

Standard -vs- Daylight
Time
***Weather/Temperature
Considerations***

State Senate Committee
State of Oklahoma October 19, 2021
Oklahoma State Capital

Sources

- TimeandDate.com: <https://www.timeanddate.com/>
- U.S. Naval Observatory: <https://www.usno.navy.mil/USNO>
- National Weather Service: <https://www.weather.gov/>
- Meteorology Today, 8th Edition, C. Donald Ahrens (text book)
- https://sunsetsunrisetime.com/sun/oklahoma_city

Significant Events/Dates for June 2021 - May 2022, Oklahoma City

- Jun 20, 2021- Summer Solstice, June 20, 2021 at 10:32 pm
 - Longest daylight period, 14:33:24
 - Jul 4-6 - Earth Farthest from Sun, 94.511 million miles
 - Aug 3 - Normal Daily Temperature starts cooling
 - Sep 22 - Autumnal Equinox, 2:21 pm
 - Sep 26 - day and night approximately equal length
 - Nov 7 - Daylight Saving Time ends at 2:00 am
-
- In terms of daylight, on the summer solstice, the daylight period is 4 hours, 48 minutes longer than on winter solstice.

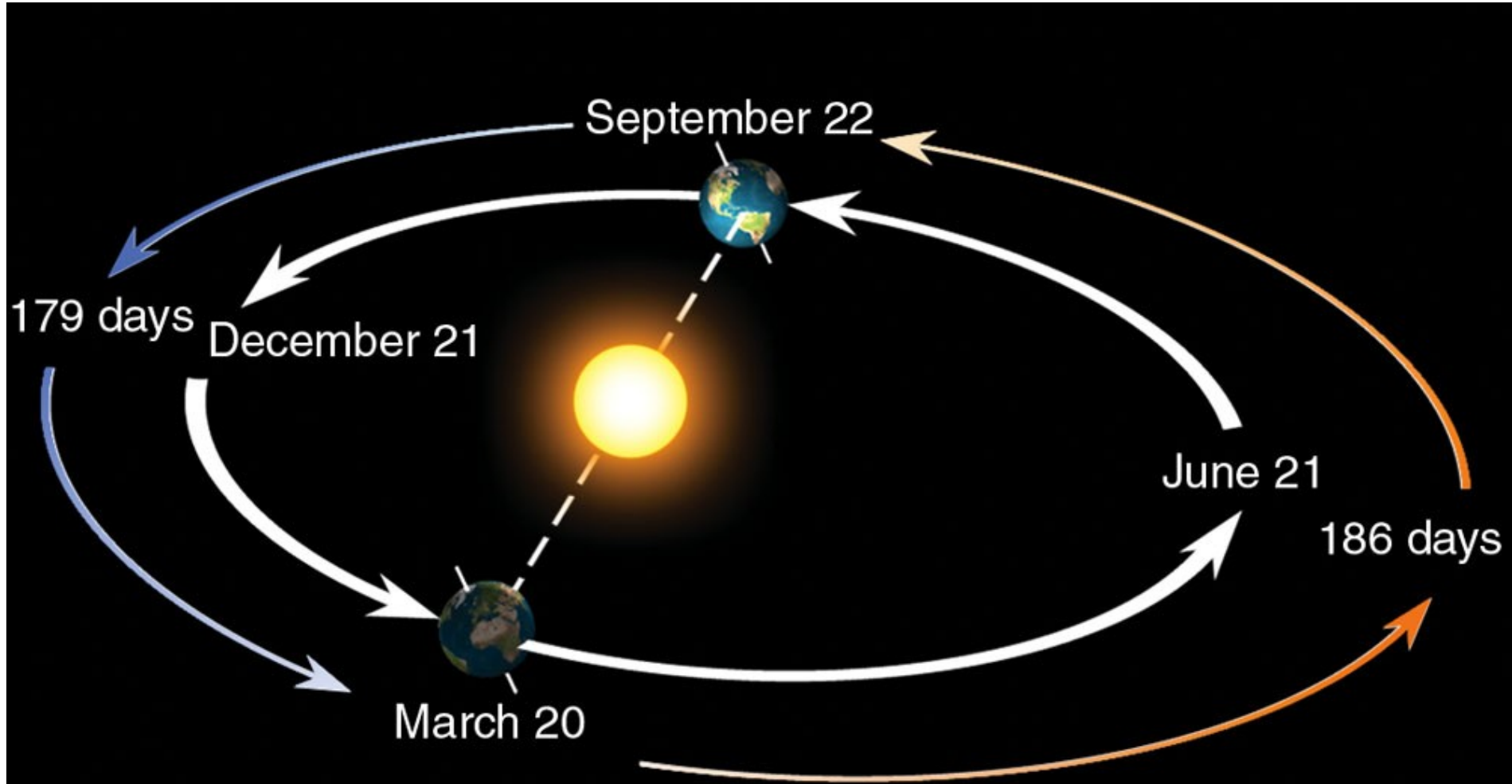
Significant Events/Dates for June 2021 - May 2022, Oklahoma City

