

# Determining the Hebrew Day of the Spring Equinox

## The Creation Calendar and the Rule of the Equinox

The **Creation Calendar** at [www.torahcalendar.com](http://www.torahcalendar.com) is a faithful restoration of the calendar used in the Hebrew Scriptures. This calendar was given by the Creator to mankind for the purpose of enabling people to properly observe and keep the **Appointed Times** of Elohim as found and described in **Leviticus 23:1-44**. The **Creation Calendar** consists of days, months and years that are determined precisely by the **greater light** and the **lesser light** seen in the sky. According to **Genesis 1:14-16**, the sun and moon were created for **signs, Appointed Times, days and years**. It is the wisdom of man to use the sun and moon for their intended purpose.

A **Hebrew Day** on the **Creation Calendar** begins and ends at the moment of *sunset*. A **Hebrew Month** begins at sunset on the evening on which the *first visible crescent* of the **New Moon** becomes potentially visible to the naked eye at Jerusalem. A **Hebrew Month** is also called a lunar month and usually consists of **29 or 30 Hebrew Days**. A **Hebrew Spiritual Year** always begins in late winter or early spring, and continues until late winter or early spring in the next tropical solar cycle. A tropical solar cycle consists of approximately **365.25** days and is divided into four seasons: **spring, summer, fall and winter**.

A typical **Hebrew Year** has **12 Hebrew Months**. However, because the total number of days within **12 Hebrew Months** is about **11 days** short of a tropical solar cycle, a system of *intercalation* is necessary in order to keep the **Hebrew Year** aligned with the seasons that are determined by the tropical solar cycle. The **Creation Calendar** occasionally *intercalates*, inserting a **Month 13** every two or three years. A **Spiritual Year** always commences on **Day 1 / Month 1** and it may *begin* in *winter* or *spring*, however when the **Spiritual Year** is *correctly intercalated* by the *rule of the equinox*, the entire **Festival of Unleavened Bread** which begins on **Day 15 / Month 1** will occur in the season of *spring*.

The *rule of the equinox* always places **Day 15 / Month 1** – the first day of the **Festival of Unleavened Bread** – on or after the **Hebrew Day** of the **spring equinox**. This rule helps ensure that the **Festival of Unleavened Bread** is always observed *in its season from year to year* as required by **Exodus 13:10**. Therefore, **Day 1 / Month 1** may occur *before, on* or *after* the **Hebrew Day** of the **spring equinox**. The logical question that arises is: How does one determine the **Hebrew Day** of the **spring equinox**?

The **Hebrew Day** of the **spring equinox** is the **Hebrew Day** in which the instantaneous moment of the annual **spring equinox** occurs. Since **Hebrew Days** begin and end at *sunset*, the decision regarding which **Hebrew Day** on which the **spring equinox** occurs is determined at *sunset*. According to the **Creation Calendar**, the *sunset ending Day 15 / Month 1* must always occur *after* the moment of the **spring equinox** in order that the entire **Festival of Unleavened Bread** will be observed *in its season from year to year* – the season of *spring*.

Although modern astronomical almanacs list time and date for the **spring equinox**, almanacs typically show times based on the **Gregorian Calendar** system of **24 civil hours** beginning at **midnight** or **00:00:00 Universal Time** as determined from Greenwich, England. Since the **Hebrew Day** of the **spring equinox** on the **Creation Calendar** is determined at sunset in Jerusalem, **Israel**, it may sometimes *appear* to be one day later than the date listed in almanacs. For example, if *sunset* in **Israel** is at **6:00 pm Israel Standard Time**, and the moment of the **spring equinox** occurs at **6:30 pm Israel Standard Time**, then a new **Hebrew Day** has begun whereas the **Gregorian Calendar** will not begin a new day until *midnight*.



## How did the Ancients Determine the Day of the Equinox?

Modern computers can quickly, accurately and precisely calculate the timing of an equinox or a solstice using complex mathematical formulas and equations created and validated by scientists and engineers. But such advanced technology was not available to those in ancient times. So, how did ancient people determine the **spring equinox**? And more specifically, how did they determine the **Hebrew Day** of the **spring equinox**?

