

## Activity 7: Measuring – Astrolabe

Use your astrolabe and:

1. For my birthday, May 25 is Zodiacal Date Gemini 3
  - Find the position of the sun on the ecliptic:  $217^{\circ}$
  - Find the azimuth of the sun at sunrise:  $28^{\circ}$  and sunset:  $332^{\circ}$
  - Find the time of sunrise: 5:39 MDT and sunset: 20:18 MDT
  - Find the sun's altitude at transit:  $68^{\circ}$
  - Find the length of daylight: 13h 39m  
  - Stellarium's position of the sun on the ecliptic:  $217^{\circ}$
  - Stellarium's azimuth of the sun at sunrise:  $28^{\circ}$  and sunset:  $332^{\circ}$
  - Stellarium's time of sunrise: 5:39 MDT and sunset: 20:18 MDT
  - Stellarium's sun's altitude at transit:  $68^{\circ}$
  - Stellarium's length of daylight: 13h 39m
2. Start of spring (Vernal Equinox) Mar 21 is Zodiacal Date Pisces 29
  - Find the position of the sun on the ecliptic:  $90^{\circ}$
  - Find the azimuth of the sun at sunrise  $40^{\circ}$  and sunset  $40^{\circ}$
  - Find the time of sunrise 7:00 MDT and sunset 19:00 MDT
  - Find the sun's altitude at transit:  $50^{\circ}$
  - Find the length of daylight: 12h 0m  
  - Stellarium's azimuth of the sun at sunrise:  $28^{\circ}$  and sunset:  $332^{\circ}$
  - Stellarium's time of sunrise: 5:39 MDT and sunset: 20:18 MDT
  - Stellarium's sun's altitude at transit:  $68^{\circ}$
  - Stellarium's length of daylight: 13h 39m
3. Start of summer (Summer Solstice) Jun 21 is Zodiacal Date Gemini 29
  - Find the position of the sun on the ecliptic:  $186^{\circ}$
  - Find the azimuth of the sun at sunrise  $27^{\circ}$  and sunset  $292^{\circ}$
  - Find the time of sunrise 5:28 MDT and sunset 20:28 MDT
  - Find the sun's altitude at transit:  $74^{\circ}$
  - Find the length of daylight: 15h 0m  
  - Stellarium's azimuth of the sun at sunrise:  $28^{\circ}$  and sunset:  $332^{\circ}$
  - Stellarium's time of sunrise: 5:39 MDT and sunset: 20:18 MDT
  - Stellarium's sun's altitude at transit:  $68^{\circ}$
  - Stellarium's length of daylight: 13h 39m

4. Start of fall (Autumnal Equinox) Sep 21 is Zodiacal Date Virgo 27
  - Find the position of the sun on the ecliptic:  $270^\circ$
  - Find the azimuth of the sun at sunrise  $44^\circ$  and sunset  $43^\circ$
  - Find the time of sunrise 6:54 MDT and sunset 7:08 MDT
  - Find the sun's altitude at transit:  $51^\circ$
  - Find the length of daylight: 12h 0m
  
  - Stellarium's azimuth of the sun at sunrise:  $28^\circ$  and sunset:  $332^\circ$
  - Stellarium's time of sunrise: 5:39 MDT and sunset: 20:18 MDT
  - Stellarium's sun's altitude at transit:  $68^\circ$
  - Stellarium's length of daylight: 13h 39m
  
5. Start of winter (Winter Solstice) Dec 21 is Zodiacal Date Sagittarius 30
  - Find the position of the sun on the ecliptic:  $0^\circ$
  - Find the azimuth of the sun at sunrise  $53^\circ$  and sunset  $53^\circ$
  - Find the time of sunrise 7:20 MST and sunset :16:16 MST
  - Find the sun's altitude at transit:  $25^\circ$
  - Find the length of daylight: 8h 56m
  
  - Stellarium's azimuth of the sun at sunrise:  $28^\circ$  and sunset:  $332^\circ$
  - Stellarium's time of sunrise: 5:39 MST and sunset: 20:18 MST
  - Stellarium's sun's altitude at transit:  $68^\circ$
  - Stellarium's length of daylight: 13h 39m
  
6. Find the time that any five first or second magnitude stars:
  - a. Star 1: Betelgeuse Date: Jan 1
    - Using my Astrolabe, the Zodiacal Date is Capricornus 21
      - Rise time 16:22 MST and azimuth  $80.0^\circ$
      - Transit time 22:55 MST and altitude  $57^\circ$
      - Set time 4:59 MST and azimuth  $273.6^\circ$
      - Length of time the star was in the sky: 12h 37m
      - The altitude  $49^\circ$  and azimuth  $137.3^\circ$  at 10:00 pm local time.
    - Using Stellarium
      - Rise time 16:44 MST and azimuth  $79.6^\circ$
      - Transit time 23:11 MST and altitude  $57.5^\circ$
      - Set time 5:37 MST and azimuth  $279.9^\circ$
      - Length of time the star was in the sky: 12h 53m
      - The altitude  $54.3^\circ$  and azimuth  $150.1^\circ$  at 10:00 pm local time
  - b. Star 2: Alpheratz Date: Sep 1
    - Using my Astrolabe, the Zodiacal Date is Virgo 8
      - Rise time 18:34 MDT and azimuth  $51.8^\circ$
      - Transit time 2:27 MDT and altitude  $79^\circ$
      - Set time 10:38 MDT and azimuth  $308.3^\circ$