- Dec 21 - Winter Solstice, 9:59 am
 - - Shortest daylight period, 9:45:37
- **Jan 2-5, 2022** - Earth closest to Sun, 91.407 million miles
- Jan 15 - Normal Daily Temperature starts warming
- **Mar13** - **Daylight Savings Time begins at 2:00 am**
- Mar 16 - day and night approximately equal length
- Mar 20 - Spring/Vernal Equinox, 10:33 am

Longest/Shortest Daylight Days, 2021, OKC

- Shortest day: December 21, 2021
 - 9:45:37
 - Sunrise 7:35 am CST, Sunset 5:21 pm CST
 - (Sunrise 8:35 am CDT, Sunset 6:21 pm CDT)
 - Sun at zenith, 31° above horizon, 12:28 pm CST
- Longest day: June 20, 2021
 - 14:33:24
 - Sunrise 6:15 am CDT, Sunset 8:48 pm CDT
 - (Sunrise 5:15 am CST, Sunset 7:48 pm CST)
 - Sun at zenith, 78° above horizon, 1:31 pm CDT

Winter is shorter than summer (Nrn Hemis.)

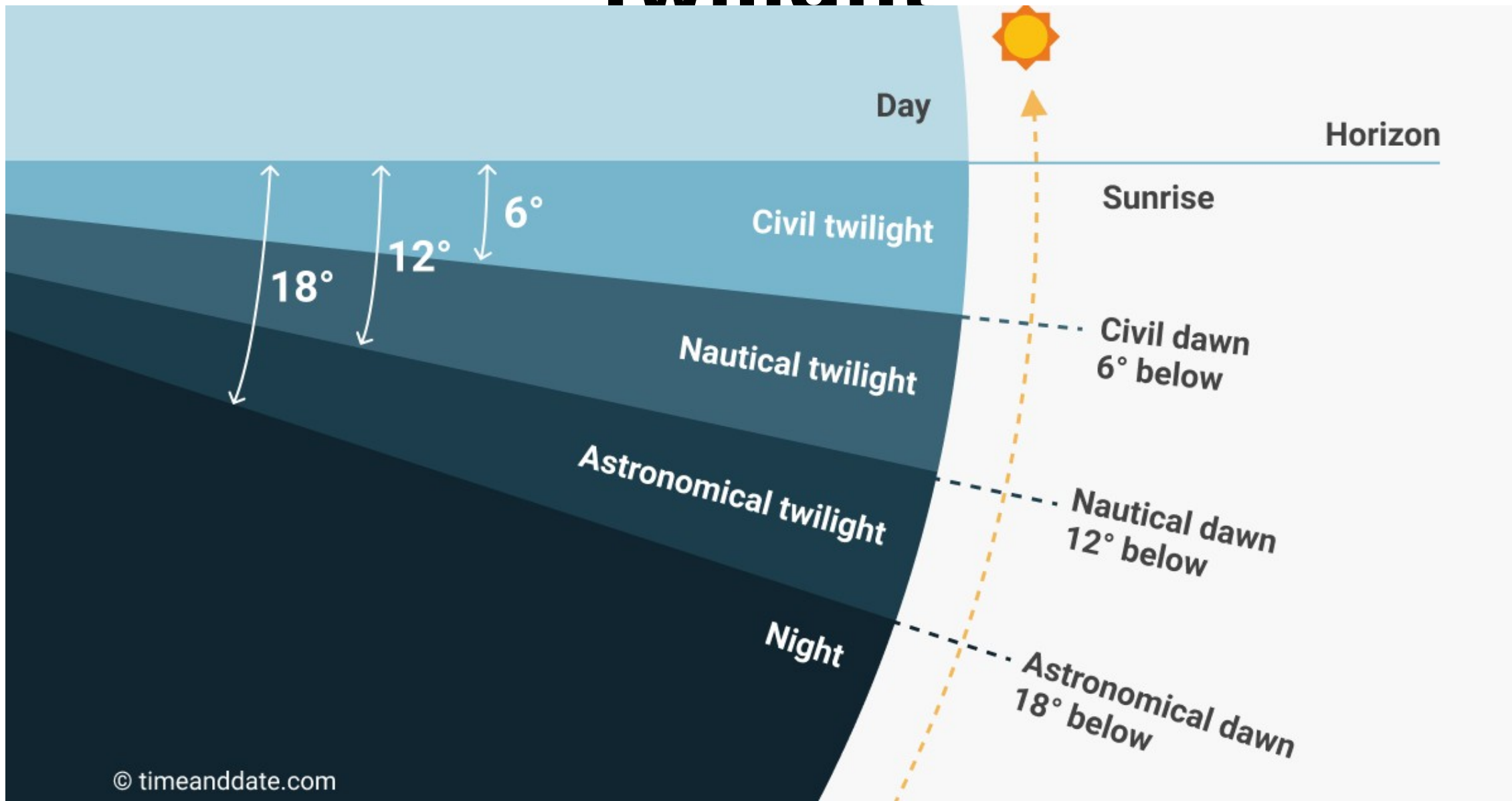


Because the earth travels more slowly when it is farther from the sun, it takes the earth a little more than **7 days longer** to travel from March 20

