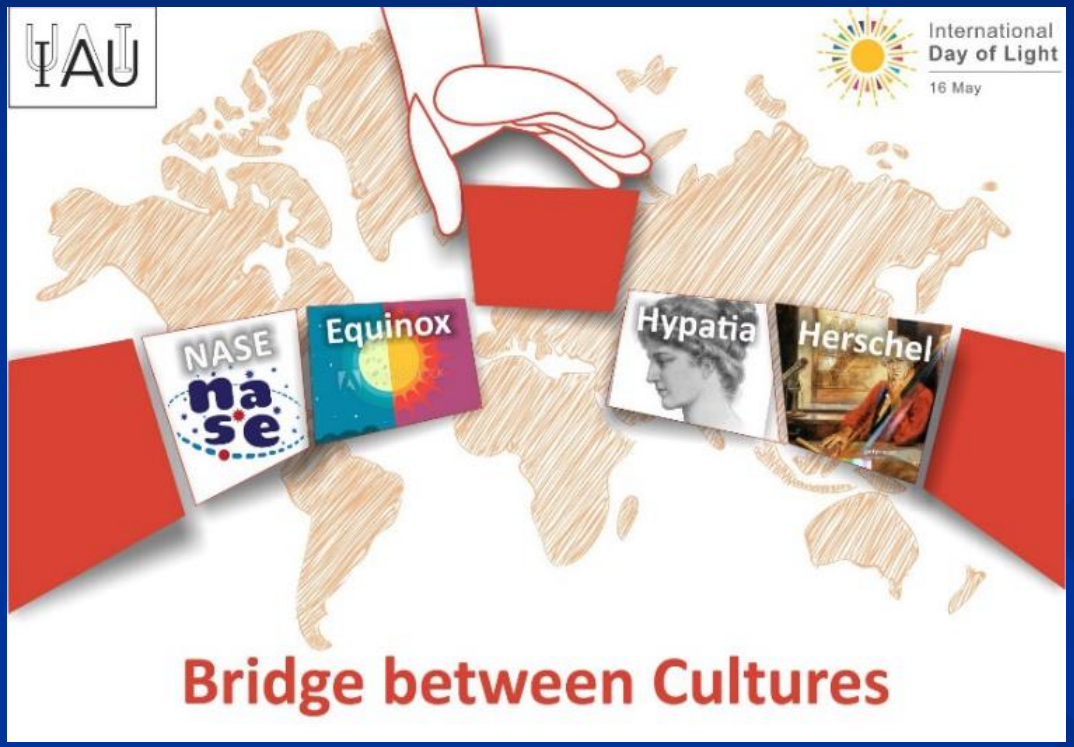
Bridges between Cultures
March 20th 2021



Inca Solar Horizon Events

Steven R. Gullberg, USA

Inca Solar Horizon Events

Steven R. Gullberg, Ph.D.

Director for Archaeoastronomy and Astronomy in Culture University of Oklahoma, Norman, Oklahoma, USA

Chair, International Astronomical Union Working Group for Archaeoastronomy and Astronomy in Culture

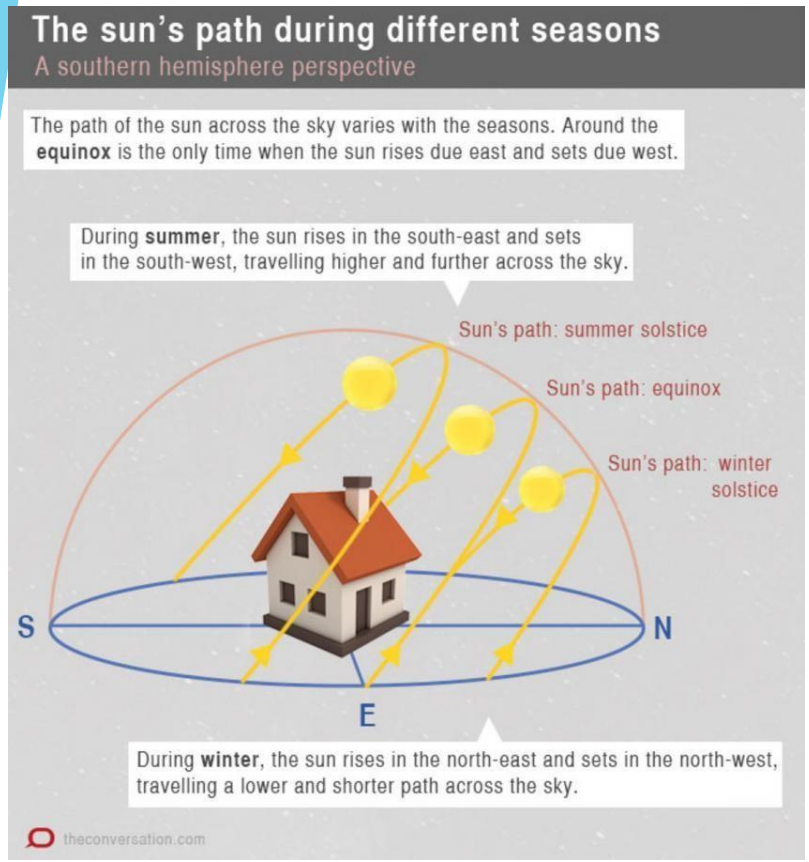
American Astronomical Society

Fellow of the Royal Astronomical Society

What is Archaeoastronomy?

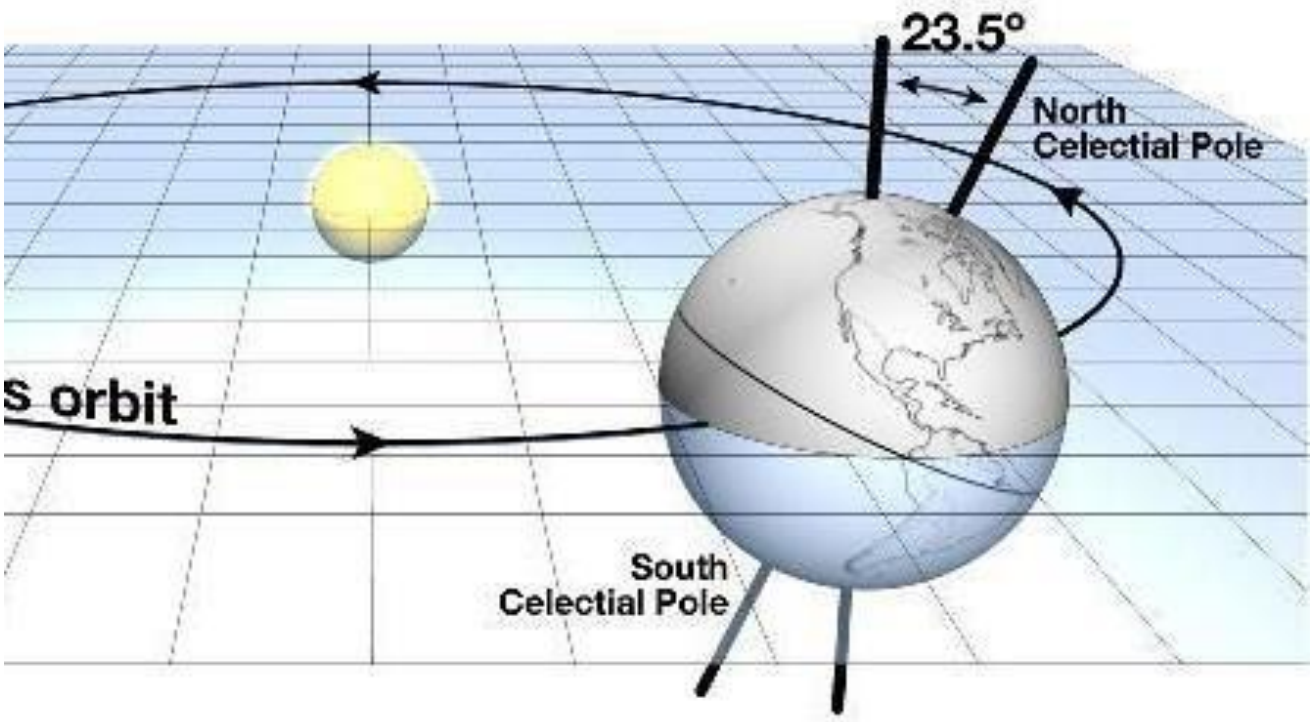
- Archaeoastronomy is the study of astronomy as it was used by ancient cultures.
- Archaeoastronomical studies are interdisciplinary in that they include fields such as astronomy, archaeology, and anthropology.
- They often involve investigating possible astronomical alignments and their cultural associations.

