Archaeoastronomy – Time Keeping

Sunrise, sunset,
Swiftly flow the days.
Seedlings turn overnight to sunflowers,
Blossoming even as we gaze.

Sunrise, sunset,
Swiftly fly the years,
One season following another,
Laden with happiness and tears.

-Jerry Bock / Sheldon Harnick,
Fiddler on the Roof

Photo: https://wallpapercave.com/w/dkilt19

What time is it? Do you have the time? If I only had enough time. Time flies…

We use and hear these phrases all the time. But what is time? How do we measure time?

In modern times, we use timepieces and technology to track the hours of the day, days of the week, and months of the year. But how did ancient people know what time of day or year it was? Time is a measurement of the earth's rotation around its axis (measures hours and days) and revolution around the sun (measures seasons and years). In ancient times, whether at Chaco Canyon, Chichen Itza, Stonehenge or many other places around the world, people have engineered a built environment to track the sun, planets and stars and measure the passage of time.

Archaeoastronomy is the branch of archaeology that studies the apparent use of astronomy by ancient civilizations to determine seasons and yearly cycles. The construction of megaliths (large stone monuments) and other ritual structures are evidence of this practice.

Try these two activities to measure time like the ancient ones!

1. Make your own sundial
2. Track the sun with Stellarium

Make A Sundial!

Long before using clocks and watches to keep track of time, ancient civilizations used the movement of the sun, stars and planets to let them know the season and time of day. This information was used to keep track of the solstices and helped farmers know when to plant and when to harvest.

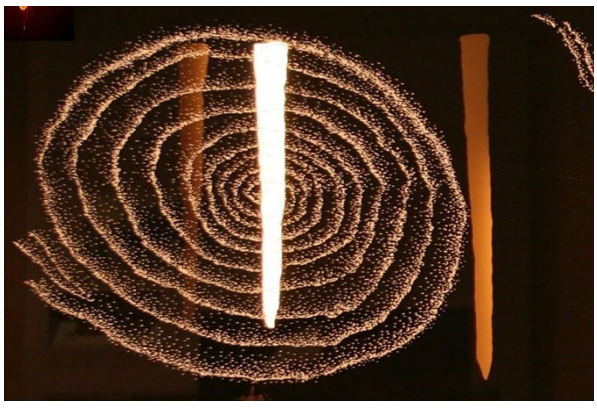
What you will Need:	
A pencil	*Ruler*
Tape	*Marker*
A paper plate	

How To:

1. Start this activity earlier in the day, around 8:00 or 9:00 AM, so you'll have more points along your sundial.
2. Use a ruler to determine the center of the paper plate and mark that point. Carefully stab a whole in the center of the plate where you marked. Slide the eraser end of the pencil through somewhat and use the tape on either side to secure it vertically.
3. Find an open area with no large shadows nearby to set up your sundial.
4. Once you've placed your sundial, draw a line and write the time of the nearest hour. If it is 8:46 AM, you would write 9:00 AM. At 9:00 AM, align your sun clock to the mark you made with the shadow cast by the pencil.
5. Mark the shadow every hour on the hour as it moves.
6. After several hours you will begin to see a pattern similar to that of a regular clock.

At the end of each hour, you'll notice that the shadow of the pencil has moved clockwise. As the Earth turns on its axis, the sun appears to move in the sky from the east to west. Every hour the Earth rotates approximately 15 degrees and so the sun appears to move 15 degrees across the sky.

During different times of year, from one viewpoint, the Sun rises from a slightly different angle and point on the horizon. By tracking these changes over time, ancient civilizations like those in Chaco Canyon could tell what season it was.