Definitions

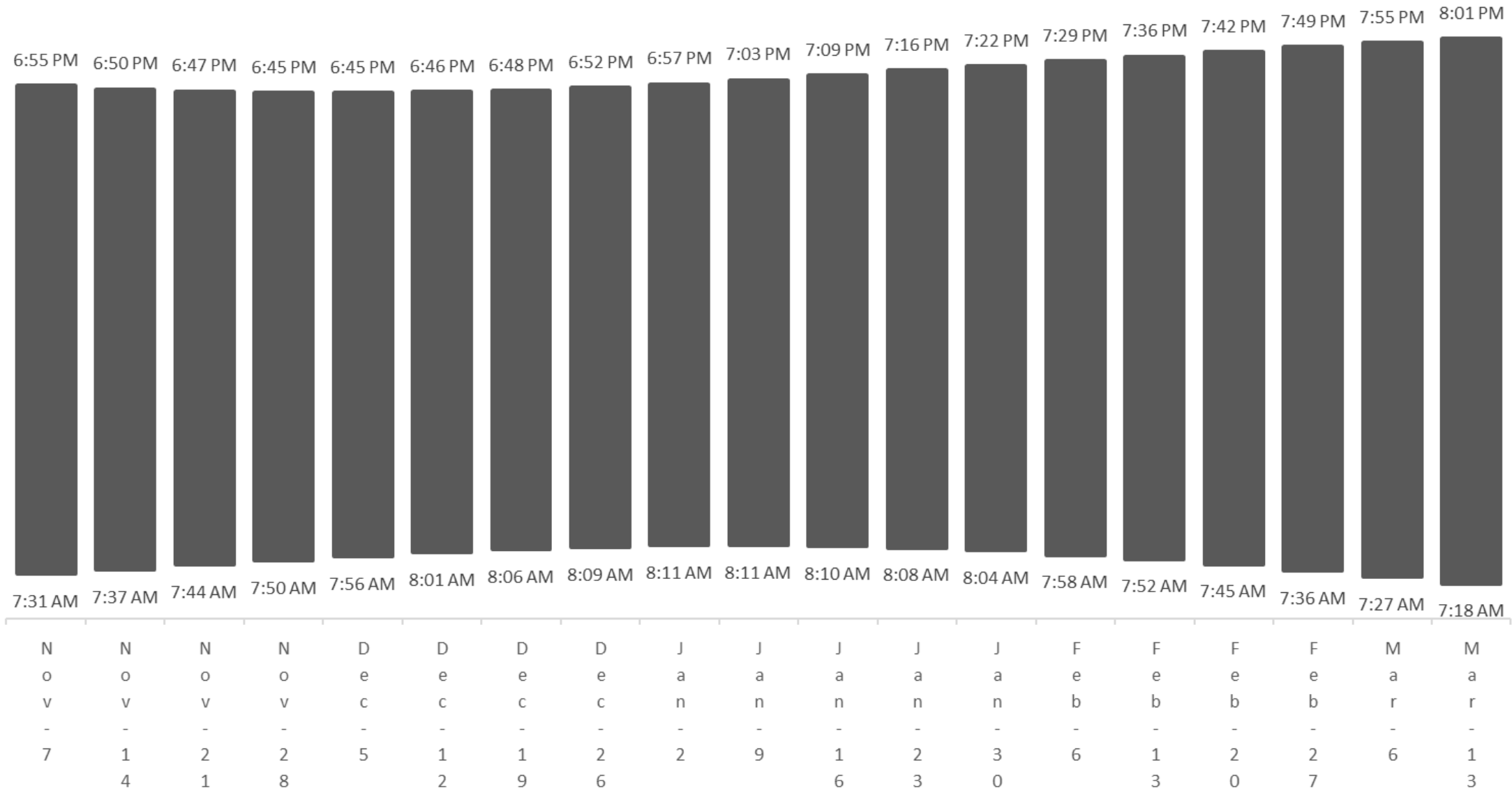
- **Sunrise:** time when sun first appears above horizon
- **Sunset:** time when sun is completely below horizon
- **Civil twilight** occurs when the Sun is less than 6 degrees below the horizon. (25-30 minutes before sunrise and 25-30 minutes after sunset.)
 - In the morning, civil twilight begins when the Sun is 6 degrees below the horizon and ends at sunrise.
 - In the evening, it begins at sunset and ends when the Sun reaches 6 degrees below the horizon.
- **Civil twilight is the brightest form of twilight.** There is **enough natural sunlight during this period that artificial light may not be required to carry out outdoor activities.** Only the brightest celestial objects can be observed by the naked eye during this time.