The positions of sunrise and sunset change

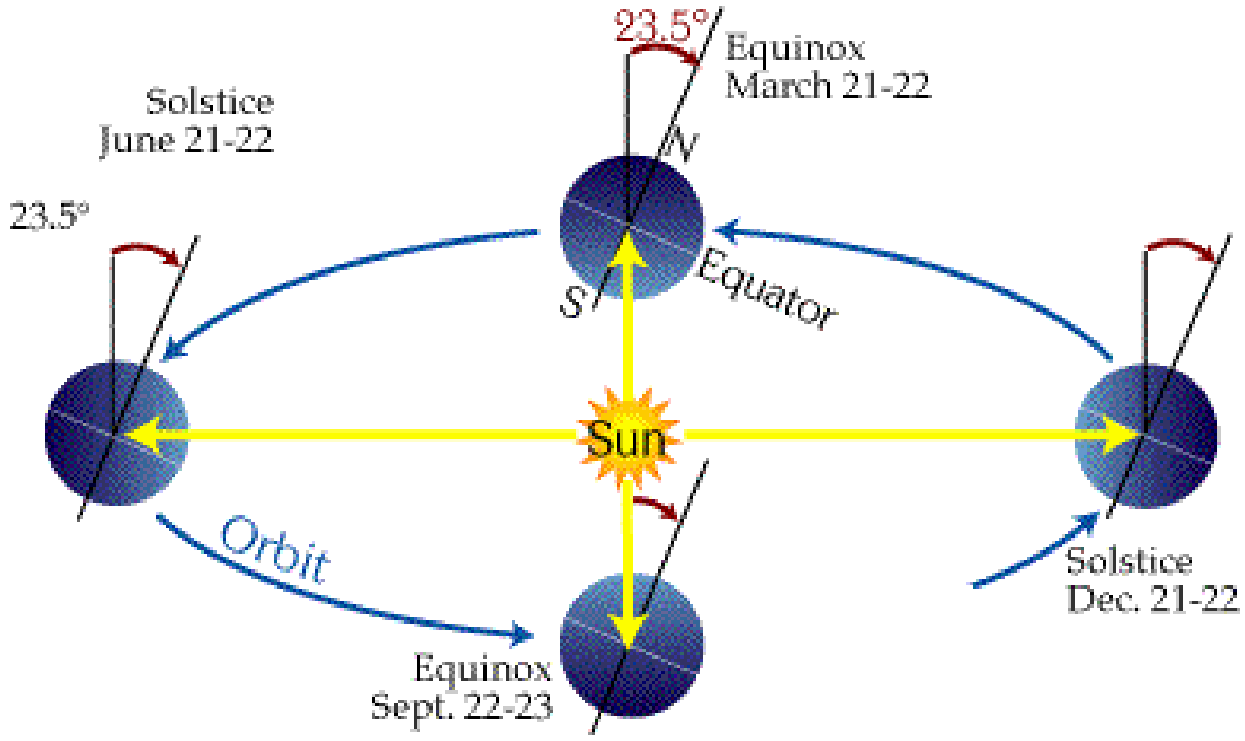


December solstice sunrise – summer

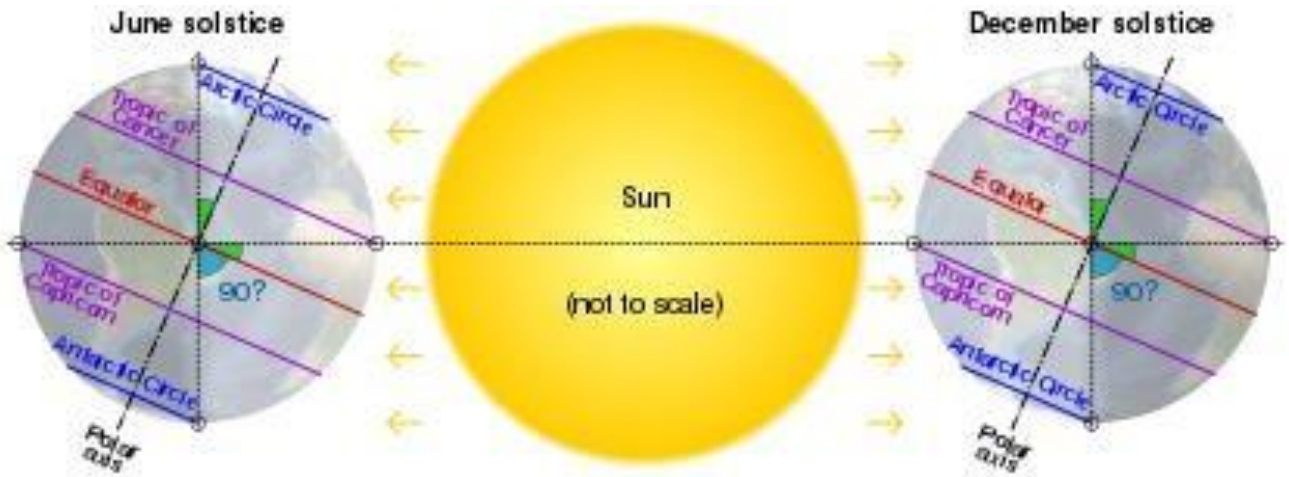
June solstice sunrise – winter



OUR AXIS IS TILTED 23.439 DEGREES



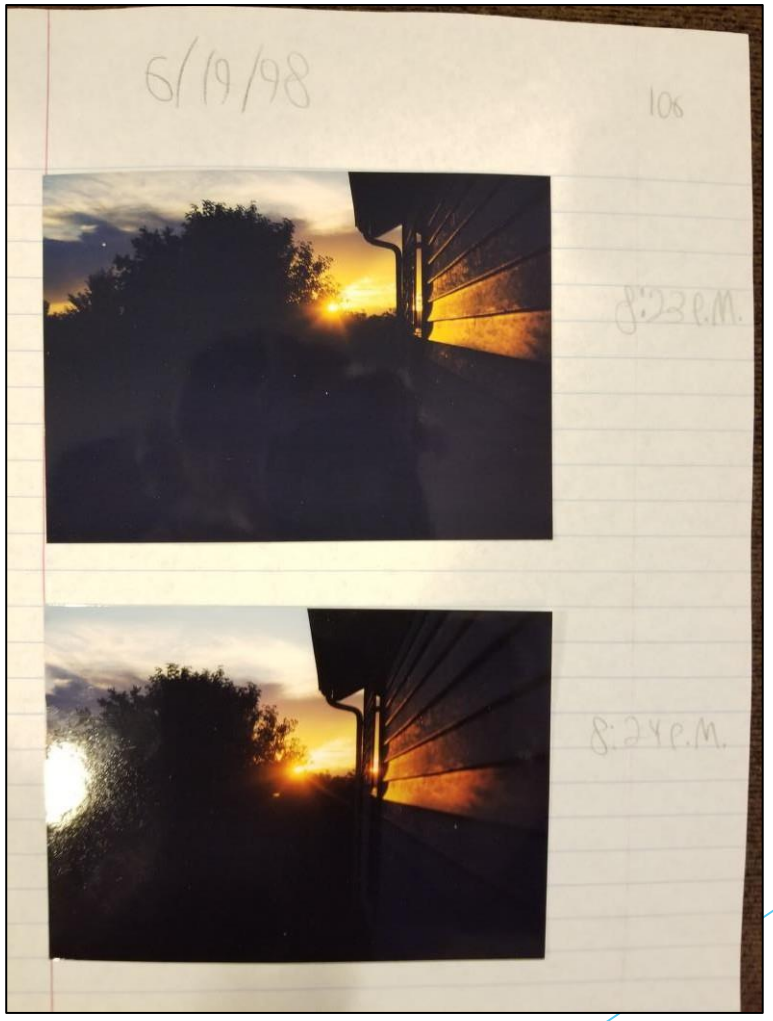
THE AXIS ALWAYS POINTS IN THE SAME DIRECTION