Where the Chaco sun dagger appears at different times of the year

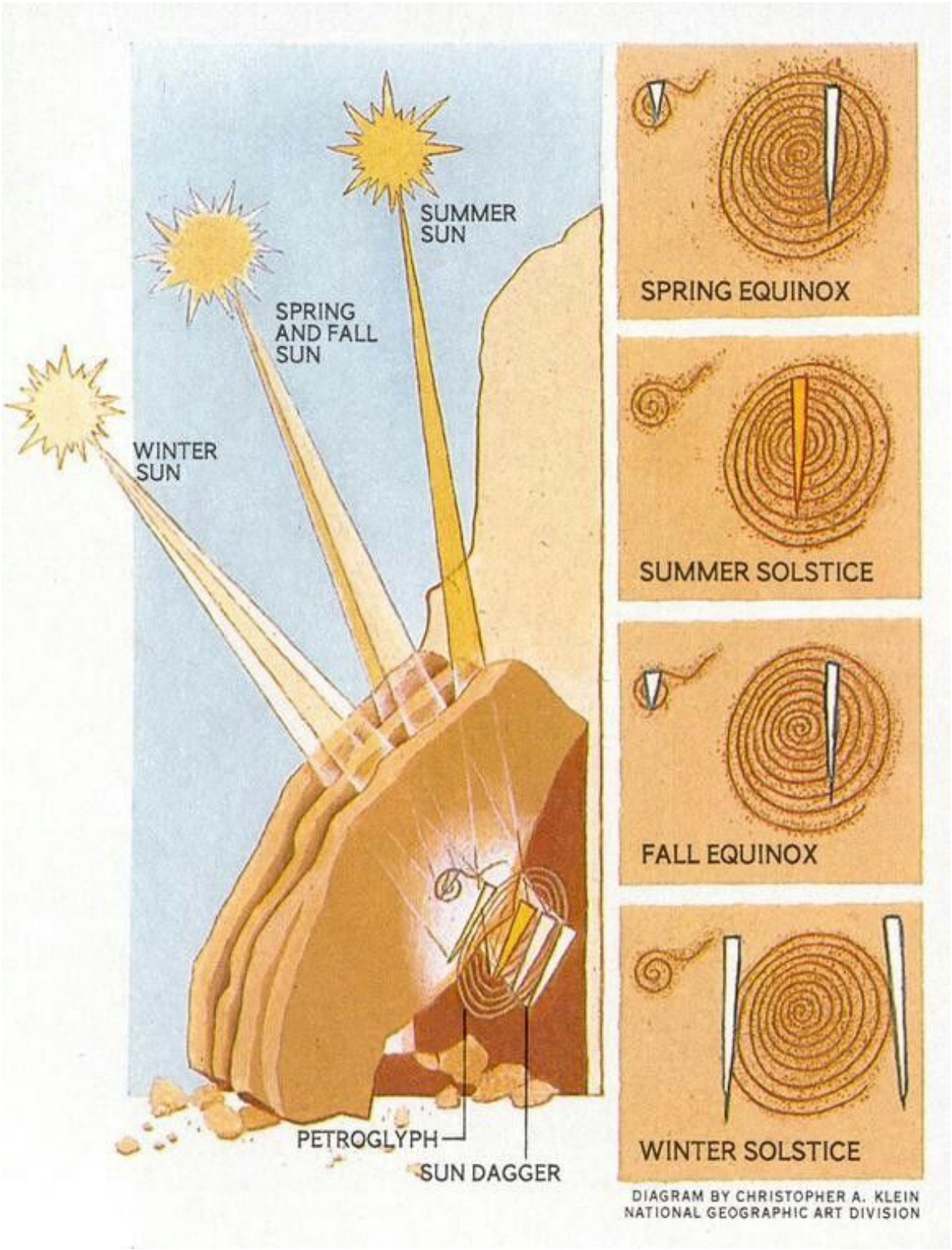
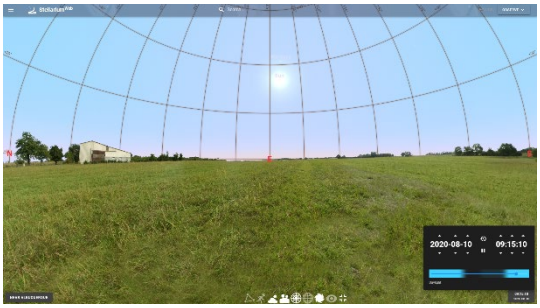


DIAGRAM BY CHRISTOPHER A. KLEIN
NATIONAL GEOGRAPHIC ART DIVISION

Track the Sun with Stellarium!

This activity uses a web app to track the pathway of the sun, moon, planets and stars over time. Tracking these celestial objects in real time could take hours, days, months or even years. With the app, you can determine the position of these objects at any time. And besides, when sun watching, **you should never look directly at the sun!** This resource provides a safe way to do that.