Several theories exist as to how the **spring equinox** was determined by those living in ancient times. Some claim that people in the ancient world used shadows cast by the sun onto a flat surface to determine the day of the equinox. Others claim they observed sunrises or sunsets. However, all ancient methods for determining the **spring equinox** had one thing in common – they were all based on *empirical observation*. And several of these methods could have successfully determined the **Hebrew Day** of the **spring equinox**.

Elohim provided the **sun** and the **moon** first and foremost for *signs*. A *sign* is something visible that can be seen and witnessed through the outward senses by an observer here on earth. So, from an astronomical perspective, the determination of the **spring equinox** in ancient times must have been based on a visual sighting or observation. Today astronomers use formulas that predict the *apparent* astronomical coordinates for the positions of the sun and moon. The *apparent* position of an object seen in the heavens differs slightly from the *actual* position when motion is involved. Due to the speed of light, the *apparent* position of an object is the position seen by an observer after the light from that object has reached the observer's eye.

In astronomy, the term *geocentric* refers to a theoretical point located in the *center* of the earth and is a coordinate typically used for calculations for determining the orbital position of the earth around the sun. In contrast, the term *topocentric* refers to a particular location on the *surface* of the earth usually designated in latitude and longitude and is distanced from the *geocentric* position by the earth's radius at that location. In order for the **Creation Calendar** to simulate the observation of the sun or moon from Jerusalem, it requires the use of *apparent* coordinate positioning while calculating observance from a *topocentric* perspective.

The four seasons exist due to the tilt of the earth's axis of approximately **23.5 degrees** from a perpendicular line with respect to the ecliptic plane that contains the nearly circular orbital path of the earth around the sun. The two equinoxes and two solstices comprise the four seasonal demarcation points. These demarcations are instantaneous since the earth is constantly in motion. In the northern hemisphere, the mid-day sun gets to its highest topocentric altitude around **June 21** at the **summer solstice**, and to its lowest topocentric altitude around **December 21** at the **winter solstice**. In summer, the days are longest in the northern hemisphere and shortest in winter.

Ancient cultures were agricultural in nature. Ancient peoples were keenly aware of the seasons. They carefully observed the motion of the sun in order to determine when to plant and harvest crops. Today, we refer to the directions of due east as **90 degrees** from true north, and due west as **270 degrees** from true north as seen on a compass. The angle in degrees from true north is called the *azimuth* angle. Over the course of a tropical solar cycle, observers in **Israel** would notice that in summer, the sun would both rise and set well north of due east and due west respectively. Likewise, in winter, these same observers would notice that the sun both rose and set well south of due east and due west respectively.

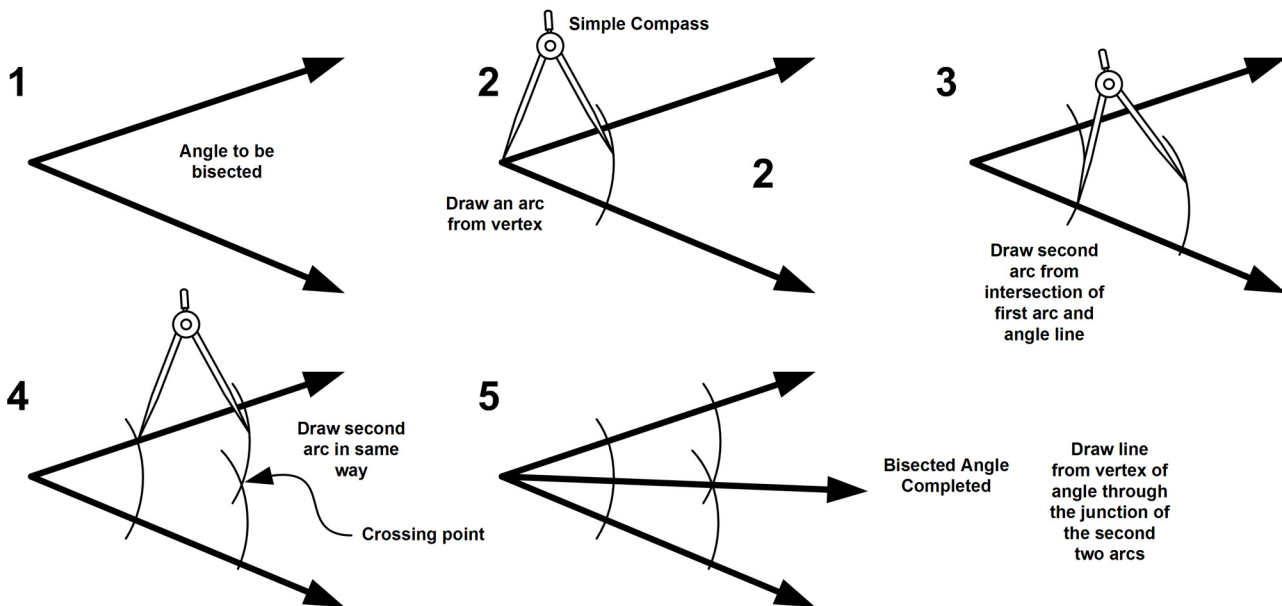
As the days of the year passed, these same observers would notice the position of each setting sun appear to travel back and forth from the most southern setting position seen at the **winter solstice** to the most northern



