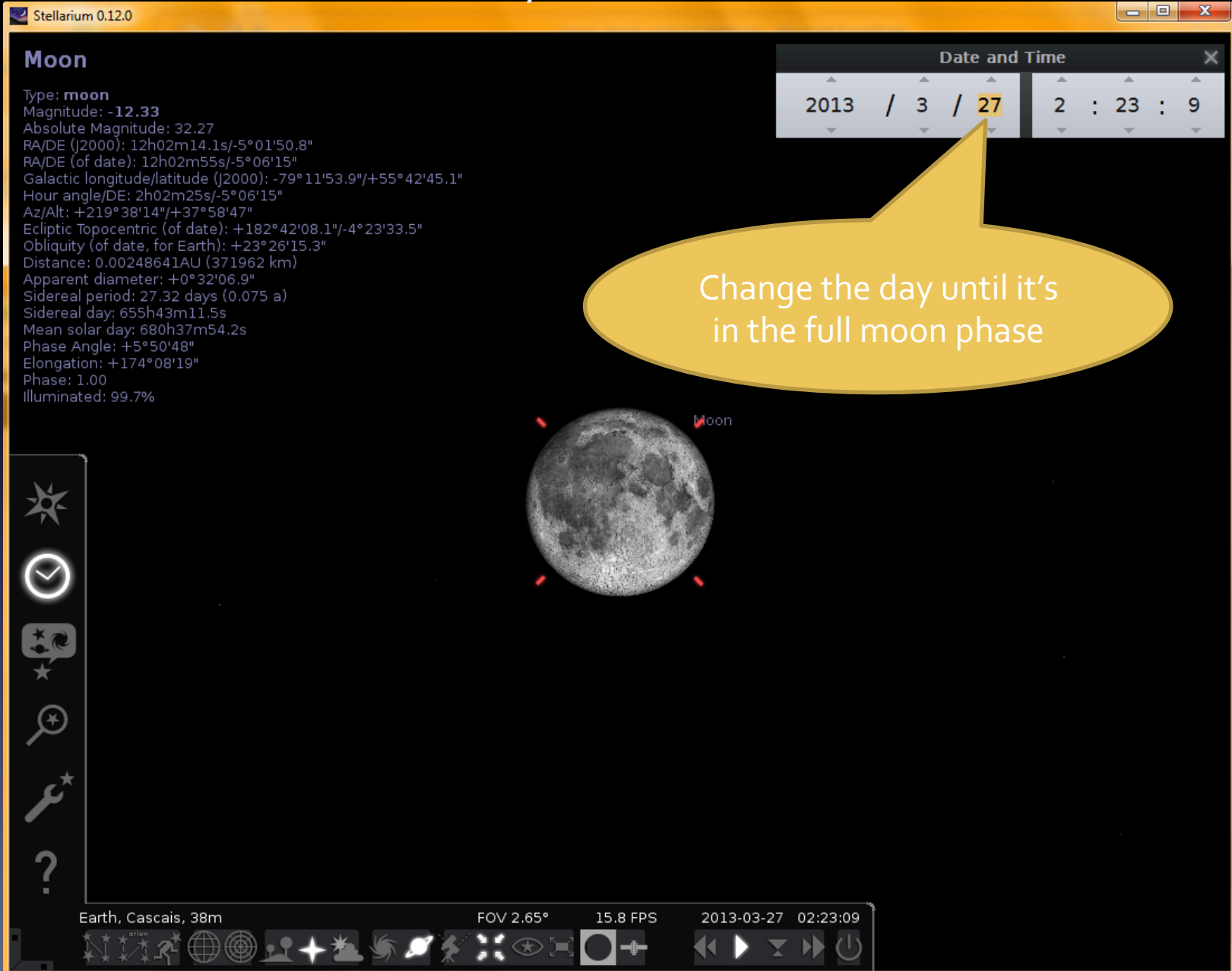
Stellarium 0.12.0

Moon

Type: moon
Magnitude: -12.33
Absolute Magnitude: 32.27
RA/DE (J2000): 12h02m14.1s/-5°01'50.8"
RA/DE (of date): 12h02m55s/-5°06'15"
Galactic longitude/latitude (J2000): -79° 11'53.9"/+55° 42'45.1"
Hour angle/DE: 2h02m25s/-5° 06'15"
Az/Alt: +219° 38'14"/+37° 58'47"
Ecliptic Topocentric (of date): +182° 42'08.1"/-4° 23'33.5"
Obliquity (of date, for Earth): +23° 26'15.3"
Distance: 0.00248641AU (371962 km)
Apparent diameter: +0° 32'06.9"
Sidereal period: 27.32 days (0.075 a)
Sidereal day: 655h43m11.5s
Mean solar day: 680h37m54.2s
Phase Angle: +5° 50'48"
Elongation: +174° 08'19"
Phase: 1.00
Illuminated: 99.7%