Civil, Nautical, Astronomical Twilight



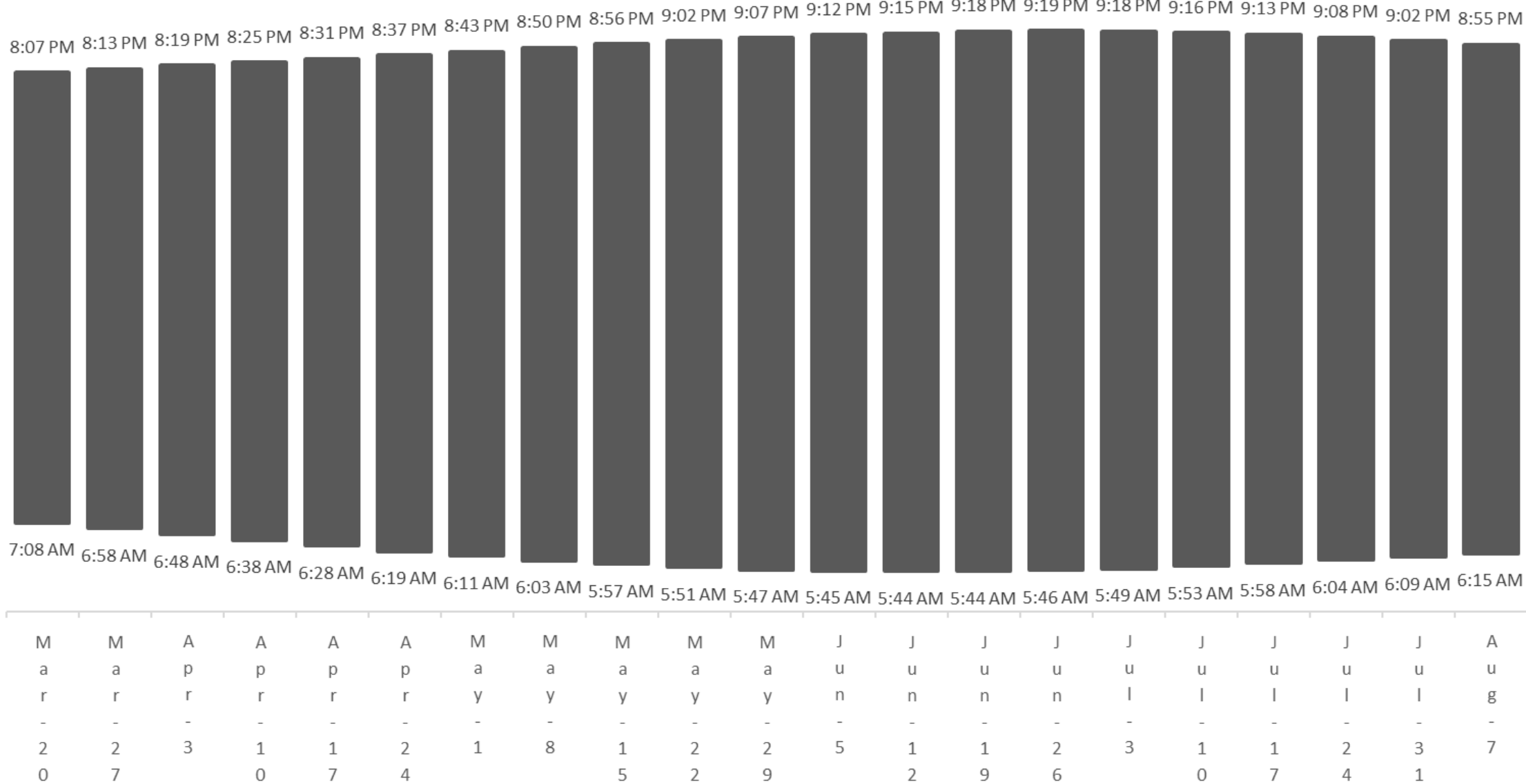
Day Period including Civil Twilight (CDT)

November 7 - March 13 OKC



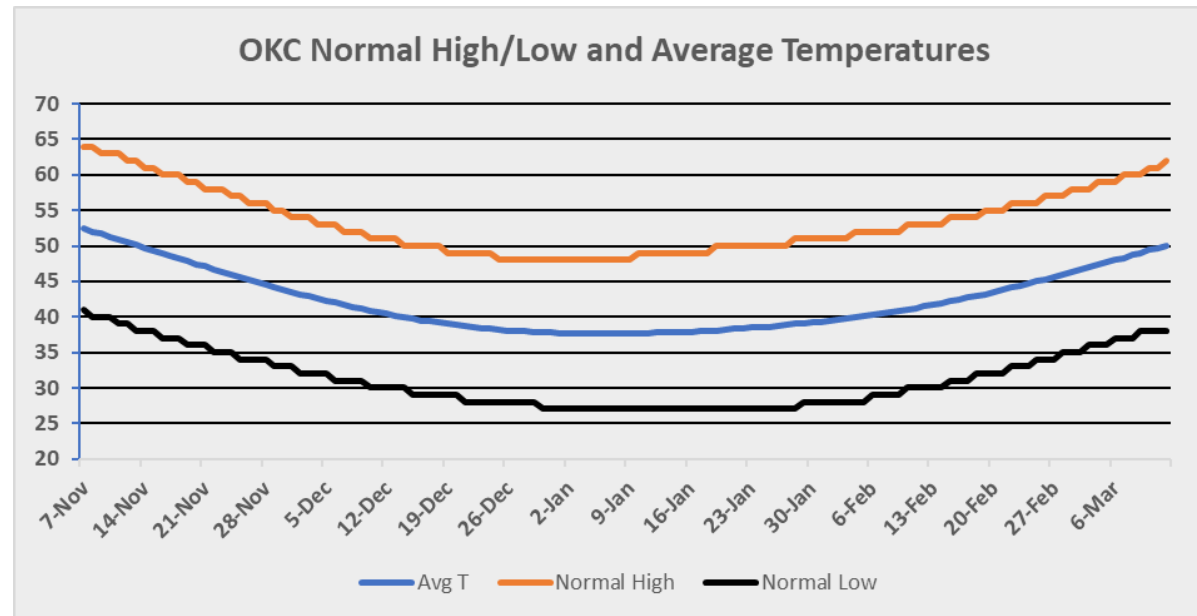
Day Period including Civil Twilight (CDT)