Having a good knowledge of the seasons is essential for our daily life (knowing how to dress each day) and for agricultural practices. Let's see how we can determine the seasons by observing the position of the rising and setting sun along the horizon throughout the year.

The Reason for the Seasons

Because the Earth is tilted on its axis as it orbits around the sun, we experience varying day lengths and temperatures throughout the year. This is the reason for the seasons. The sun rises and sets at different points along the eastern and western horizons and travels at different angles in the sky at different times of the year.

We can determine the seasons by tracking where along the horizon the sun rises and sets.

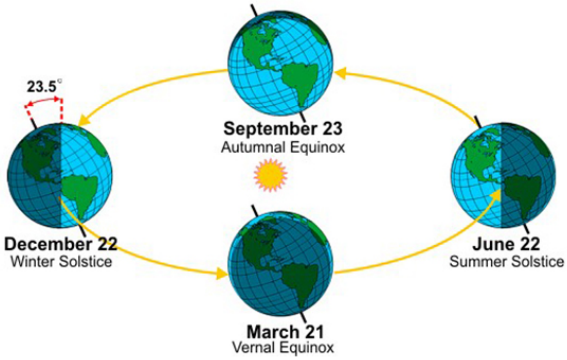


Illustration: NOAA

What to do:

For this activity, use the Stellarium web app and the slide images below to complete the worksheet on the next page.

1. Visit https://stellarium-web.org/ to get started.
2. Enter in Albuquerque, NM in the location search on the lower left of the page.
3. In the tool bar (bottom center) turn on atmosphere, landscape and azimuthal grid. Leave all other tools off for this activity.
4. Enter in the date and time for each season noted on the worksheet in the time adjustment window in the lower right corner.
5. Compare the app with the slide images and determine which season each slide is.
6. Complete the rest of the worksheet information.

Note: This activity can be completed entirely using the worksheet figure as well.

Use the Stellarium app or the figure on the right to complete this worksheet.

Choose from the list at right and match the season, relative day length and temperature with each slide below:

Slide 1: Season ____
day length ____
temperature ____

Slide 2: Season ____
day length ____
temperature ____

Slide 3: Season ____
day length ____
temperature ____

Slide 4: Season ____
day length ____
temperature ____

Slide 5: Season ____
day length ____
temperature ____

Slide 6: Season ____
day length ____
temperature ____

Season

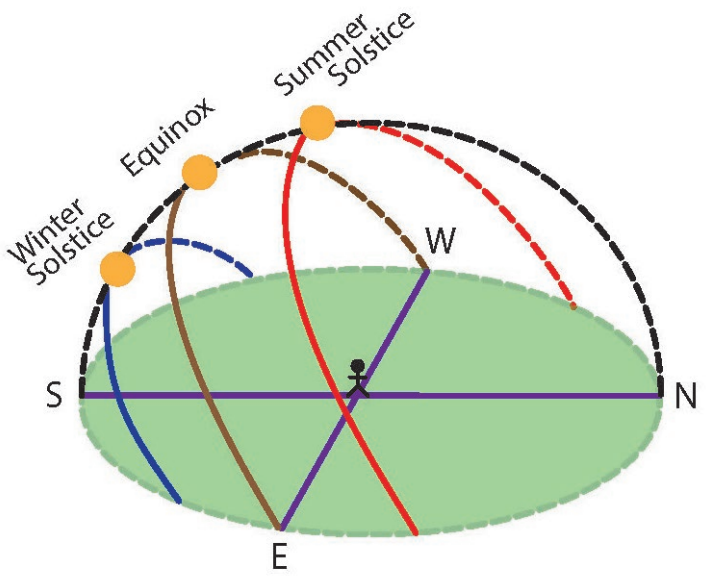
1. Vernal equinox sunrise
   March 20, 2021 @ 7:00 AM
2. Summer solstice sunrise
   June 21, 2021 @ 5:40 AM
3. Summer solstice sunset
   June 21, 2021 @ 8:25 PM
4. Autumnal equinox sunset
   September 22, 2021 @ 7:00 PM
5. Winter solstice sunrise
   December 22, 2021 @ 7:00 AM
6. Winter solstice sunset
   December 22, 2021 @ 5:10 PM