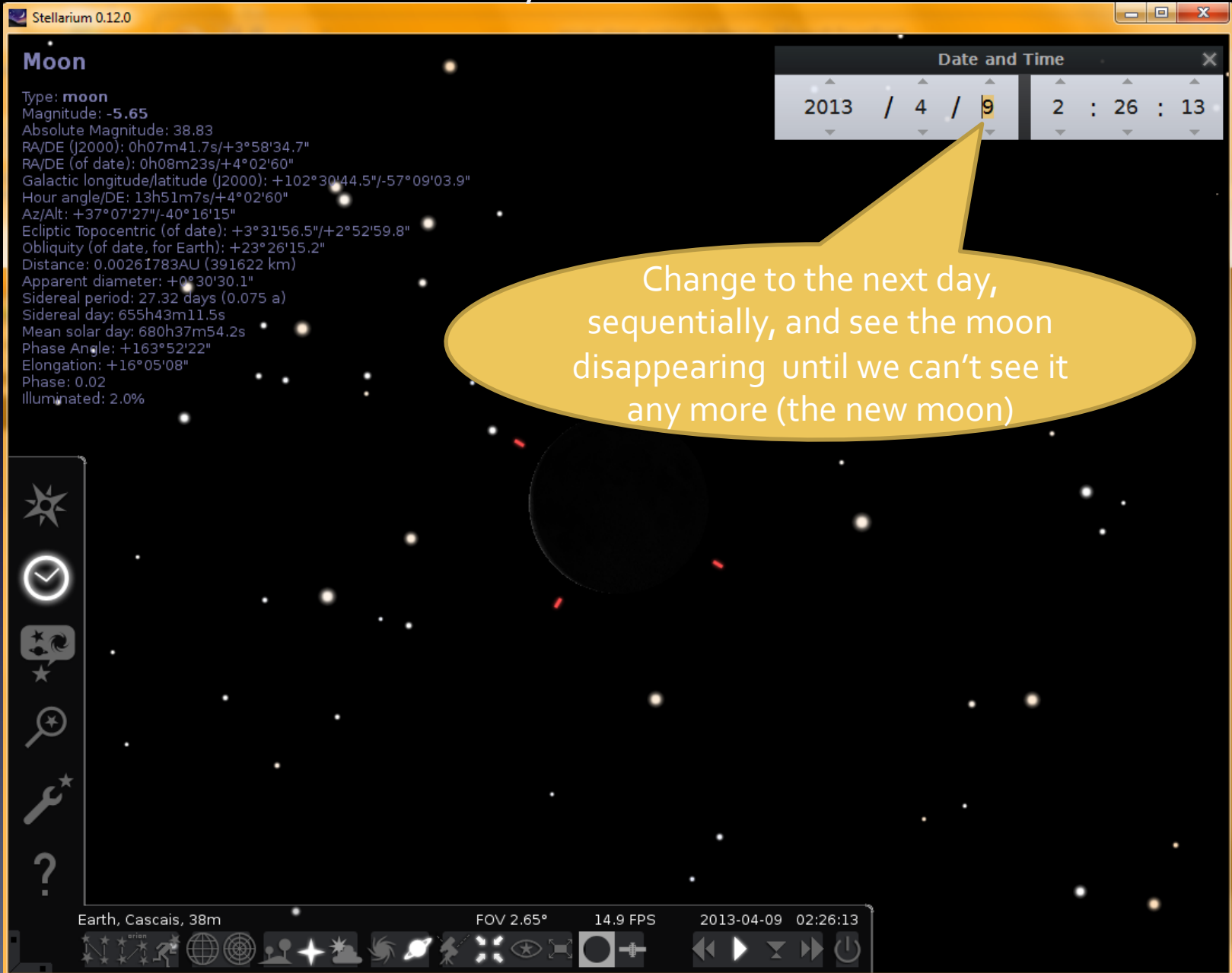
Date and Time
2013 / 3 / 27 2 : 23 : 9

Change the day until it's in the full moon phase



Earth, Cascais, 38m FOV 2.65° 15.8 FPS 2013-03-27 02:23:09

Day transition



Stellarium 0.12.0

Moon

Type: **moon**
Magnitude: **-5.65**
Absolute Magnitude: 38.83
RA/DE (J2000): 0h07m41.7s/+3°58'34.7"
RA/DE (of date): 0h08m23s/+4°02'60"
Galactic longitude/latitude (J2000): +102°30'44.5"/-57°09'03.9"
Hour angle/DE: 13h51m7s/+4°02'60"
Az/Alt: +37°07'27"/-40°16'15"
Ecliptic Topocentric (of date): +3°31'56.5"/+2°52'59.8"
Obliquity (of date, for Earth): +23°26'15.2"
Distance: 0.00261783AU (391622 km)
Apparent diameter: +0°30'30.1"
Sidereal period: 27.32 days (0.075 a)
Sidereal day: 655h43m11.5s
Mean solar day: 680h37m54.2s
Phase Angle: +163°52'22"
Elongation: +16°05'08"
Phase: 0.02
Illuminated: 2.0%

Date and Time
2013 / 4 / 9 2 : 26 : 13

Change to the next day, sequentially, and see the moon disappearing until we can't see it any more (the new moon)

Earth, Cascais, 38m FOV 2.65° 14.9 FPS 2013-04-09 02:26:13

See the relative position of Sun/Moon in the new moon phase



Moon.

Type: moon
Magnitude: -1.46
Absolute Magnitude: 43.01
RA/DE (J2000): -0h56m31.4s/+8°09'23.0"
RA/DE (of date): 0h57m13s/+8°13'40"
Galactic longitude/latitude (J2000): +125°06'35.0"/-54°41'37.9"
Hour angle/DE: 13h11m37s/+8°13'40"
Az/Alt: +23°07'37"/-40°17'31"