March 20 - August 7 OKC



Daily Normal Temperature Trends

- Coldest time of the day: Morning; +/- 20 minutes of sunrise
- Warmest time of the day: Afternoon; 1-3 hours before sunset
- Average coldest days, OKC: Early January; max 48°F and min 27°F
- Question: Is it better to have an extra hour of daylight at 27°F or 48°F?



Question: How can we maximize daylight during warmest part of the day?

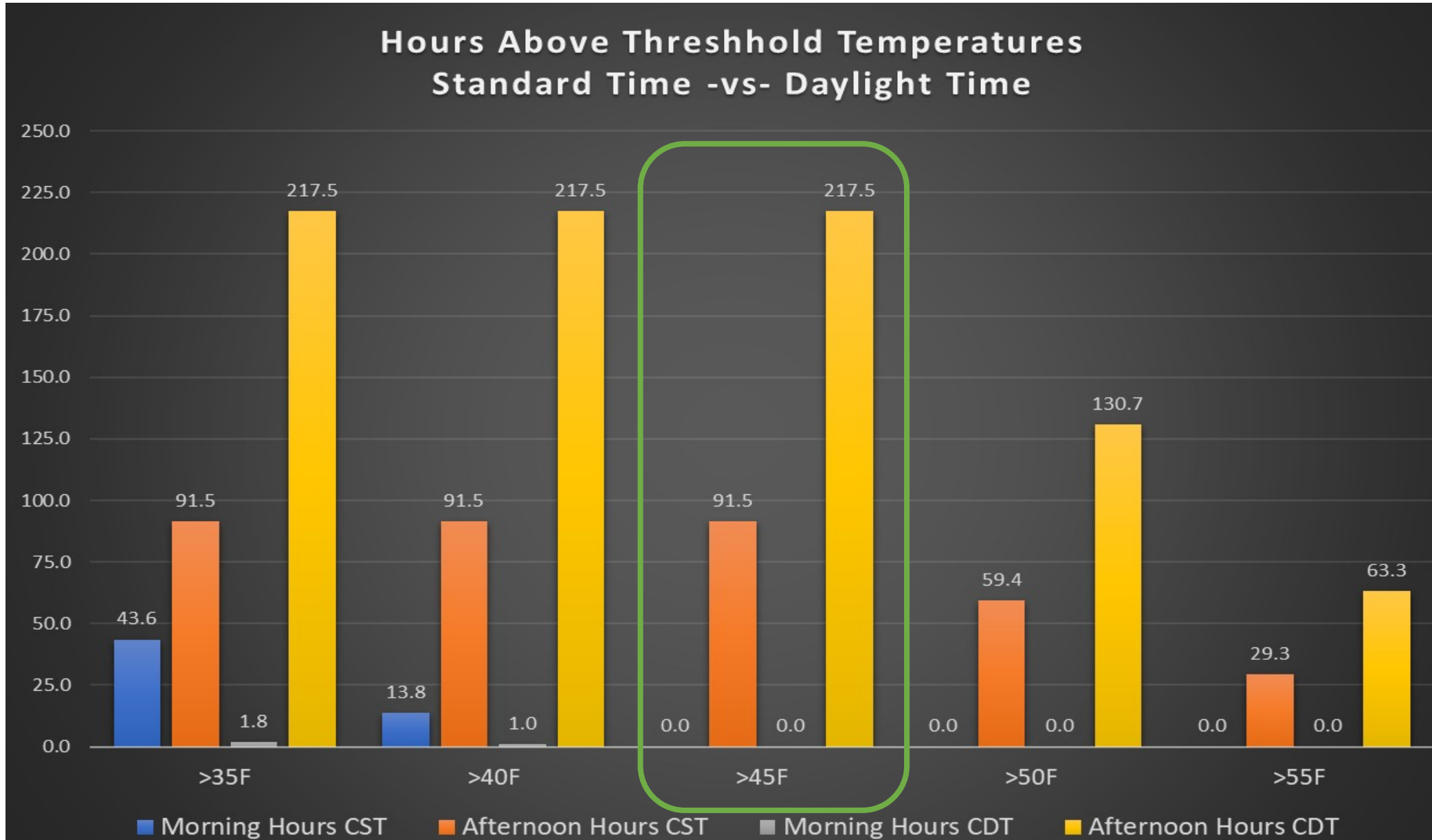
1. Use standard workday: 8 am – 5 pm.
2. Compare standard time to daylight saving time.
3. Period of interest: November 7, 2021 – March 13, 2022.
 1. Period when Oklahoma moves to Central Standard Time.
- 4. Count minutes of daylight before 8 am and after 5 pm that exceed certain temperature threshold values.**
5. Use average of morning low and afternoon high temp for each day.
 1. Add 2F to morning low. Subtract 2F from afternoon high.
6. Compare/contrast, using standard time and daylight saving time.