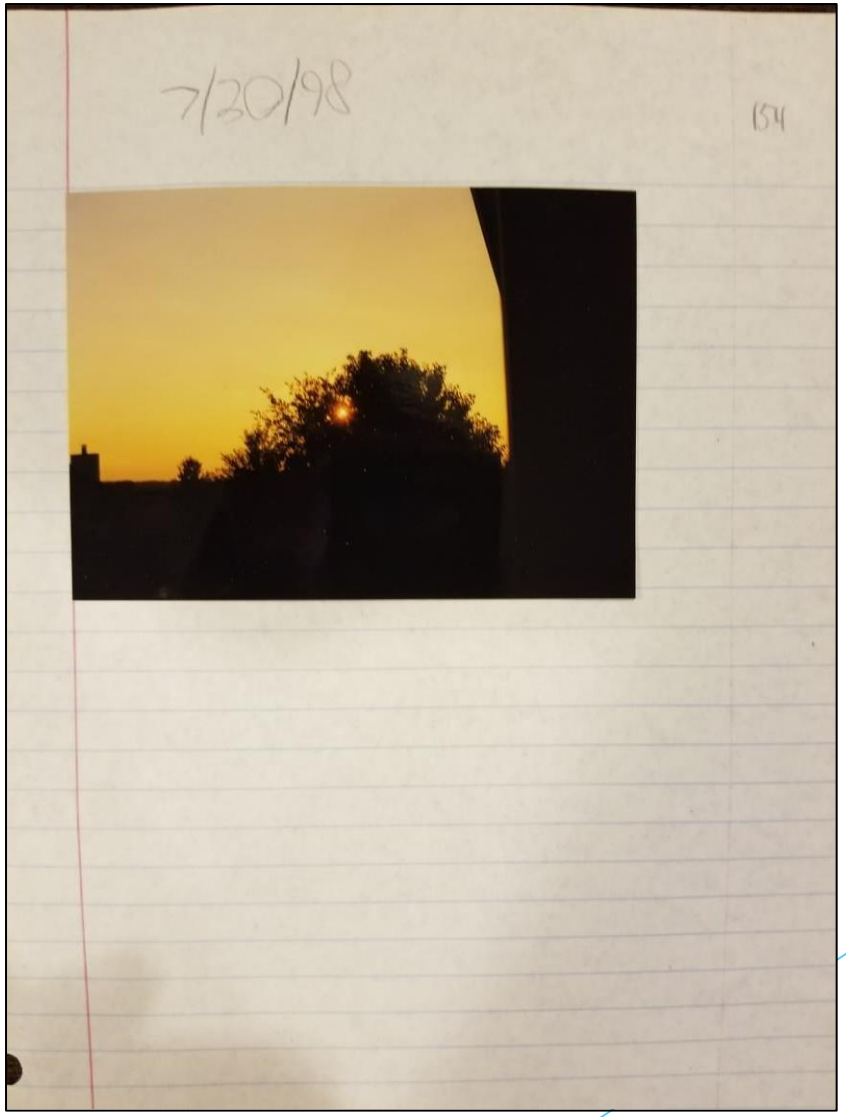
THE SUN ABOVE THE TROPICS

SUN ABOVE TROPIC OF CAPRICORN, EQUATOR, TROPIC OF CANCER

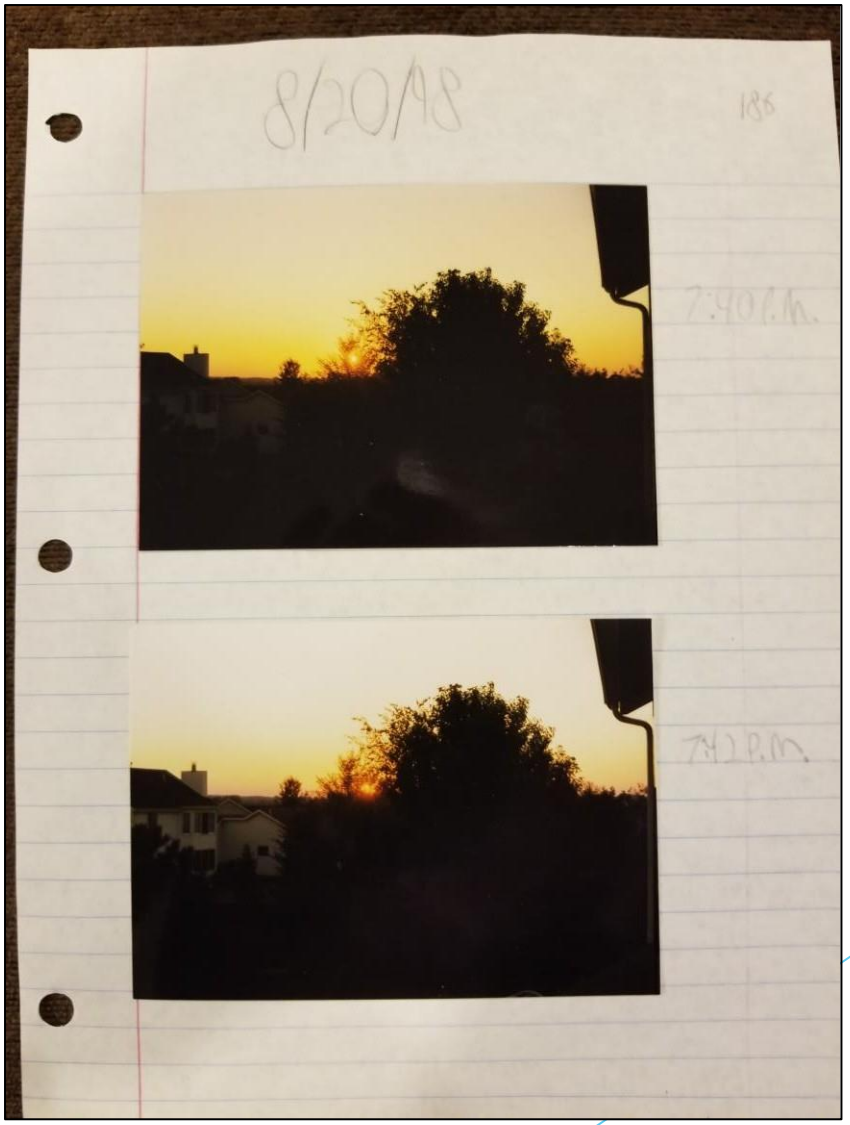
SCIENCE FAIR PROJECT
SUNSET IN JUNE



SUNSET IN JULY



SUNSET IN AUGUST

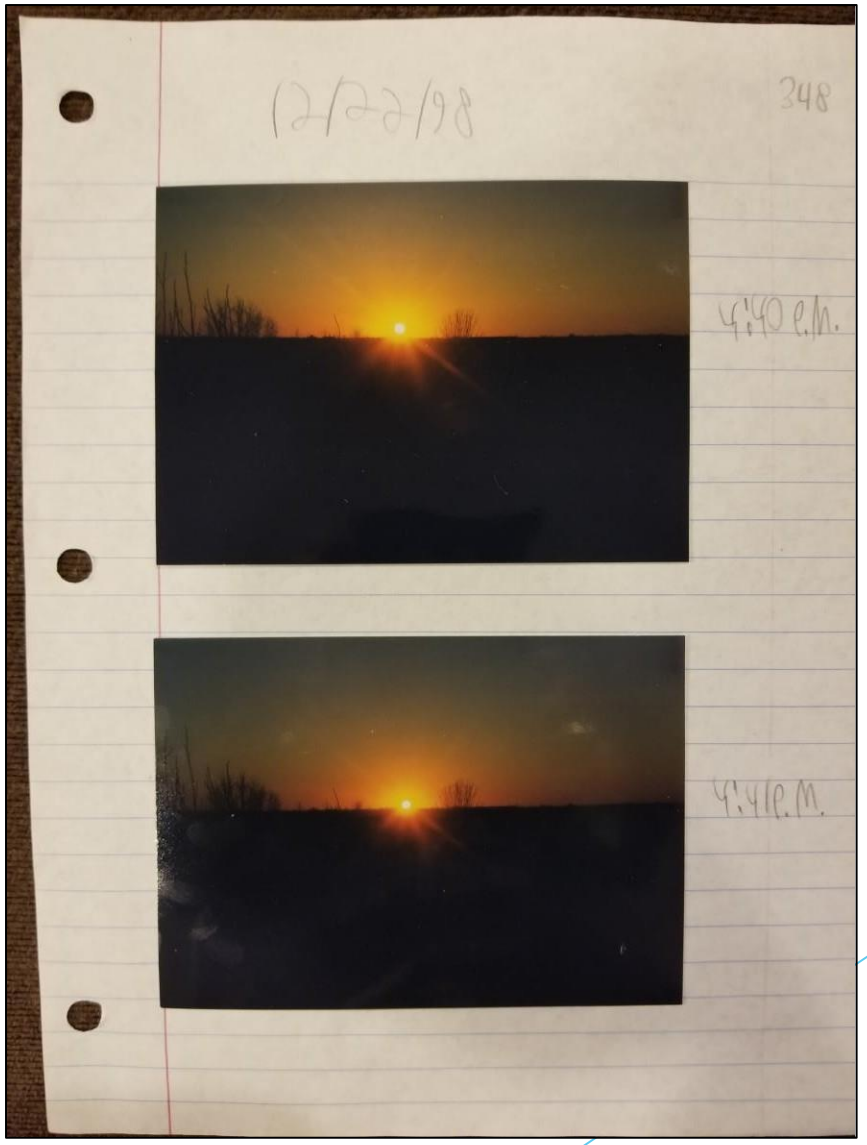


SUNSET IN SEPTEMBER

SUNSET IN OCTOBER

SUNSET IN NOVEMBER

SUNSET IN DECEMBER



SUN ABOVE TROPIC OF CAPRICORN, EQUATOR, TROPIC OF CANCER

Astronomy of the Inca Empire

Inca Solar Orientations

Astronomy was an integral part of Andean mythology and creation and was at the very heart of the Incas' religion and agriculture

The Incas proclaimed themselves to be the children of the Sun. They worshipped it and viewed their emperor as being the Sun's direct descendant.

The emperor, Pachacuti, his son, and grandson successively built the largest empire ever known in the Americas, 4800 km from Chile to Columbia.

They established armies in fortresses at distant stations with the infrastructure of roads and storehouses that was necessary to support them.

The Incas learned the cycles of solstices and equinoxes and used this knowledge as a key component of their annual crop management activities, as well as for determining dates for religious celebrations.