Ecliptic Topocentric (of date): +16°20'43.2"/+1°57'04.1"
Obliquity (of date, for Earth): +23°26'15.2"
Distance: 0.00264120AU (395118 km)
Apparent diameter: +0°30'14.0"
Sidereal period: 27.32 days (0.075 a)
Sidereal day: 655h43m11.5s
Mean solar day: 680h37m54.2s
Phase Angle: +175°32'00"
Elongation: +4°27'17"
Phase: 0.00
Illuminated: 0.2%

Date and Time
2013 / 4 / 10 2 : 31 : 36

When you stop seeing the Moon, zoom out to see that the moon is in the direction of the sun (new moon phase)

Earth, Cascais, 38m FOV 65.6° 13.3 FPS 2013-04-10 02:31:36

Has completed the lunar cycle in approximately 29 days

Stellarium 0.12.0

Moon

Type: **moon**
 Magnitude: **-12.38**
 Absolute Magnitude: 32.28
 RA/DE (J2000): 14h24m48.4s/-15°58'33.0"
 RA/DE (of date): 14h25m32s/-16°02'08"
 Galactic longitude/latitude (J2000): -26°35'53.0"/+41°18'23.0"
 Hour angle/DE: 0h49m39s/-16°02'08"
 Az/Alt: +194°06'50"/+34°05'53"
 Ecliptic Topocentric (of date): +21.08°
 Obliquity (of date, for Earth): -23.44°
 Distance: 0.00241335AU
 Apparent diameter: +0.518°
 Sidereal period: 27.321661 days
 Sidereal day: 655h43m12.8s
 Mean solar day: 680h37m54.8s
 Phase Angle: +3°37'19"
 Elongation: +176°22'10"
 Phase: 1.00
 Illuminated: 99.9%

Date and Time			
2013	/	4	/ 26
	:	2	: 34 : 52

Zoom in with the mouse wheel to enlarge the Moon and then continue through the days until you get back to the phase of full moon (took about 1 month)