setting position seen at the **summer solstice**. In particular, they would notice that the change of the sunset position on the horizon each day would appear to decelerate down to a standstill, changing little from day to day when near the time of a solstice extreme, then would appear to accelerate from day to day approaching the time of either the **spring equinox** or the fall equinox. Mathematically, when plotted onto graph paper, we can see that the cyclical pattern of sunset position changes resembles the shape of a sine wave. (See Figure 2)

Ancient astronomers created simple observatories having an unobstructed view of the western horizon in order to observe sunset positions. By noting the sun setting positions from a single common reference point, these astronomers were able to aim pointing devices: one device pointed to the most southern setting point at the **winter solstice**, and another device pointed to the most northern setting point at the **summer solstice**. The two pointing devices formed a V-shaped angle that could be geometrically bisected.

It was then a simple matter of geometry to bisect the resulting angle in order to fashion a mid-position pointer aimed toward the point of the horizon for the equinox (see Figure 1). The point on the horizon for the **spring equinox** would therefore be exactly *halfway* between the two extreme solstice sunset positions. For the sake of illustration, we will refer to the midway point on the horizon as the **equinox point**.



**Figure 1** – Illustration of how to geometrically bisect an angle in order to determine the equinox point. Notice that no numerical methods are required, just the use of a simple compass to draw arcs and a straight edge to draw lines.

During the time of the **spring equinox**, the ancients looked for the first sunset *north* of the **equinox point** to determine the **Hebrew Day** of the **spring equinox**. So if the sunset beginning a **Hebrew Day** was to the *left* of the equinox point (*south* of equinox point), and the sunset ending that same day was to the *right* of the equinox point (*north* of equinox point), that day would have been the **Hebrew Day** of the **spring equinox**.

At the location of the temple mount in Jerusalem at **latitude N31d, 46m, 43.8s** and **longitude E35d, 14m, 5.1s**, the most northern sunset position has a topocentric azimuth of about **North 298.804** degrees at the time of the **summer solstice**. At the same location, the most southern sunset position has a topocentric azimuth of about **North 242.367** degrees at the time of the **winter solstice** (see **Table 2**). Therefore, the resulting difference angle measures about **56.437** degrees in azimuth. When this difference angle is bisected, the resulting midpoint angle rests at a topocentric azimuth of about **North 270.5855** degrees.

So when the ancient Hebrews sought to determine the **Hebrew Day** of the **spring equinox**, they looked to see if the sun set left or right of the **equinox point** which for Jerusalem calculates to **North 270.5855** degrees. The topocentric azimuth of **North 270.5855** degrees is also expressed as **North 270 degrees, 35 arcminutes, 7.8 arcseconds**.

At first glance, it is easy to assume that the **equinox point** at Jerusalem is **North 270.0000** degrees. However, the **equinox point** is **only North 270.0000** in azimuth for observers at the **equator**. For observers at Jerusalem the **equinox point** is actually **North 270.5855** degrees in azimuth. The **0.5855** of a degree difference in azimuth makes all the difference in correctly determining the **Hebrew Day** of the **spring equinox**. For latitudes further away from the equator the azimuth difference angle increases. More importantly, the midpoint angle and the resulting **equinox point** between the solstices is seen to be **northward** from the azimuth of **North 270.0000** degrees for observers in the northern hemisphere.