- Many waqas were orientated to the June solstice sunrise, while others pointed to the Sun at December solstice.

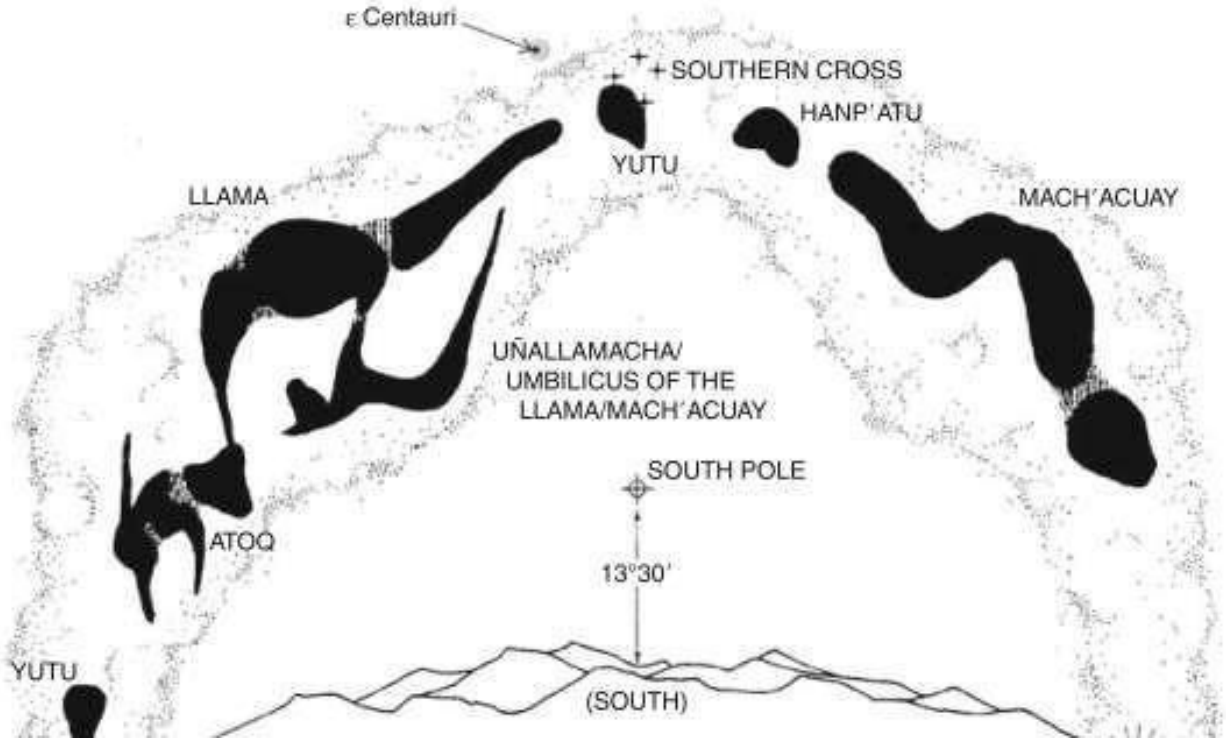
- Light tubes or cave openings allowed altars to be illuminated at specific times while other orientations guide the eye to the horizon on significant solar dates.

- Pillars were set on hills to mark the passage of the Sun on the horizon as a calendar.

Dark ‘constellations’

The Milky Way provided visual inspiration for several themes of Inca cosmology. The Incas recognized dark constellations, or the shapes of beings formed by dark clouds in the visible band of the galaxy.

The Incas saw great cosmological characters meant to guide them in their daily lives.



Incan Milky Way

Dark ‘constellations’

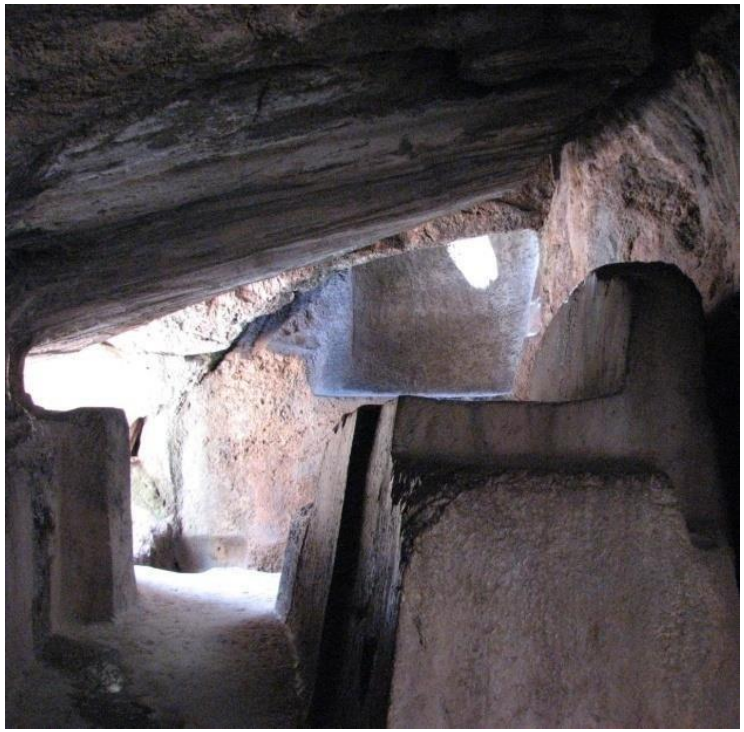
1)Machacuay, 2)Hanp’atu, 3)Yutu, 4)Yacana, 5)Unallamacha, 6)Atoq, 7)Yutu

Kenko Grande

- Limestone outcropping
- Carved in situ
- Two sucancas (gnomons)
- Effects of light and shadow
- June solstice sunrise
- “The Awakening of the Puma”