- Star icon
- Checkmark icon
- Star and eye icon
- Star icon
- Star and magnifying glass icon
- Wrench and star icon
- Question mark icon

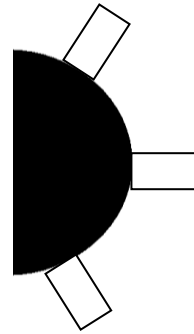
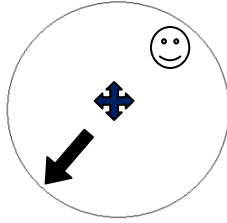
Earth, Cascais, 38m FOV 3.77° 15.3 FPS 2013-04-26 02:34:52

FASES DA LUA

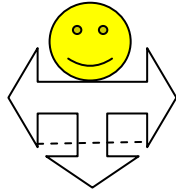


MODELOS A IMPRIMIR

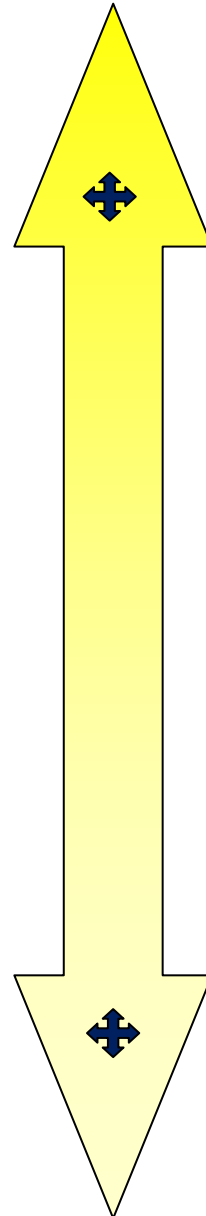
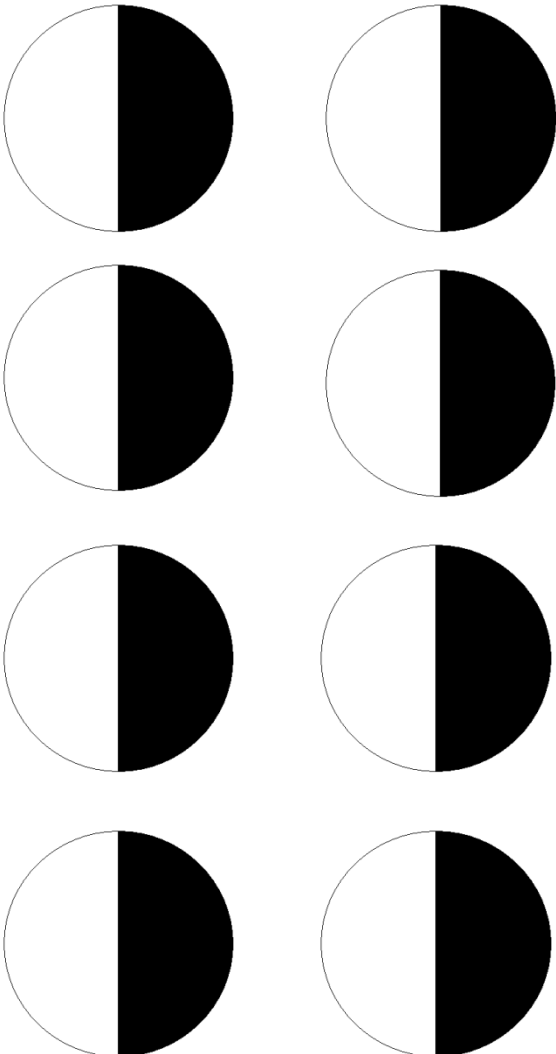
Lua