Sunrise/Sunset CDT/CST Time Comparison

Warmest
and
Coldest
Parts of
the Day,

Nov 7 to
Mar 13

OKC
Normals



Conclusion: Daylight Saving Time provides more time at warmer temperatures during daylight, non-working hours.

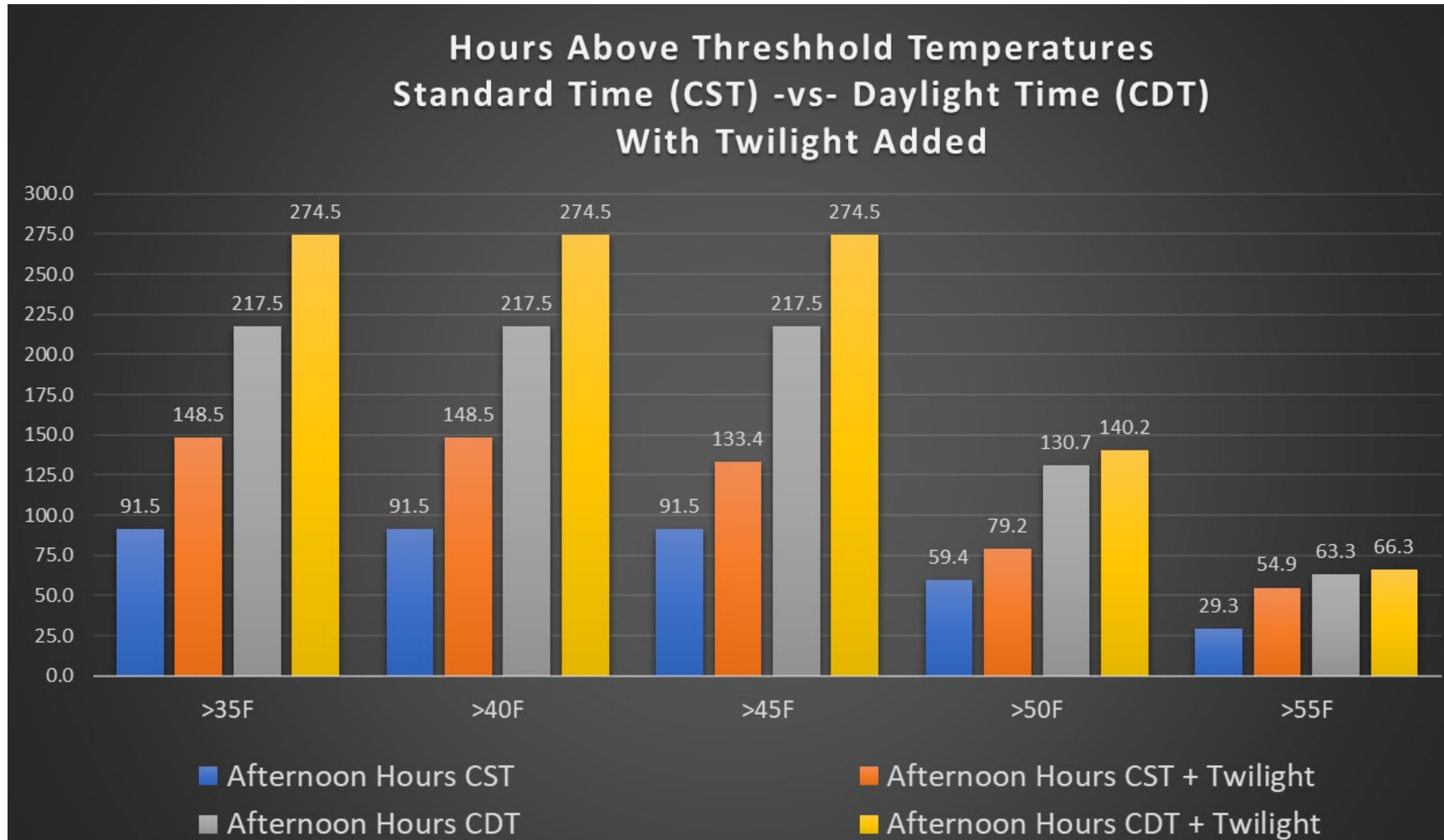
Temp Threshold	Morn Hours CST	Aftn Hours CST	Morn Hours CDT	Aftn Hours CDT
>35F	43.6	91.5	1.8	217.5
>40F	13.8	91.5	1.0	217.5
>45F	0.0	91.5	0.0	217.5
>50F	0.0	59.4	0.0	130.7
>55F	0.0	29.3	0.0	63.3