The error of **assuming** that the **equinox point** is the topocentric azimuth of **North 270.0000** degrees for the latitude of Jerusalem leads to **incorrect intercalation** of the **Hebrew Year**. Some have **speculated** that the ancient Hebrews did **not** intercalate in the spring of **2 B.C.E.** based on the **mistaken idea** that the ancient Hebrews would have observed the sun cross the **equinox point** on **March 22, 2 B.C.E.** Though we may never know how the Hebrews intercalated in **2 B.C.E.**, the fact of the matter is **they should have intercalated**.

The reason some may advance the idea that the ancient Hebrews **did not intercalate** in the spring of **2 B.C.E.** is to promote the teaching that the Messiah was born on the evening of **August 31, 2 B.C.E.** which is **mistakenly** equated with **Yom Teruah** on **Day 1 / Month 7**. However as the **Creation Calendar** mathematically executes the **rule of the equinox**, **August 31, 2 B.C.E.** **truthfully** corresponds to **Day 1 / Month 6**.

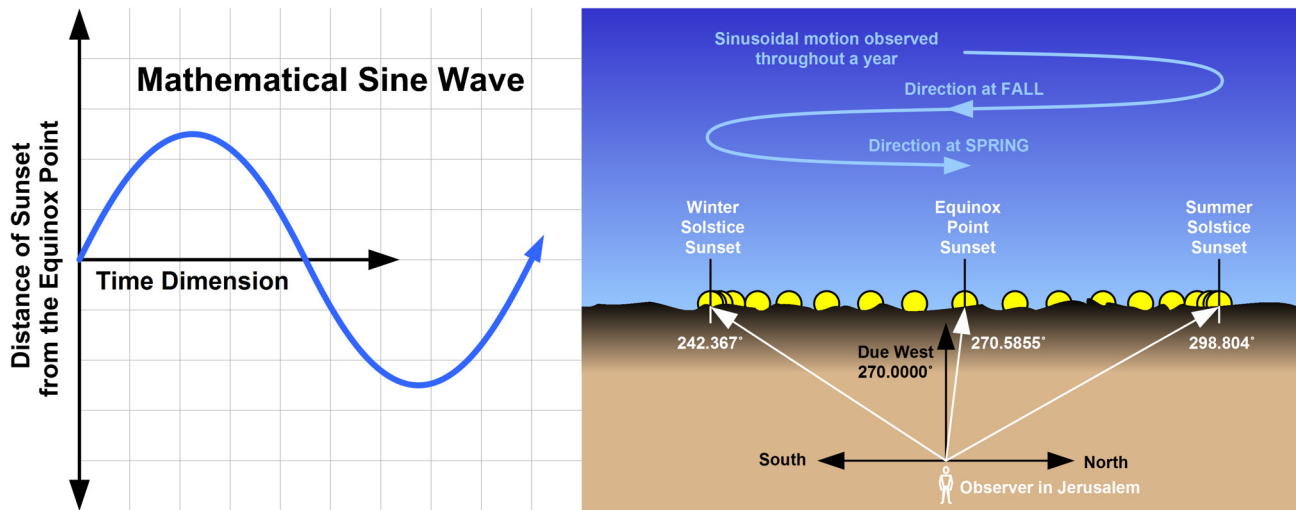
In order to correctly execute the counsels of Elohim and to properly observe His **Appointed Times** and **Festivals**, it is necessary to correctly implement the **rule of the equinox**. This must be done in order not to trespass against the instruction in **Exodus 13:10** which prohibits **Unleavened Bread** from occurring in winter.