Observador na Terra

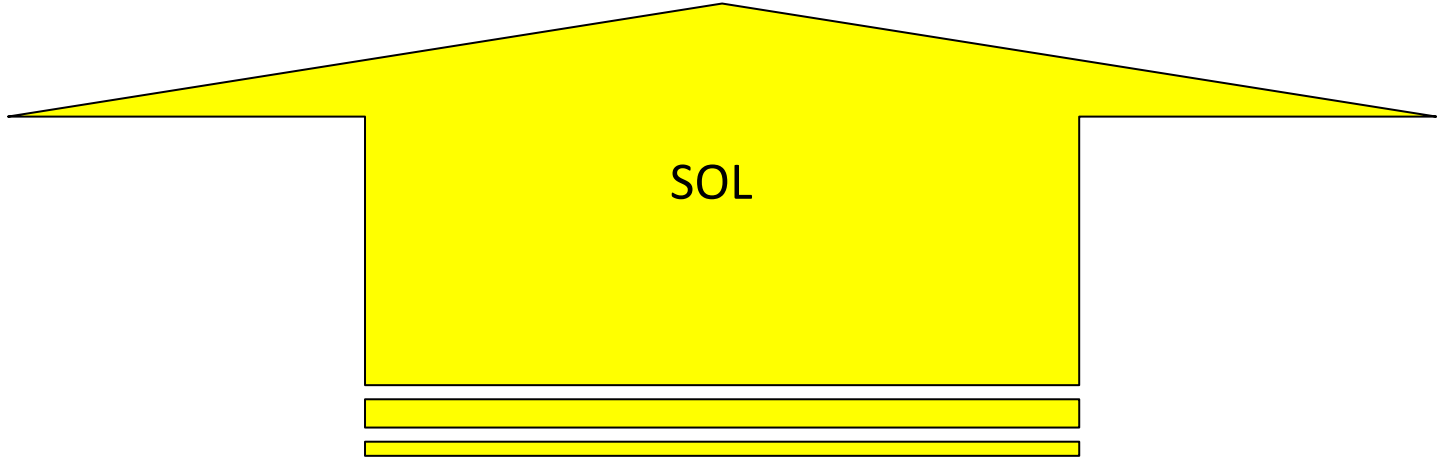


A Lua para um observador fora da Terra





BASE para a LUA



SOL



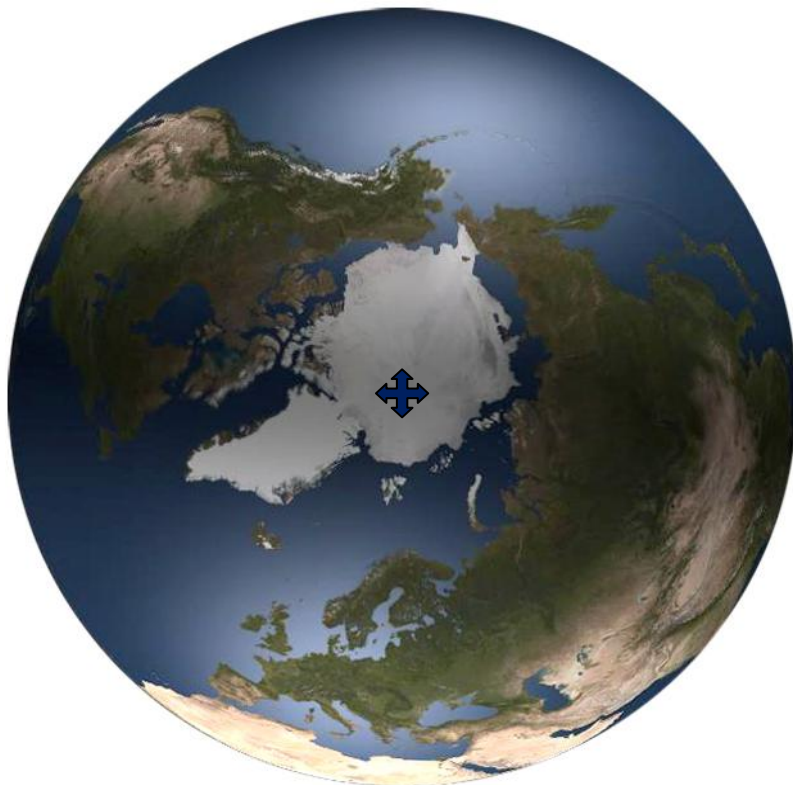