Relative day length

A. Long day/short night
B. Equal day and night
C. Short day/long night

Relative temperature

Cold
Mild
Hot



Position of sun along the celestial sphere from sunrise to sunset

Vocabulary

Altitude: the angular distance of an object in the sky measured from the horizon (0°) to the zenith (90°) directly overhead

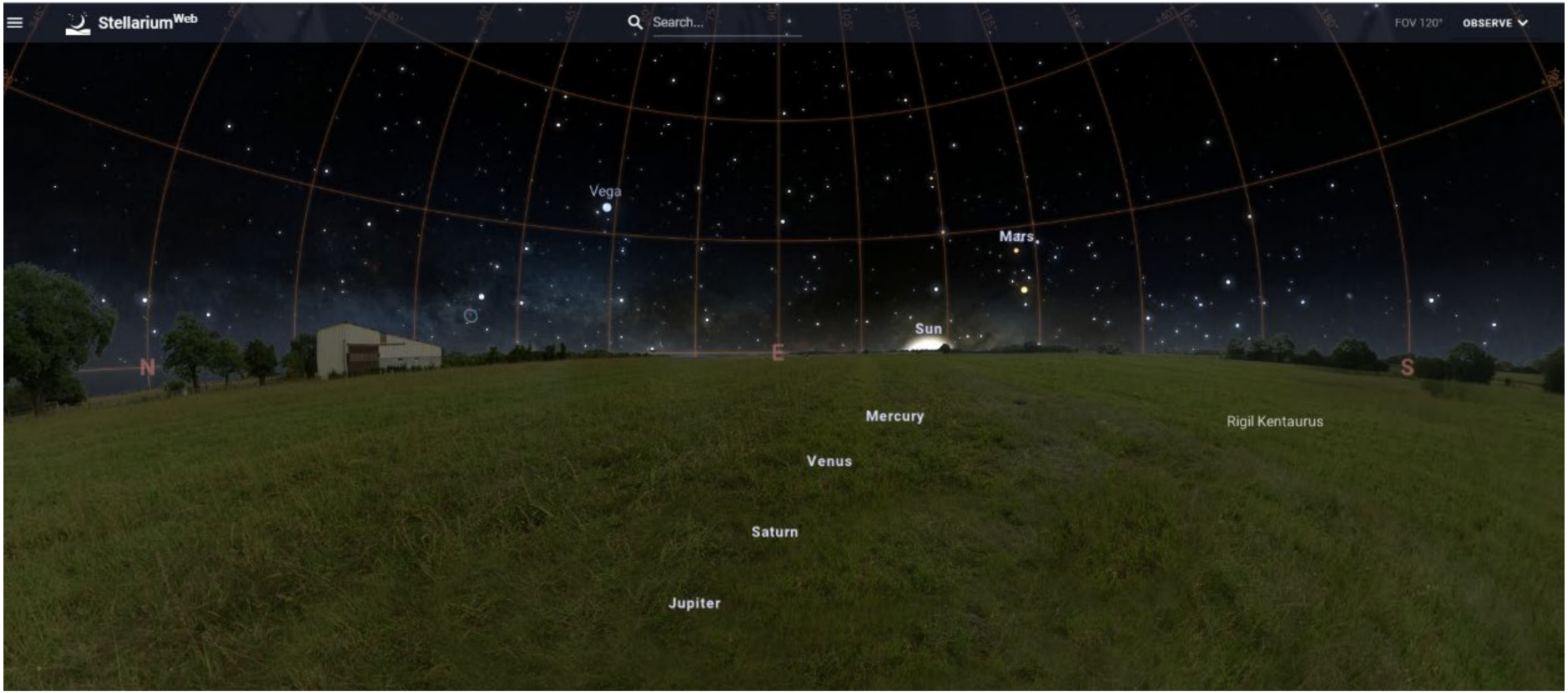
Azimuth: the angular distance measured eastward (clockwise) along the horizon from North (0°)

Equinox: the instant of time in which the plane of the Earth's equator passes through the center of the sun

Solstice: literally, sun standing still, astronomical event where the sun appears to stop its yearly movement and reverse its altitude in the sky