## The **Creation Calendar** Calculates the Rule of the Equinox Correctly

Observers in ancient times watched the sun's setting positions, and determined the **equinox point** on the horizon by noting the most northern and southern sunset positions of both the **summer solstice** and **winter solstice** respectively. They then determined the **midpoint** on the horizon for the **equinox point** by **bisecting** the resulting angle formed between the two solstice extremes. The **Nasi** was the president of the Sanhedrin and it was his job to determine whether to intercalate or not. At the end of **Month 12** the **Nasi** would have determined how many days it was until the **spring equinox**. In the spring of **2 B.C.E.** it would have had been a close call. The critical sunset in question is the one that occurred on **Saturday, March 22, 2 B.C.E.** on the proleptic **Julian Calendar**.



At sunset on **Sabbath, March 22, 2 B.C.E.** the topocentric azimuth of the sun was **North 270.156 degrees** (see **Table 1**). The *Nasi* would have observed that although the topocentric azimuth of the sun *was* greater than **270 degrees** at this moment in **2 B.C.E.**, it *was not* greater than **North 270.5855 degrees** which is the *bisected midpoint* or the *equinox point* for determining the **Hebrew Day** of the **spring equinox** in Jerusalem. This *equinox point* would have been *established over time* by *visual observation* by the ancient Hebrews using their simple observatories with an unobstructed view of the western horizon.



**Figure 2** – Sun setting positions seen by an observer at Jerusalem, Israel change throughout the year in a sinusoidal motion, coming to a standstill and changing directions at the solstices. Note the difference between the azimuth of due west and that of the Equinox point on the horizon as seen from Jerusalem.

Date at Jerusalem	Hebrew Day	Sunset Time (UT)	Sun's Apparent Longitude	Sun's Topocentric Azimuth
March 20, 2 B.C.E.	13	15h 49m 7.571s	357.290°	269.235°
March 21, 2 B.C.E.	14	15h 49m 43.436s	358.265°	269.696°
March 22, 2 B.C.E.	15	15h 50m 19.144s	359.239°	270.156°
<b>March 23, 2 B.C.E.</b>	<b>16</b>	15h 50m 54.712s	<b>0.213°</b>	<b>270.617°</b>
March 24, 2 B.C.E.	17	15h 51m 30.159s	1.186°	271.077°

**Table 1** – This table shows the position of the sun at the time of sunset as seen from Jerusalem for various dates near the spring of the year **2 B.C.E.** Although on **March 22 (Hebrew Day 15)**, the sun set at azimuth **270.156°** having crossed the due west cardinal coordinate of azimuth **270.0000°**, it was still to the left and south of the required **270.5855°** equinox point. The sun's apparent longitude had not yet crossed **360°** in longitude at sunset on **March 22**. The precise moment of the **spring equinox** occurs when the sun's apparent longitude crosses **360°** which is also **0.0°**. Only on **March 23 (Hebrew Day 16)** can it be seen that the sun set at **270.617°** which is right of the equinox point of **270.5855°** making **Hebrew Day 16**, the Hebrew Day of the **spring equinox** in **2 B.C.E.**



Date at Jerusalem	Time of Solstice	Sunset Time (UT)	Sun's Apparent Longitude	Sun's Topocentric Azimuth
Dec 22, 3 B.C.E.	Winter	14h 43m 12.636 s	269.294°	242.369°
<b>Dec 23, 3 B.C.E.</b>	Winter	14h 43m 42.657s	<b>270.313°</b>	<b>242.367°</b>
Dec 24, 3 B.C.E.	Winter	14h 44m 14.056s	271.331°	242.375°
June 24, 2 B.C.E.	Summer	16h 43m 49.364s	89.328°	298.803°
<b>June 25, 2 B.C.E.</b>	Summer	16h 44m 3.177s	<b>90.282°</b>	<b>298.804°</b>
June 26, 2 B.C.E.	Summer	16h 44m 15.748s	91.237°	298.797°

**Table 2** – This table shows the position of the sun at the time of sunset as seen from Jerusalem for various dates around the time of solstices nearest to the spring of the year **2 B.C.E.** The first three lines correspond to the timing of the **winter solstice** in **3 B.C.E.** The last three lines correspond to the **summer solstice** in year **2 B.C.E.** Note that the most extreme angles for topocentric azimuth measurements are seen to occur on **December 23** in **3 B.C.E.** and on **June 25** in **2 B.C.E.** The sun's apparent longitude crosses **270°** at the moment of the **summer solstice**, and crosses **90°** at the moment of the **winter solstice**. The time of equinox occurs at the azimuth that is halfway between the azimuths of **242.367°** at the **winter solstice**, and **298.804°** at the **summer solstice**. The exact moment of the **winter solstice** occurs at **7:00 (UT)** on **December 23, 3 B.C.E.** The exact moment of the **summer solstice** occurs at **9:17 (Universal Time)** on **June 25, 2 B.C.E.** Both of these solstices are shown on their corresponding Hebrew Days on the **Creation Calendar** at [www.torahcalendar.com](http://www.torahcalendar.com)