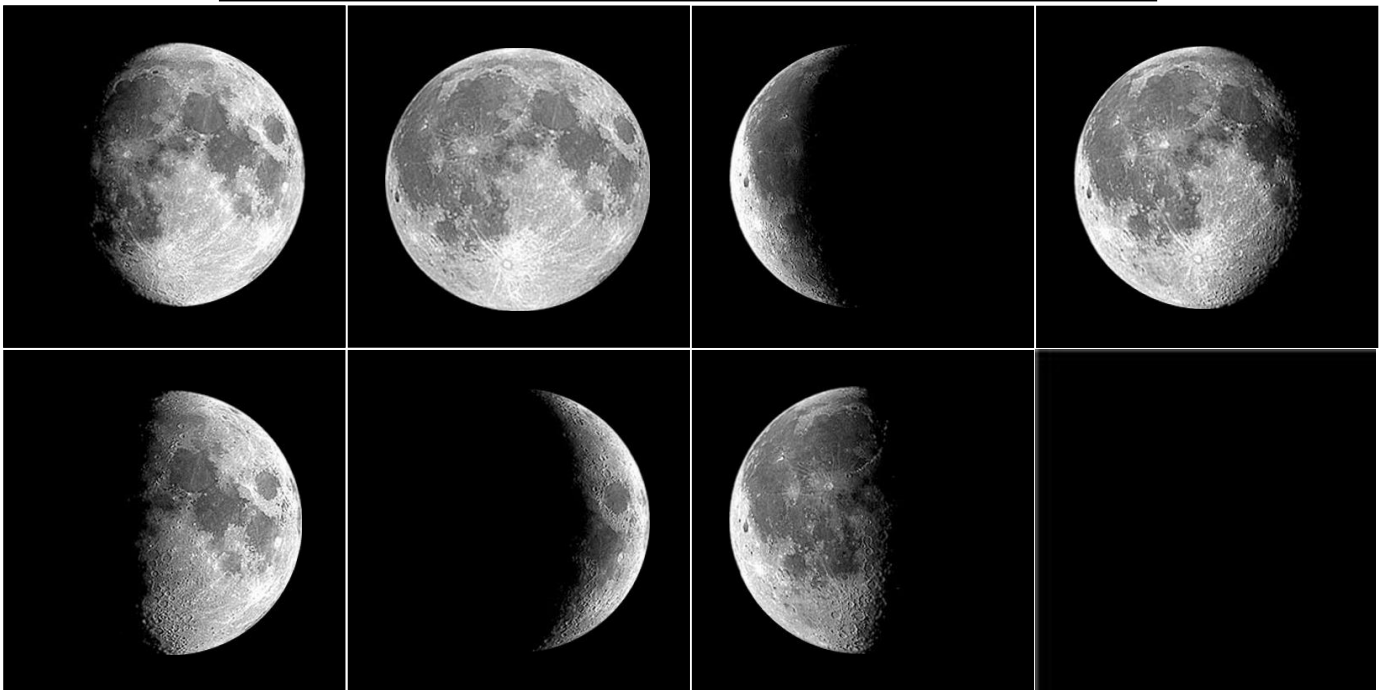
TERRA



Quando a Lua e o Sol se alinham



Fases da Lua

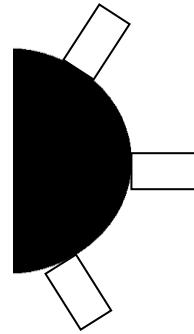
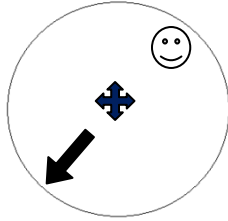