Afternoon CST/CDT Comparison Using Twilight

Warmest
and
Coldest
Parts of
the Day,

Nov 7 to
Mar 13

OKC
Normals



Sunset + Twilight Hours Above Threshold Temperatures

Temp Threshold	Aftn Hours		Aftn Hours	
	Aftn Hours CST	CST + Twilight	Aftn Hours CDT	CDT + Twilight
>35F	91.5	148.5	217.5	274.5
>40F	91.5	148.5	217.5	274.5
>45F	91.5	133.4	217.5	274.5
>50F	59.4	79.2	130.7	140.2
>55F	29.3	54.9	63.3	66.3

Question: How can we maximize daylight during warmest part of the day?




Answer: Remain on Central Daylight Saving Time

- Remaining on Central Daylight time:
 - Provides over twice as many hours above a given temperature threshold than changing to Central Standard Time.
 - When Civil Twilight is included, times increase further.

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Yearly Plot of Sun Rises/Sets and Twilights

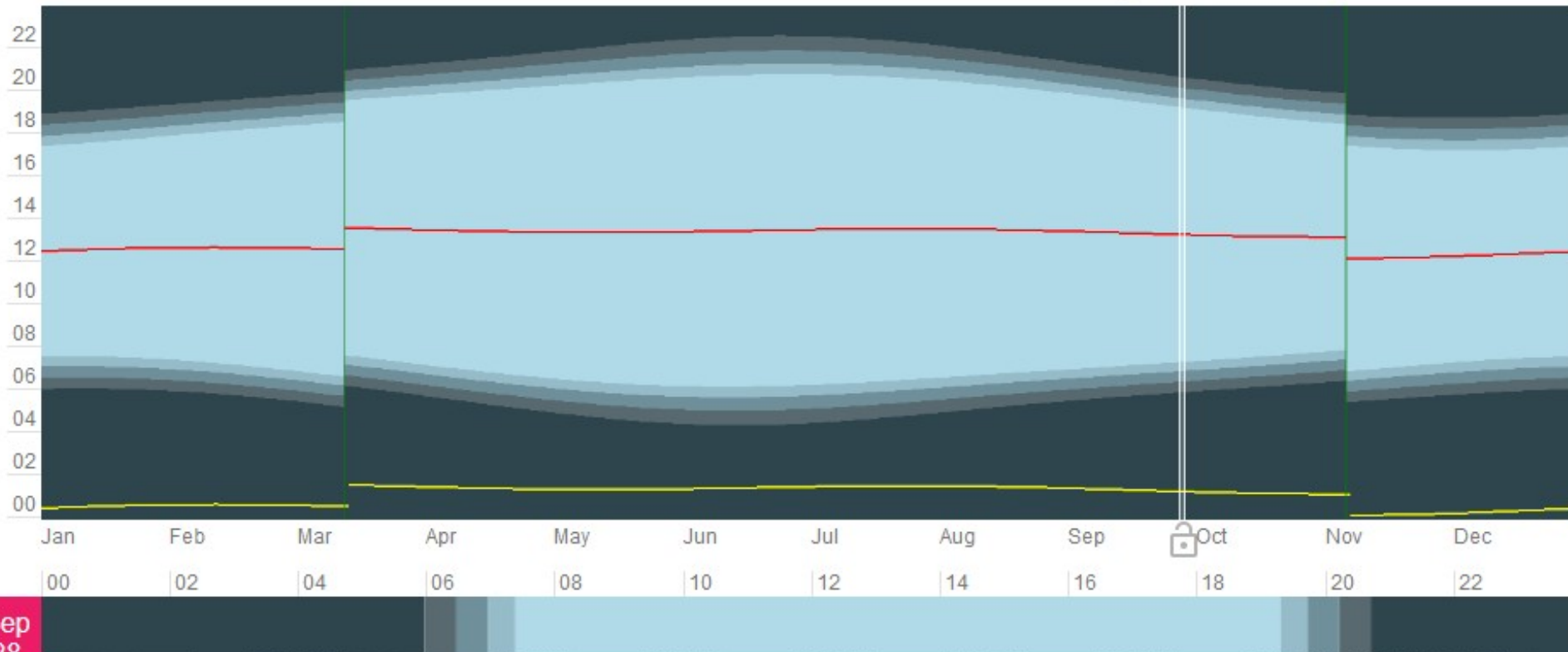
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Sunset Today: 7:17 pm ← 268° West