Therefore, at sunset ending **Sabbath, March 22, 2 B.C.E.**, the moment of the **spring equinox** would *not* have appeared to have occurred to the *Nasi* based on the *ancient observational methods* of the Hebrews. If the skies were not cloudy that night and they had a clear view of the horizon, they would have seen that the sun set *south* or *left* of the *equinox point* and this would have indicated to them that they were still in the season of *winter*.

If the **Judeans** had been able to witness the **New Moon** at sunset on **March 7, 2 B.C.E.**, they would have known on **March 22, 2 B.C.E.** that they had just completed the **15<sup>th</sup> day** of that month in *winter*. If the *Nasi* had correctly intercalated a **Month 13** after the **New Moon** on **March 7, 2 B.C.E.**, then his decision to *intercalate* would have been *validated* at sunset ending **Sabbath, March 22, 2 B.C.E.** For if it was not cloudy on this evening in Jerusalem he would have known that *spring* had not yet begun at that time.

If the *Nasi* had not intercalated a **Month 13** after the **New Moon** on **March 7, 2 B.C.E.**, he would have known at sunset ending **Sabbath, March 22, 2 B.C.E.** that the first day of the **Festival of Unleavened Bread** had just been kept in the season of *winter* as *spring* had not yet begun. This would have been a concern for him as it was his responsibility to ensure that **Israel** kept the **Festival of Unleavened Bread** in the season of *spring* from year to year in order to fulfill the requirements of **Exodus 13:10**.

On **Sabbath, March 22, 2 B.C.E.** in Jerusalem, **Israel** the sun set at a point *south* or *left* of the *equinox point* of **North 270.5855** degrees azimuth *before* the *equinox point* had been crossed. The **Creation Calendar** correctly calculated and validated the position of the sun at the moment of sunset on this day and it correctly implemented the *rule of the equinox* which always places **Day 15 / Month 1** on or after the **Hebrew Day** of the **spring equinox**.

The *sunset ending* the **Hebrew Day** of the **spring equinox** always occurs *after* the *equinox point* has been crossed – on the *right side of the line* in an ancient observatory. At *sunset ending* the **Hebrew Day** of the **spring equinox** the righteous always want to be on the *right* side of the line. This is easy to remember if you associate it with the parable of the sheep and the goats.



The **Creation Calendar** at [www.torahcalendar.com](http://www.torahcalendar.com) accurately *simulates* the *observational methods* that were used by the ancient Hebrews for determining the **Hebrew Day** of the **spring equinox**. Although the **Creation Calendar** uses *21<sup>st</sup> century methods* to calculate the *rule of the equinox*, it *simulates* the *observational methods* used by the ancient Hebrews and *accurately* determines the *apparent position* of the sun from a *topocentric perspective*. The *equinox point* on the western horizon as seen from Jerusalem, **Israel** is at the topocentric azimuth of about **North 270.5855** degrees.

Ancient observations can be mathematically *simulated* and *verified* today thanks to the accurate and precise retro-calculated computations of the **Creation Calendar**. It is one aspect of the *narrow way* which leads to life spoken of by יהושע Messiah. It enables those who believe in Him to walk the way that He walked and to observe the **Sabbaths**, **New Moons** and **Appointed Times** exactly as He did when He was last on earth.

The **Creation Calendar** is also a useful tool for those wishing to *verify* ancient dates as they search the Scriptures and study to show themselves approved unto Elohim. As Paul said – Prove all things, hold fast that which is good.

**Deuteronomy 32:4** *He is the Rock, His work is perfect; For all His ways are judgment, an Elohim of truth and without injustice; Righteous and upright is He.*