MOON PHASES

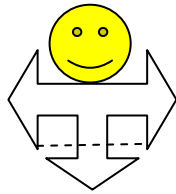


MODEL TO PRINT

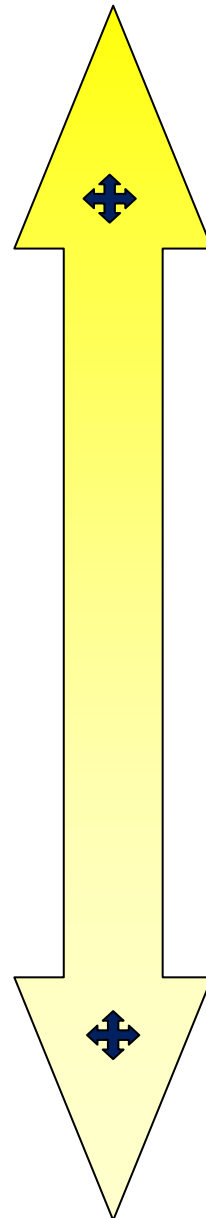
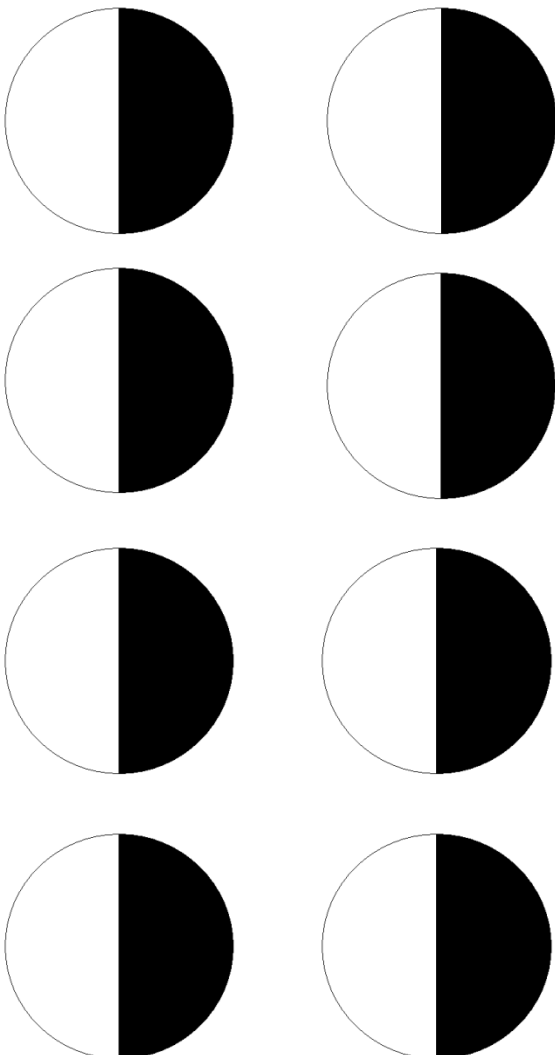
Moon