Sunrise: the time of day in which the sun appears at the eastern horizon

Sunset: the time of day in which the sun disappears at the western horizon


StellariumWeb
Search...
FOV 120°
OBSERVE
Vega
Mars
Sun
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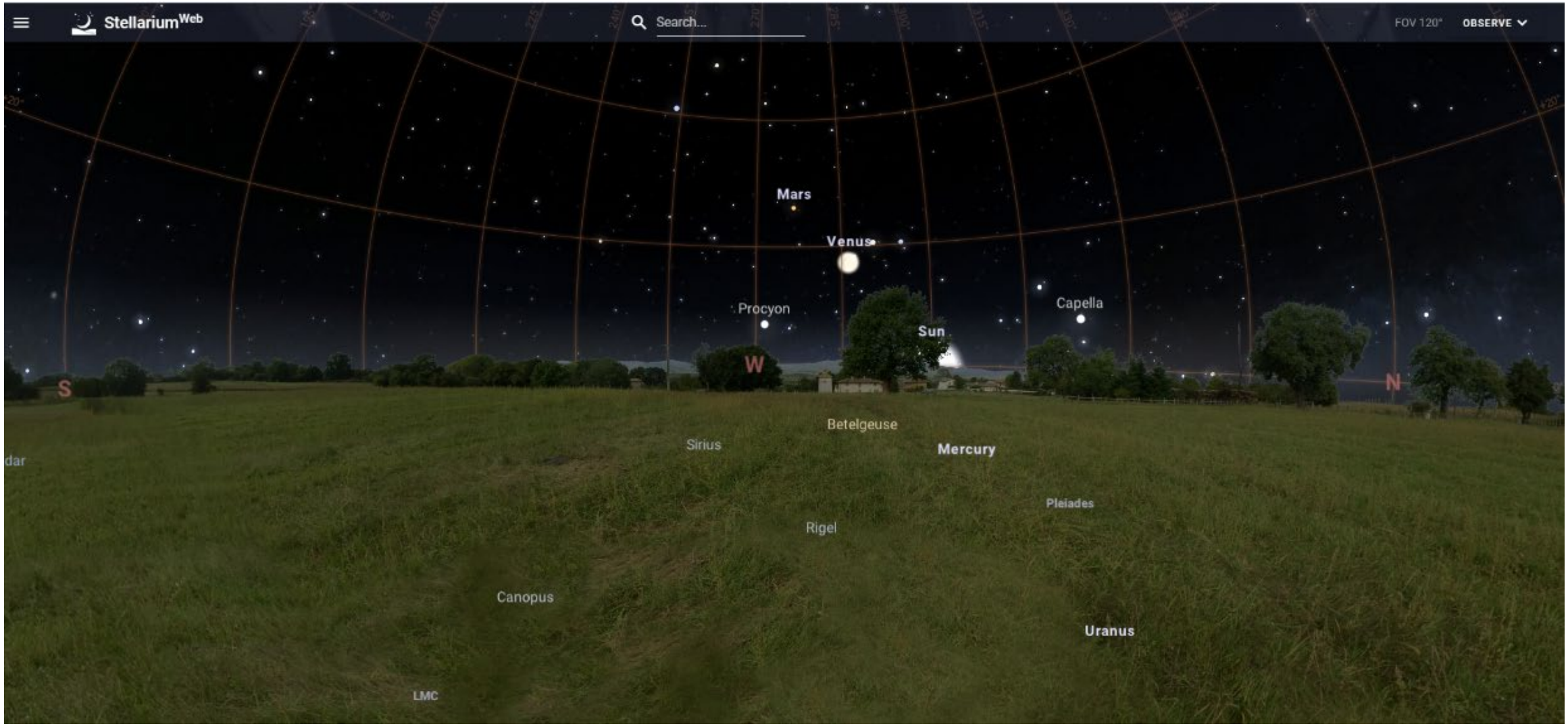
Mercury
Rigil Kentaurus
Venus
Saturn
Jupiter