- Length of time the star was in the sky: 16h 04m
    - The altitude  $36^\circ$  and azimuth  $69.8^\circ$  at 10:00 pm local time
  - Using Stellarium
    - Rise time 18:29 MDT and azimuth  $50^\circ$
    - Transit time 2:22 MDT and altitude  $79.9^\circ$
    - Set time 10:15 MDT and azimuth  $310.1^\circ$
    - Length of time the star was in the sky: 15h 46m
    - The altitude  $36.1^\circ$  and azimuth  $79.6^\circ$  at 10:00 pm local time
  - Actual Observation
    - Transit time 2:17 MDT and altitude  $80.5^\circ$
    - The altitude  $37.1^\circ$  and azimuth  $80.5^\circ$  at 10:00 pm local time
- c. Star 3: Altair Date: Sep 1
  - Using my Astrolabe, the Zodiacal Date is Virgo 8
    - Rise time 15:49 MDT and azimuth  $88.9^\circ$
    - Transit time 22:20 MDT and altitude  $61^\circ$
    - Set time 4:54 MDT and azimuth  $271.1^\circ$
    - Length of time the star was in the sky: 12h 5m
    - The altitude  $66^\circ$  and azimuth  $204.8^\circ$  at 10:00 pm local time
  - Using Stellarium
    - Rise time 15:34 MDT and azimuth  $78^\circ$
    - Transit time 22:06 MDT and altitude  $59^\circ$
    - Set time 4:37 MDT and azimuth  $282.1^\circ$
    - Length of time the star was in the sky: 12h 03m
    - The altitude  $59^\circ$  and azimuth  $177.5^\circ$  at 10:00 pm local time
  - Actual Observation
    - Transit time 22:06 MDT and altitude  $60.5^\circ$
    - The altitude  $60.2^\circ$  and azimuth  $178.8^\circ$  at 10:00 pm local time
- d. Star 4: Diphda Date: Nov 1
  - Using my Astrolabe, the Zodiacal Date is Scorpio 8
    - Rise time 17:18 MDT and azimuth  $113.6^\circ$
    - Transit time 23:04 MDT and altitude  $33^\circ$
    - Set time 3:06 MDT and azimuth  $246.4^\circ$
    - Length of time the star was in the sky: 8h 46m
    - The altitude  $31^\circ$  and azimuth  $164.3^\circ$  at 10:00 pm local time
  - Using Stellarium
    - Rise time 17:58 MDT and azimuth  $113.1^\circ$
    - Transit time 22:47 MDT and altitude  $29.9^\circ$
    - Set time 3:57 MDT and azimuth  $246.9^\circ$
    - Length of time the star was in the sky: 8h 59m
    - The altitude  $30.6^\circ$  and azimuth  $164^\circ$  at 10:00 pm local time
  - Actual Observation
    - Transit time 22:54 MDT and altitude  $32.5^\circ$
    - The altitude  $30.8^\circ$  and azimuth  $164.8^\circ$  at 10:00 pm local time
- e. Star 5: Alkaid Date: Apr 1
  - Using my Astrolabe, the Zodiacal Date is Aries 19
    - Rise time 14:22 MDT and azimuth  $10.1^\circ$

- Transit time 1:42 MDT and altitude  $82^\circ$
- Set time 12:15 MDT and azimuth  $349.9^\circ$
- Length of time the star was in the sky: 21h 53m
- The altitude  $54^\circ$  and azimuth  $57.4^\circ$  at 10:00 pm local time
- Using my Stellarium
  - Rise time 14:59 MDT and azimuth  $8.6^\circ$
  - Transit time 2:05 MDT and altitude  $80.7^\circ$
  - Set time 13:08 MDT and azimuth  $351.3^\circ$
  - Length of time the star was in the sky: 22h 09m
  - The altitude  $56.2^\circ$  and azimuth  $58.4^\circ$  at 10:00 pm local time

7. In the above calculations versus modern technology versus the actual observations, how much difference do you see between the results that modern technology can produce versus that predicted by technology that is centuries old?

The results from using the Astrolabe are surprisingly close to the actual values predicted by Stellarium.

With all the practice I have had using it, I've become very proficient in using it.

I am very impressed with my paper Astrolabe. It is a very accurate instrument.

8. Using my astrolabe as a measuring tool:
- a. My latitude by measuring the height of Polaris:  $39.9^\circ$
  - b. The angular height of a tree: The angular height of the tree across the street from my home was  $16.1^\circ$ . The tree was 102 feet away. Ergo, the height of the tree is 29.5 feet.
  - c. Altitude of the sun at local noon: On 6/26/2024, the Sun's altitude was  $67.1^\circ$

9. Use the astrolabe to tell time at night. Do you like a nocturnal or astrolabe better?

- a. Star: Deneb Date: July 24, 2024
  - Using my Astrolabe, the Zodiacal Date is Leo 1
    - The altitude is  $49.3^\circ$  at 21:43 MDT local time
    - Astrolabe time is 21:36 MDT local time.

I think the nocturnal is easier to use at night because it is easier to see in the dark. Even with a red light, it would be difficult to accurately read all the scales necessary to determine the actual astrolabe time.