Observer on Earth

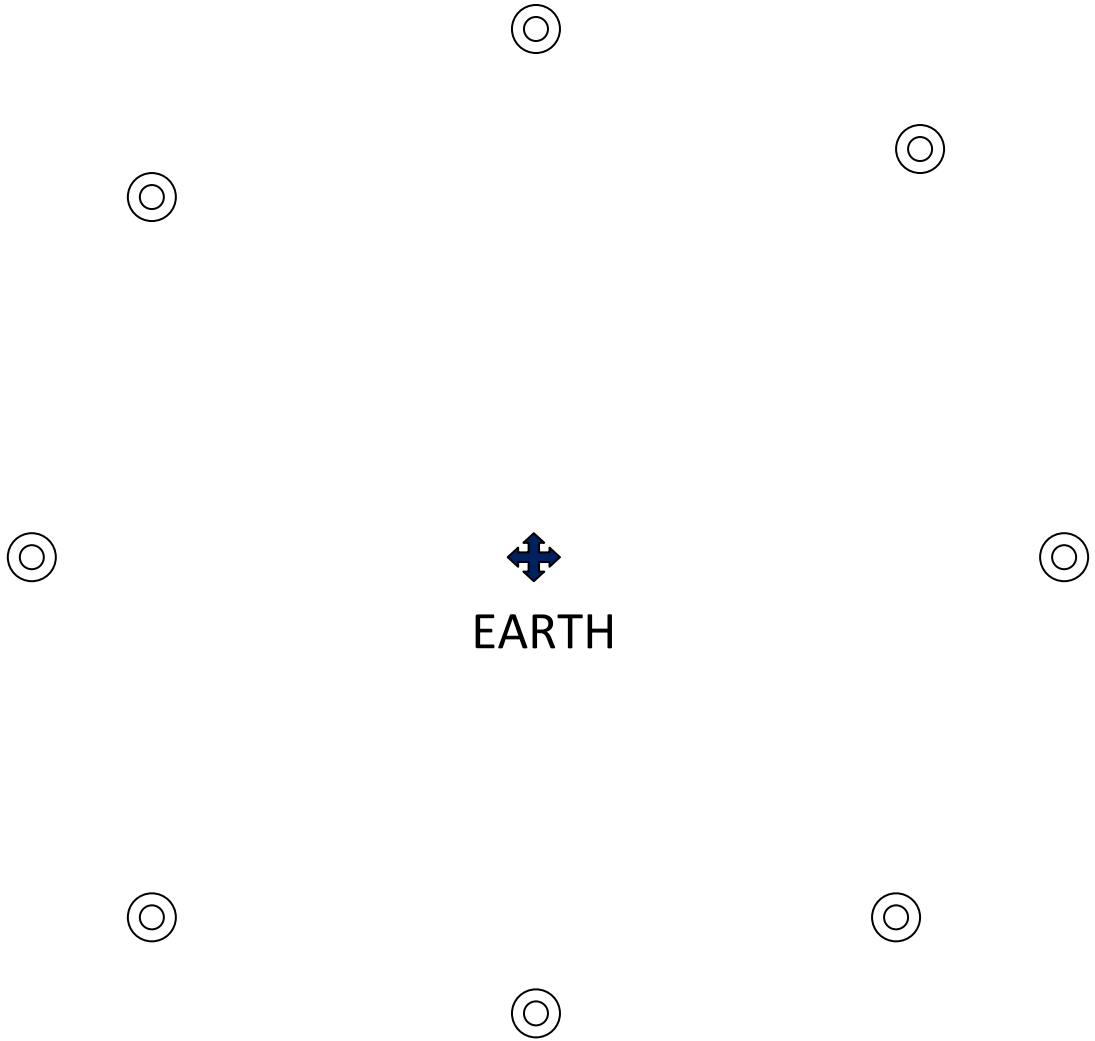
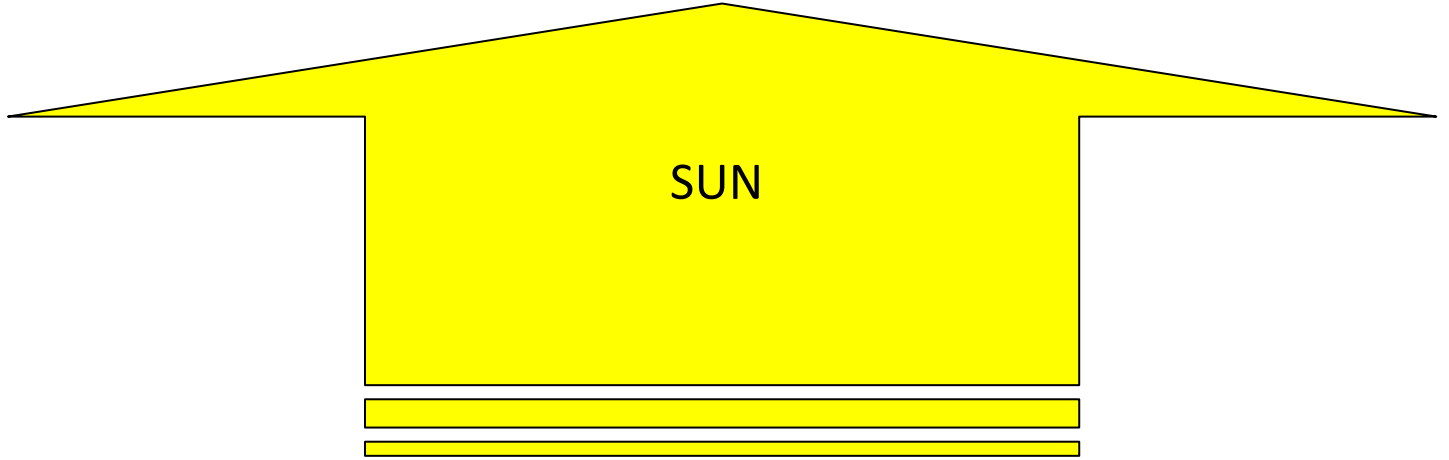


The Moon to an observer outside the Earth





MOON BASE



When the Moon aligns with the Sun



Moon Phases