Kenko Grande

Kenko Grande



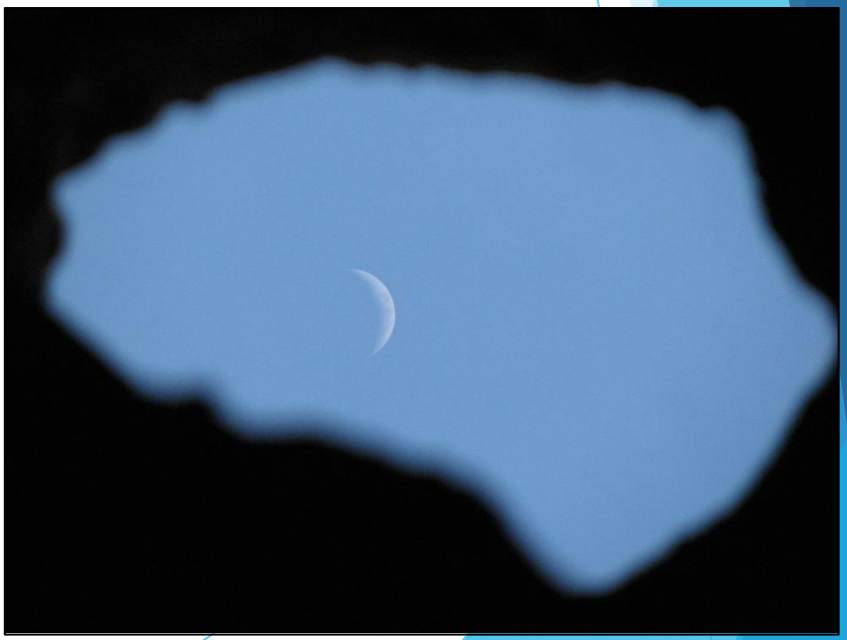
- Cave within Kenko Grande
- Altar and three stairs
- June solstice
- Sunlight climbs the stairs

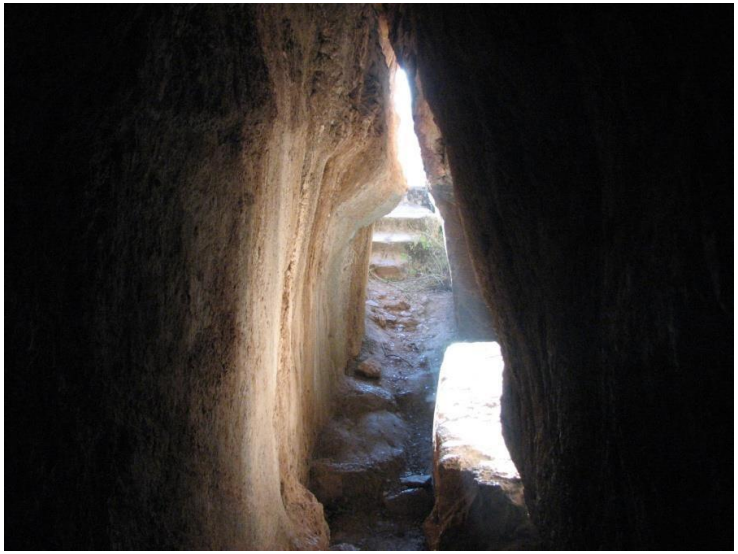
Kenko Grande

Lacco
Southwest Cave

- Limestone outcropping
- Light-tube
- Directed at altar
- Crescent moon

Lacco with Nevado Ausengate





Lacco Northeast Cave

- Northeast Cave opening oriented June solstice sunrise
- Illuminates altar and cave interior

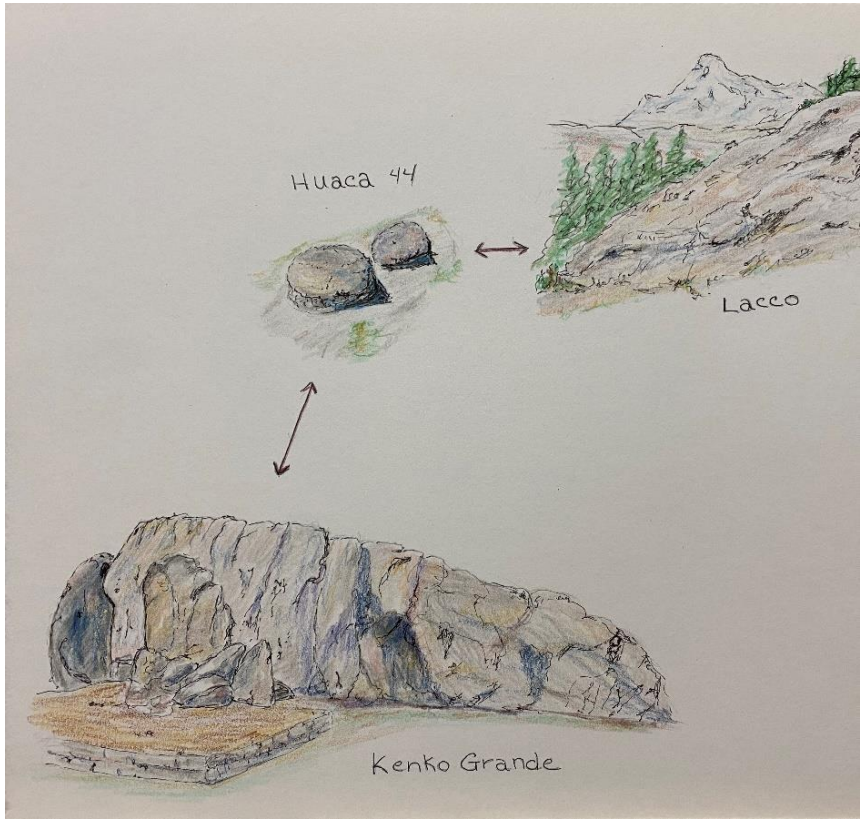
Lacco Southeast Cave Entrance

Lacco Southeast Cave Inner Chamber

- Temple of the Moon
- Light-tube/Altar
- Zenith Sun

Lacco
Southeast Cave

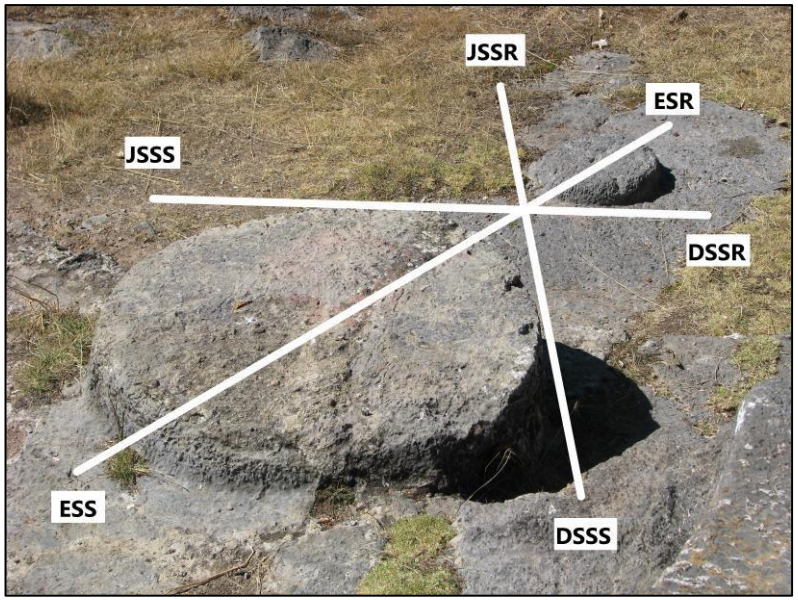
Waqa 44



- Limestone outcropping
- Two carved circles
- Carved seats
- Alignments for solstice and equinox horizon events

Waqa 44

Waqa 44



June Solstice Sunrise

Q’espiwanka Pillars

- Sixteen towers once on Cusco horizon
- Beyond Cusco 2 survive near Urubamba on Cerro Saywa
- Mark rising Sun at June solstice when viewed from palace of Huayna Capac
- Validate chronicles of Cusco pillars

Q’espiwanka Pillars

The white granite boulder of Q’espiwanka in front of a modern chapel

Q’espiwanka Pillars

Q’espiwanka Pillars

Cerro Unoraqui

- DSSR view from white granite boulder at Q'espiwanka
- View across Cerro Pumahuachana
- Pillars on 4377m summit
- North/South alignment

Cerro Unoraqui
4377m/14,360 ft Above Sea Level

Ollantaytambo

The most striking feature when first approaching Ollantaytambo is a magnificent set of 17 stone terraces that ascend the hillside.