Slide 1


StellariumWeb
Search...
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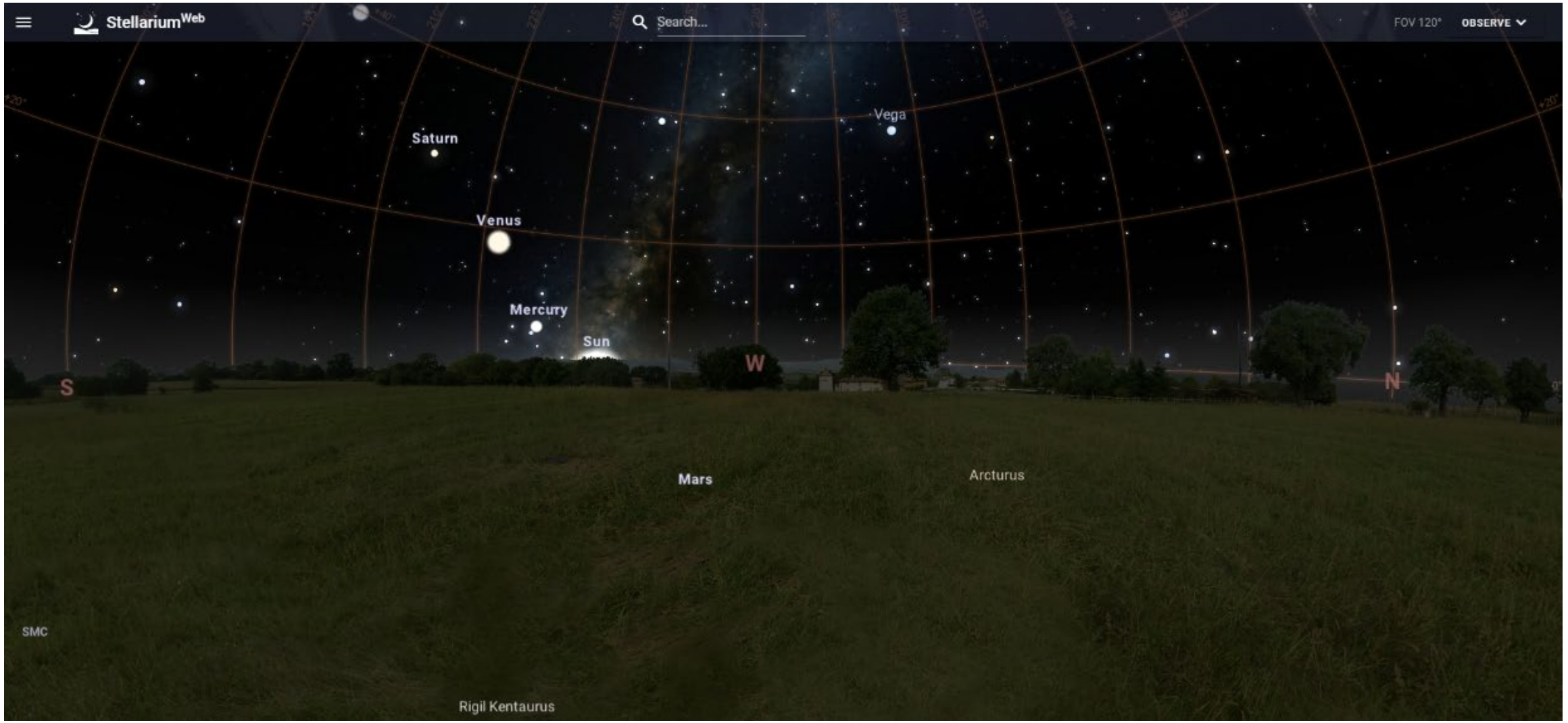
Canopus
Uranus
LMC

