

TEACHING NOTES FOR ARCHAEOASTRONOMY LAB**Equipment Needed:**

- 12 computers with Starry Night preloaded
- Starry Night User Manual (just in case)

The focus of this lab is to introduce the students to the motions of the Sun and stars that are visible to the naked eye and their application to the calendar. This lab relies heavily on the capabilities of Starry Night Pro to show the sky from any Earthly location at any time of year in any year from 4713 BC to 9999 AD. (The earliest date available corresponds to Julian day 1, if anyone asks.)

In addition to the two sight-lines marked in the lab script for Hovenweep Castle, a third possible alignment exists for the doorway of the viewing room – through the exterior doorway of the viewing room to the eastern doorway of the viewing room. This direction points almost due east. From a sunwatcher's perspective, there is nothing special about the directions east and west since the Sun passes them by at its fastest rate – we only use east and west because of the magnetic compass and our celestial coordinate system. The doorway alignment points to the position of sunset 4 days after the vernal equinox, a date that lies halfway between winter solstice and summer solstice. It is believed that the alignment was determined by counting through half the days between winter and summer solstice, rather than in relation to the equinox.

A great book for supplemental reading, and where much of the archaeoastronomy background material was taken, is Living the Sky: The Cosmos of the American Indian, by Ray A. Williamson. The original article by John Eddy on Bighorn Medicine Wheel is *Science*, 1974, **184**, 1035.

Questions:

1. The Hovenweep Castle ports are aligned in 1200 AD with:
 1. Summer solstice sunset (June 6)
 2. Winter solstice sunset (December 15) (The dates were determined using *Starry Night*.)

For Hovenweep Castle, because the dates of alignment span the year and the fact that the observing room is connected to a large building suggests it was inhabited year-round. With just the alignments, it is difficult to tell what the whole story is. Archaeological excavations in the other rooms of Hovenweep Castle support the conclusion that it was inhabited year-round.

The alignments found by John Eddy for Bighorn Medicine Wheel for 1200 AD are:

1. Summer solstice sunset (June 6)
2. Aldebaran rises (June 4)
3. Summer solstice sunrise (June 6)
4. Rigel rises (July 2)
5. Sirius rises (July 17) (The dates were determined using *Starry Night*.)

The inaccessibility of Big Horn Medicine Wheel in winter and the narrow range of dates of astronomical alignments *suggests* it was a summer-only observatory. John Eddy's study of Bighorn Medicine Wheel has come under question since his original paper in *Science*. Other theories suggest the stone pattern is the foundation of a large building or enormous tipi or just a symbolic pattern with a purely cultural meaning to those who built it. Archaeological excavations at the site suggest it was in fact used around 1200-1700 AD, in agreement with the period the astronomical alignments existed.

For both these sites, archaeologists are still debating the possible astronomical and cultural significance of these sites, so any reasonably supported answer is as good a guess as the professionals in the field.

2. This question relates to the *real* motion of the Earth around the Sun and the *apparent* motion of the Sun relative to the "fixed stars" during the course of a year. A diagram showing the changing Earth-Sun line of sight relative to the background stars is what I had in mind.

3. This question is intentionally broad to make the students think about the other issues archaeoastronomers contend with. A wide range of concerns affect the study of archaeological sites for astronomical significance:

Are walls and/or windows as they were or have possible alignments been modified by past erosion of the site or by contemporary archaeological reconstruction or preservation? (This concern affects the study of Casa Rinconada at Chaco Canyon. One niche in the eastern wall catches the setting sun at winter solstice. But it appears that an exterior wall would have blocked this view at the time of original habitation, so the alignment is purely coincidence and was not intended by the builders.)

Is there any evidence from the society's traditions, or traditions of a related tribe, that they made routine observations of the sky? (The sunwatching societies in the Southwest, like the Zuni and Hopi, have been used as cultural analogies of the Anasazi. However, the Plains tribes that neighbor the medicine wheels profess little knowledge of them.)

On the dates of suspected observations, was the site accessible and useable? (For many medicine wheels at high elevation, snow is a concern. Big Horn Medicine Wheel would have been under feet of snow for many months of the year.)

Was an alignment that is visible to a modern observer sufficiently modified by precession that it didn't exist 500 or 5000 years ago? (This is especially true of structures like Stonehenge or the Pyramids that are many thousands of years old. Dating techniques or historical information can sometimes narrow the possible dates of use.)

4. The number 28 is related to the lunar month. As this number has no other obvious meaning than a lunar connotation, the fact that Medicine Wheel has 28 spokes strongly suggests an astronomical purpose.

Fuentes

I went ahead and actually Did the Archeoastronomy lab keeping track of all possible answers +/- 5 degrees for each line of sight. I did it using the newer version of Starry Night pro that I have on my laptop. The differences should be totally negligible.

The loosing fitting of solstice and the sight line should be noted. These are listed first by brightness, then by distance from the sight line.

Utah:

l.o.s. 1:

- Summer Solstice Sunset, ~6/14
- Heliacal Setting of Arcturus, ~11/20
- Heliacal Setting of Alpheratz, ~3/20

l.o.s. 2:

- Winter Solstice Sunset, ~12/11
- Heliacal Setting of Antares, 11/5

Wyoming:

l.o.s. 1:

- Not the sun
- Pollux, setting, ~7/6
- Arcturus, setting, ~12/4
- Elnath, setting, ~5/22

(the teaching notes also listed the Summer solstice here, but It didn't work for me. The solstice was at az=304)

l.o.s. 2:

- Not the sun
- Hamal, rising, ~4/3
- Aldebaran, rising, ~5/15
- Regulus, rising, ~8/10

l.o.s. 3:

- Summer Solstice Sunrise, ~6/21
- Arcturus, Rising, ~9/18
- Alpheratz, rising, ~1/20
- Algieba, rising, ~8/2

l.o.s. 4:

- Spica, Rising, ~10/3
- Rigel, Rising, ~7/2

l.o.s. 5:

- Sirius, rising, ~7/20 (should clearly be best possibility)

If anyone wants to check these results, please do so, and we might consider attaching this to the .teach files.

Please check the star charts to find anyother stars that have the same dec as the solstice. The students will give you those if they rule out a questionable solstice alignment.