Ollantaytambo

The extensive terraces of Pumatillis face out to the rise of the December solstice Sun and, in the opposite direction, face in toward and frame nicely the June solstice sunset

Ollantaytambo

The Incamisana

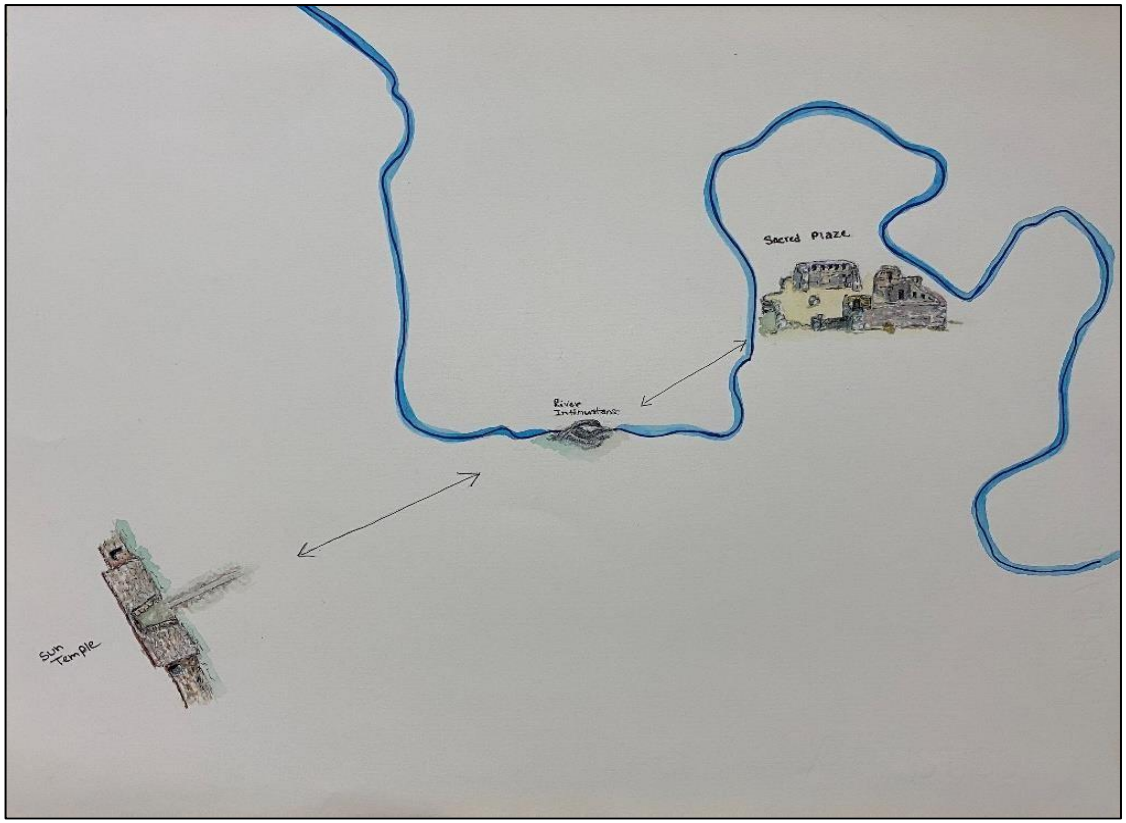
Ollantaytambo

The horizontal gnomons of the Incamisana

Ollantaytambo

- On the December solstice at local noon the shadow of one of the gnomons is said to reach down and “insert” itself to fill a carved triangular notch in the base below.

Machu Picchu Region

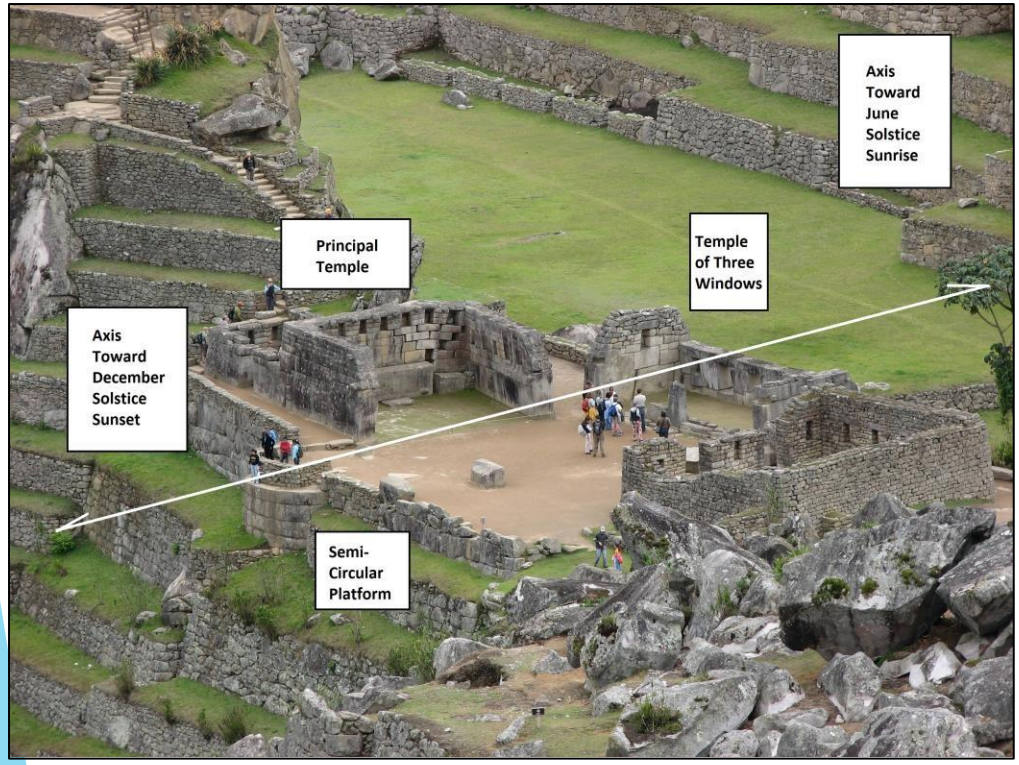


- Llactapata
- River Intihuatana
- Machu Picchu
- JSSR-DSSS Axis
- Equinox Axis

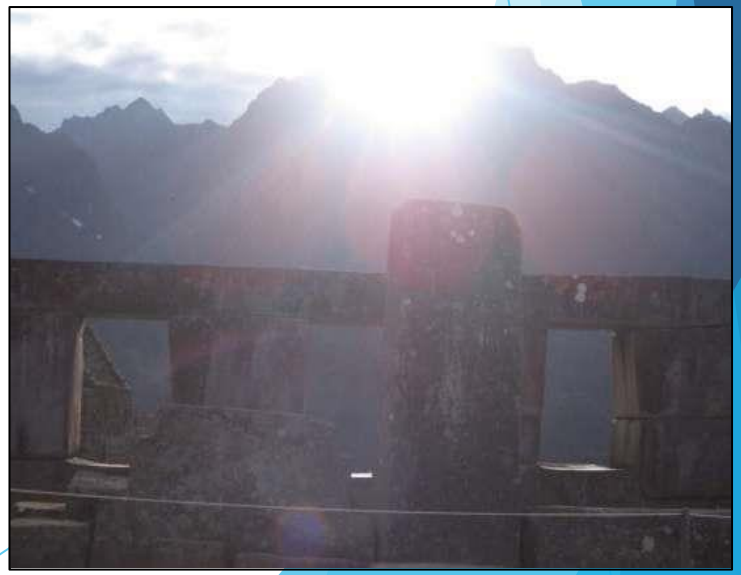
Llactapata, River Intihuatana, and Machu Picchu

Machu Picchu

Sacred Plaza



- Principal Temple
- Temple of Three Windows
- Semi-circular platform
- JSSR-DSSS Axis



The Torreon

Includes a carefully fitted rock wall that includes a window open to the horizon positions of the June solstice sunrise and the heliacal rise of the Pleiades