Slide 2


StellariumWeb
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FOV 120°
OBSERVE
Saturn
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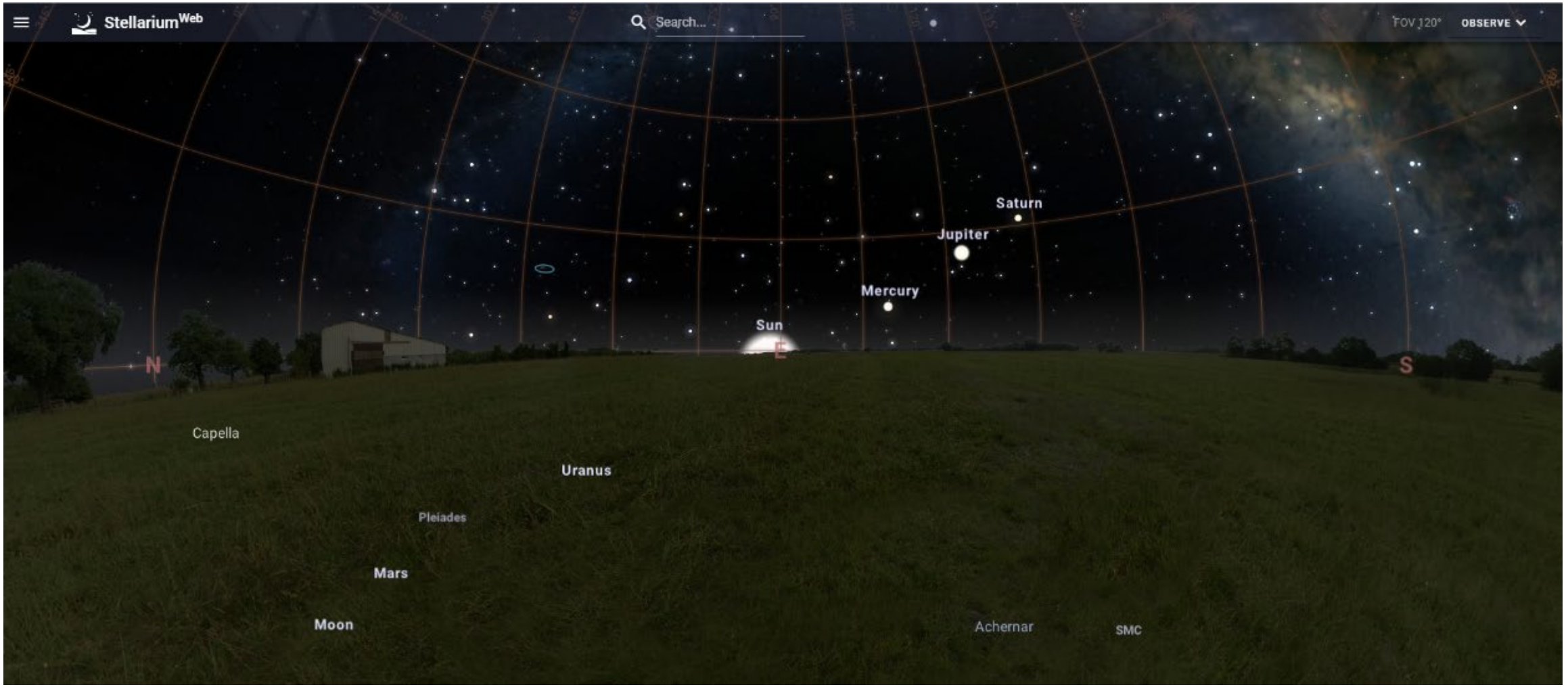
SMC
Rigil Kentaurus

Slide 3


StellariumWeb
Search...
FOV 120°
OBSERVE
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Jupiter
Mercury
Sun
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Capella
Uranus
Pleiades
Mars
Moon
Achernar
SMC

Slide 4


StellariumWeb
Search...
FOV 120°
OBSERVE
Arcturus
Venus
Mercury
Sun
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Rigil Kentaurus
Capella
Procyon

Slide 5


StellariumWeb
Search...
FOV 120°
OBSERVE
Uranus
Pleiades
Capella
Mercury
Sun
N
E
S
Betelgeuse
Rigel
Achernar
Venus
SMC
Mars
Procyon
Sirius
LMC
Canopus

Slide 6

Resources:

Ancient Observatories: Chaco Canyon, Exploratorium
https://www.exploratorium.edu/chaco/HTML/canyon.html

Decoding the ancient astronomy of Stonehenge
https://www.youtube.com/watch?v=Fx-KrvuiafE&feature=youtu.be