2021 Sun Graph for Oklahoma City

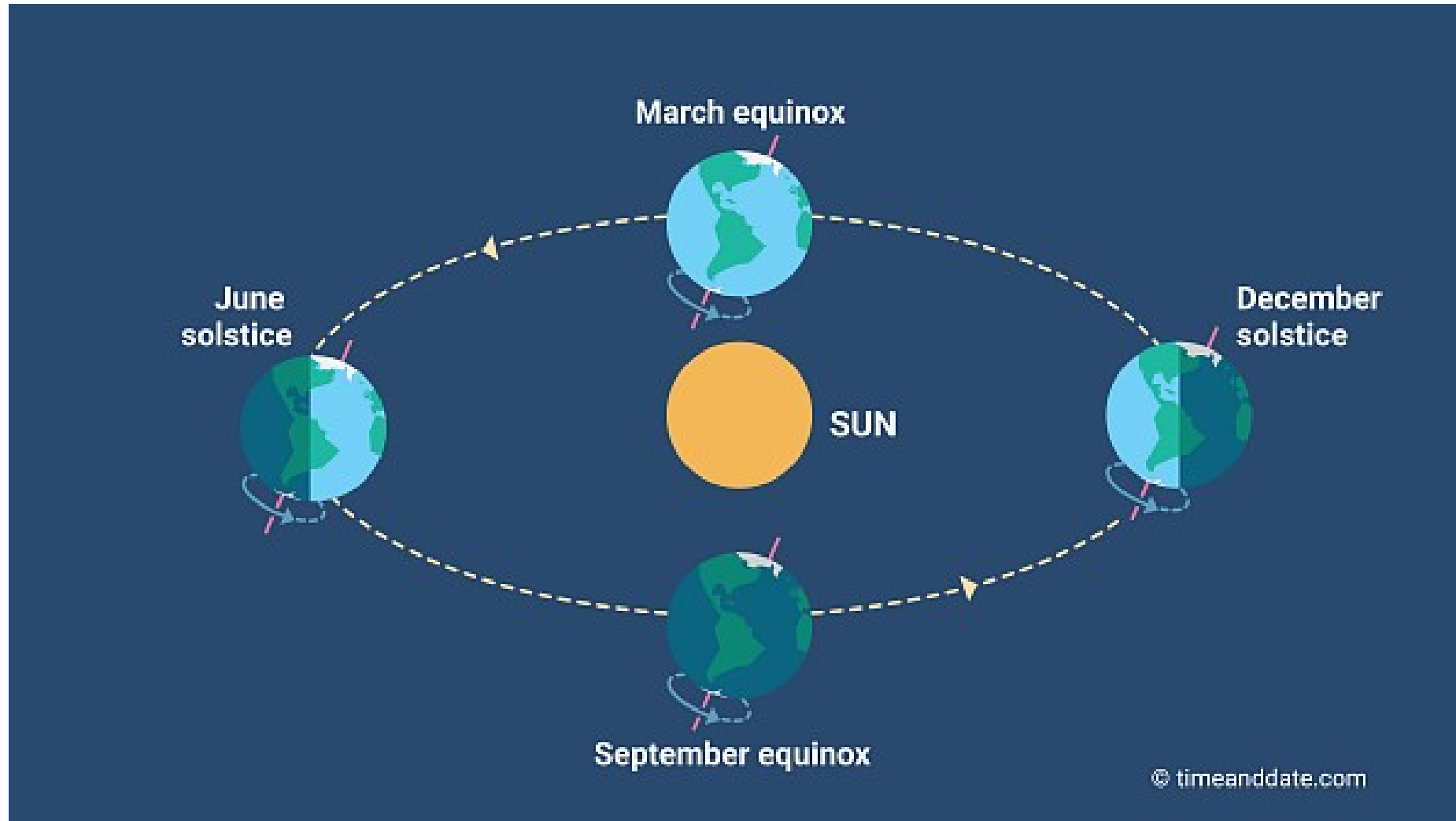
Rise/Set Times

Day/Night Length



<https://www.timeanddate.com/sun/usa/oklahoma-city?month=12&year=2021>

Earth Orbit, Equinox and Solstice



Sun's Upper Edge Defines Sunrise

- One of the reasons why most locations on Earth do not enjoy exactly 12 hours of daytime and 12 hours of nighttime on the equinoxes is how sunrise and sunset are defined.
- If sunrise and sunset were defined as the moment the geometric center of the Sun passes the horizon, then the day and night would be exactly 12 hours long. But that is not the case. **Sunrise and Sunset are defined as the exact moment the upper edge of the Sun's disk touches the eastern and the western horizon, respectively.** The time it takes for the Sun to fully set, which can be several minutes, makes the day just a bit longer than the night on the equinoxes.
- <https://www.timeanddate.com/astronomy/equinox-not-equal.html>

Nautical Twilight

- Each twilight phase is defined by the solar elevation angle, which is the position of the Sun in relation to the horizon. During nautical twilight, the geometric center of the Sun's disk is between 6 and 12 degrees below the horizon.
- In clear weather conditions, the horizon is faintly visible during this twilight phase. Many of the brighter stars can also be seen, making it possible to use the position of the stars in relation to the horizon to navigate at sea. This is why it is called nautical twilight.
- <https://www.timeanddate.com/astronomy/equinox-not-equal.html>

“When you can measure what you are speaking about and express it in numbers, you know something about it; but when you cannot measure it, when you cannot express it in numbers, your knowledge is of a meager, unsatisfactory kind.” Lord Kelvin (Lord William Thomson Kelvin, 1824-1907)