Machu Picchu Intihuatana and Llactapata

Llactapata Ridge

5 km from Machu Picchu across gorge

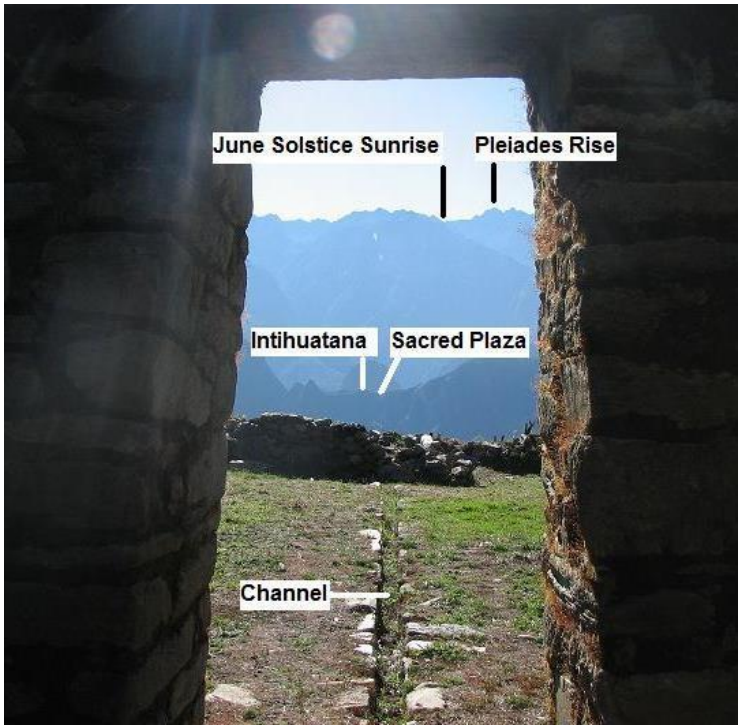
Llactapata

- Overlooks Machu Picchu
- Oriented for June solstice sunrise & Pleiades rise

Llactapata

Sun Temple Llactapata

- Llactapata Sun Temple Overlooks Sacred Plaza
- Oriented for June solstice sunrise & Pleiades rise – El Niño



Sun Temple Llactapata

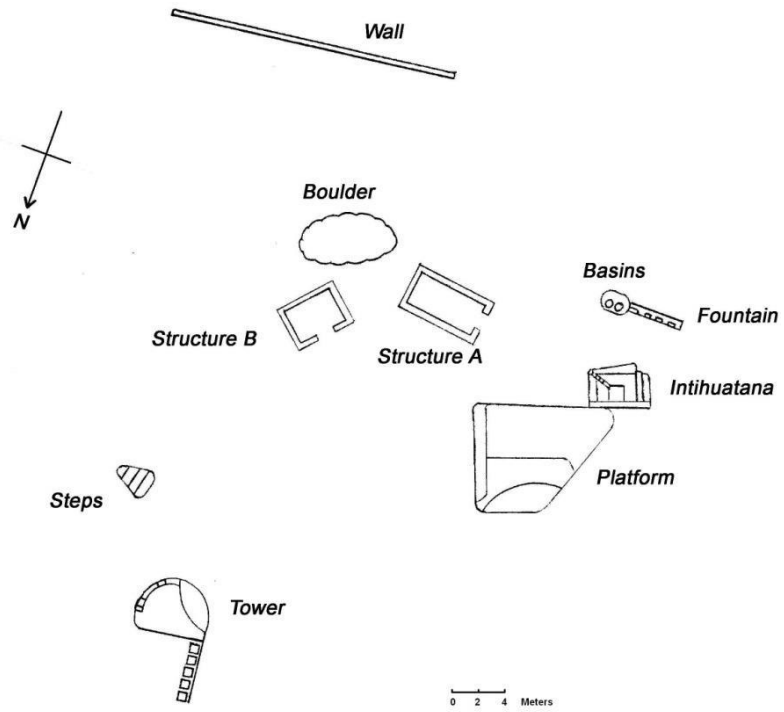
June Solstice Sunrise

The River Intihuatana

The River Intihuatana

- Urubamba River canyon
- Carved granite
- Between Machu Picchu & Llactapata
- Platform, steps, fountain, basins, cave
- Hiram Bingham 1911

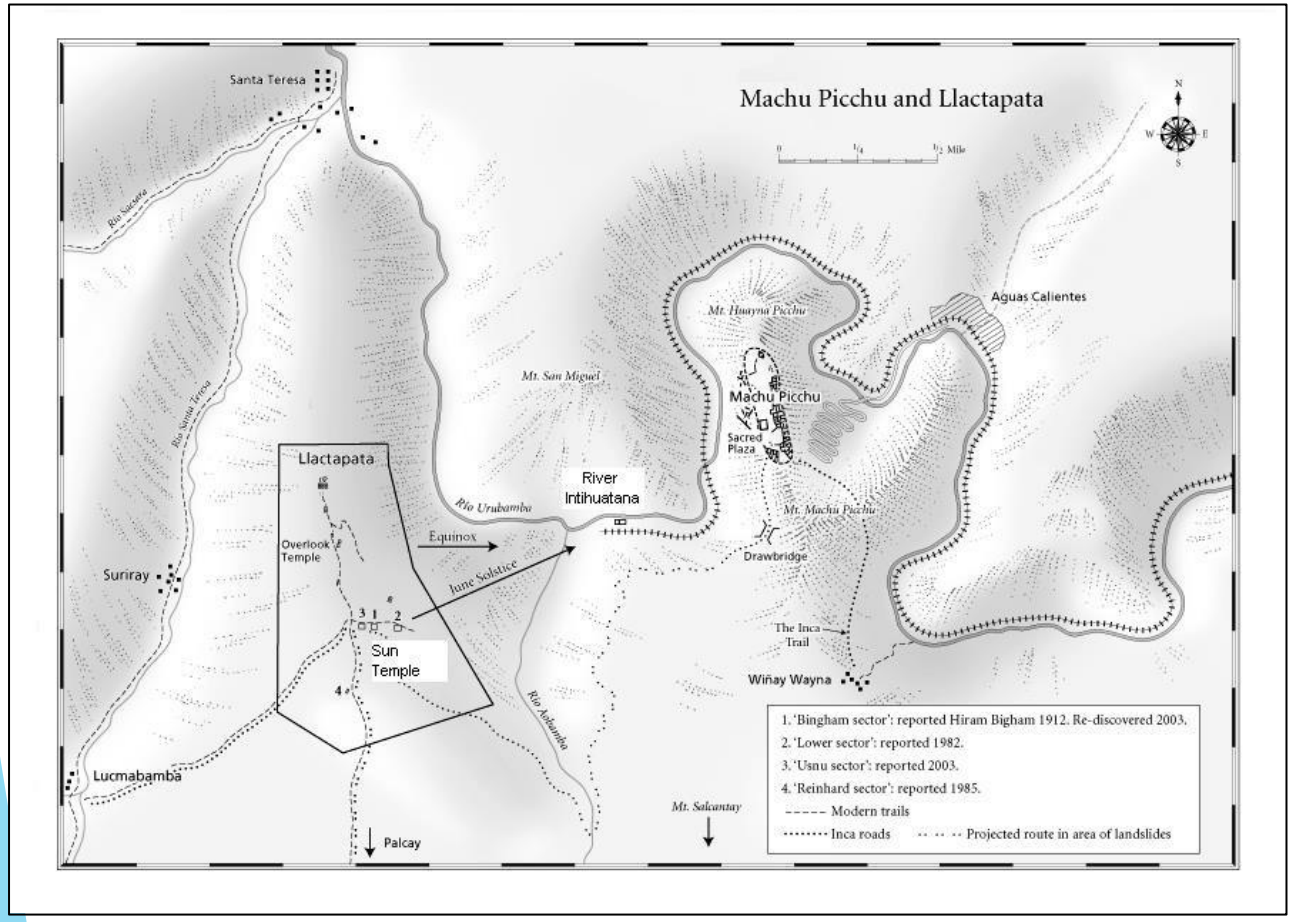
River Intihuatana Sanctuary Plan



- Intihuatana, fountain, basins
- Structures
- Steps
- Tower
- Terraces

Ground Plan of the River Intihuatana Sanctuary

Machu Picchu Region



- Llactapata
- River Intihuatana
- Machu Picchu
- JSSR-DSSS Axis
- Equinox Axis
- Ceremonial Complex