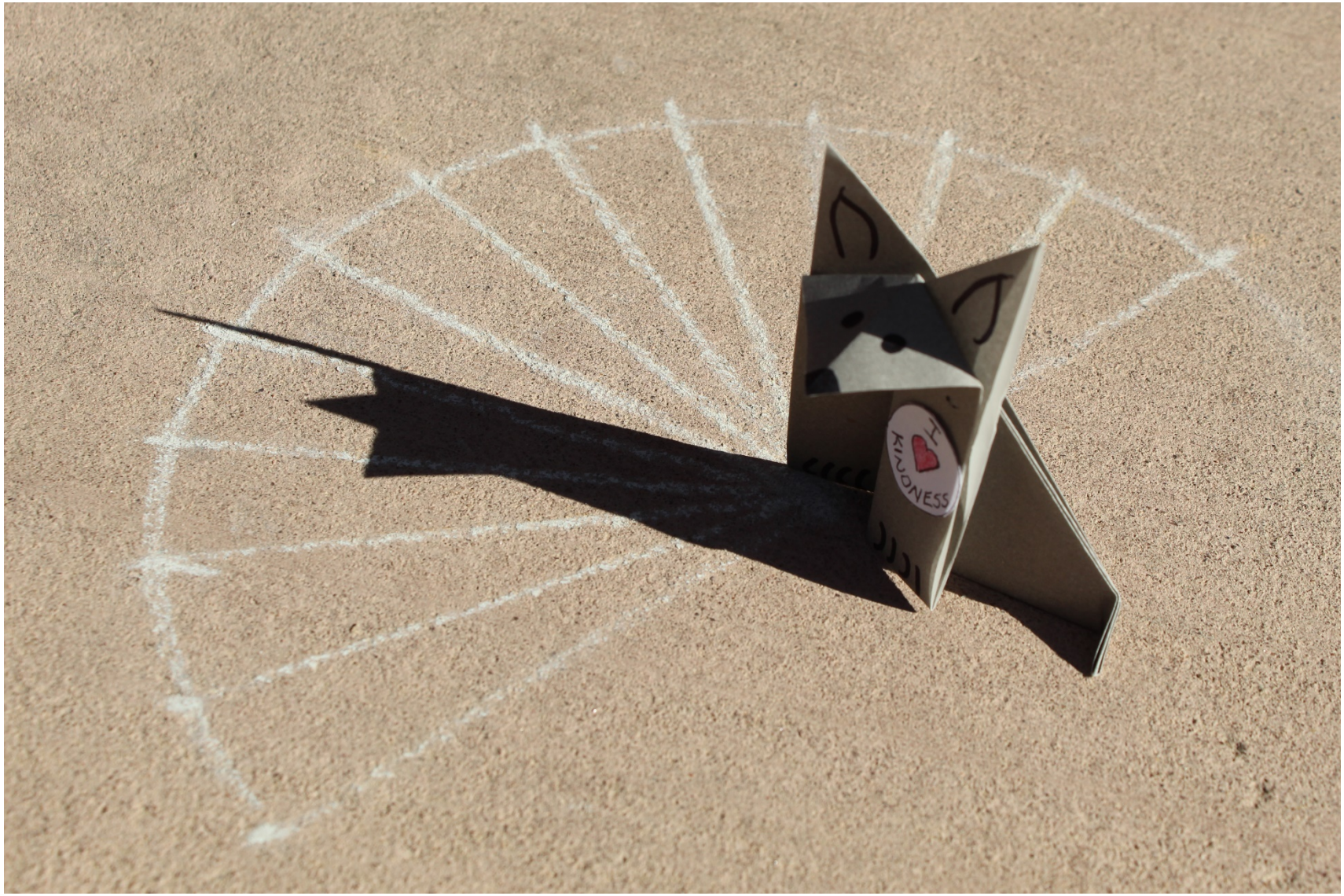
Ancient Observatories: Timeless Knowledge, information and photo gallery on sites around the world, NASA
https://sunearthday.nasa.gov/2005/locations/chaco.htm

The Earth's Tilt 1: The Reason for the Seasons
https://www.youtube.com/watch?v=Pgq0LThW7QA

What Causes the Seasons, from NASA Science Space Place
https://spaceplace.nasa.gov/seasons/en/

Changing Seasons, NOAA
https://www.noaa.gov/education/resource-collections/climate/changing-seasons

Answer Key:
Slide 1: 5, C, cold, Slide 2: 3, A, hot, Slide 3: 6, C, cold, Slide 4: 1, B, mild, Slide 5: 4, B, mild, Slide 6: 2, A, hot



Lulu measuring time like an ancient one