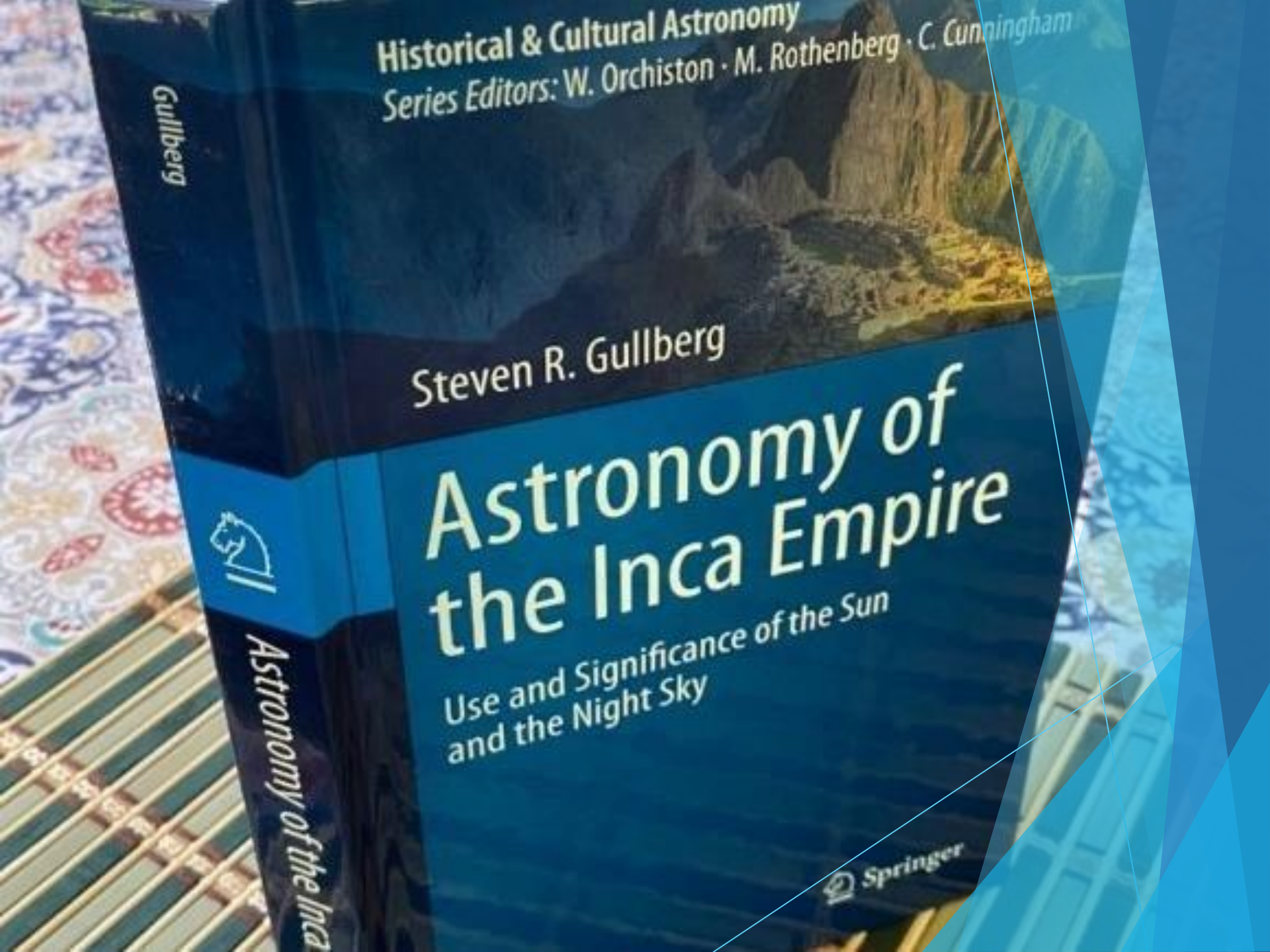
Llactapata, River Intihuatana, and Machu Picchu

Summary

Findings show that the Inca landscape most definitely is filled with examples of astronomy used in their culture. Examples of light and shadow effects throughout the year, especially at times of the solstice, equinox, zenith and anti-zenith suns, were found at many sites.

Regarding the 8 primary solar horizon events, those at the solstices were most prominent. June solstice sunrise occurred most often, but December solstice sunrise was a close second.

Two of the Inca's primary annual festivals occurred at these two times of the year. Astronomy was thoroughly interwoven throughout Inca society.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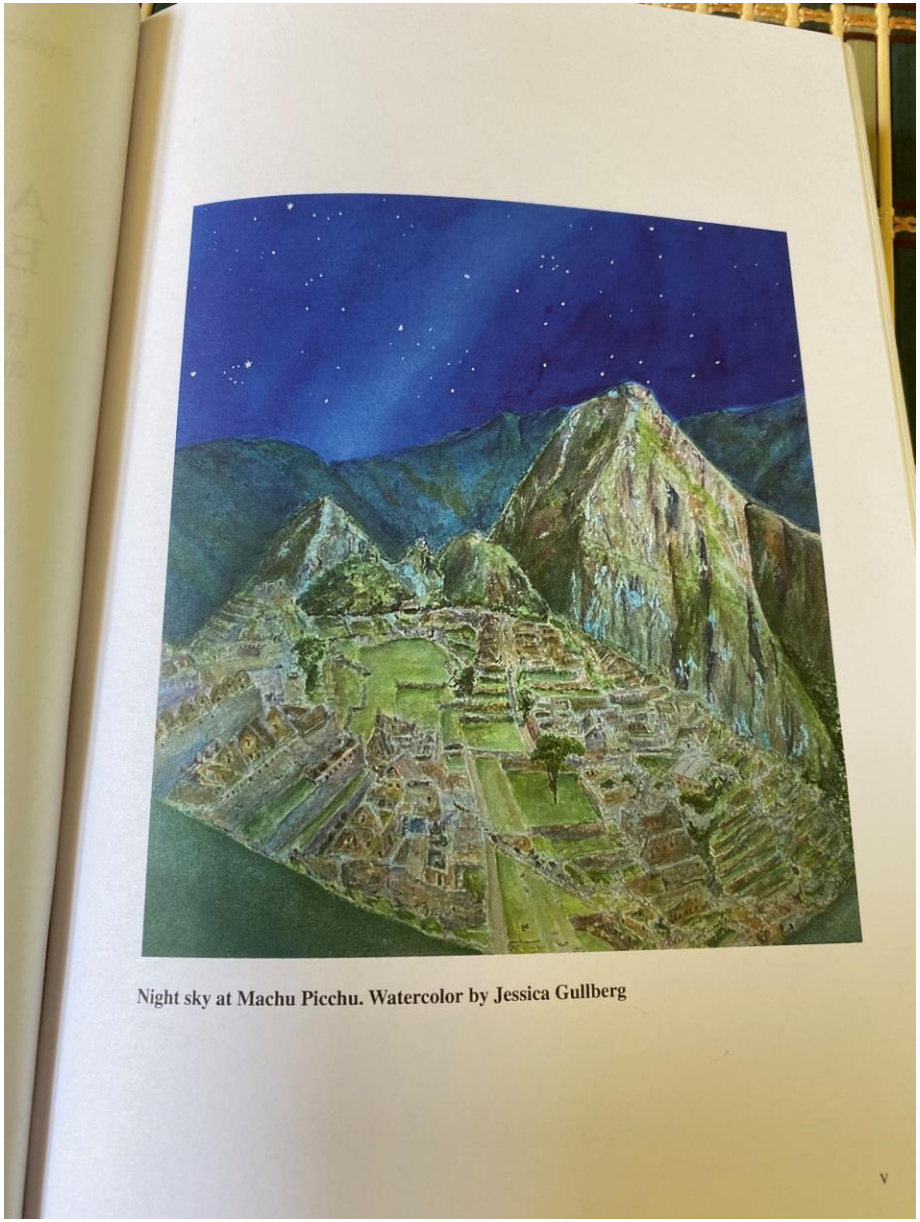

Night sky at Machu Picchu. Watercolor by Jessica Gullberg

Questions?

Email:
srgullberg@ou.edu