



MORRISON PLANETARIUM

Seasons and the Sun
Planet-Watching
Phases of the Moon
Eclipses
Meteor Showers

2023

POCKET ALMANAC

ALEXANDER F. MORRISON PLANETARIUM

Since 1952, the Academy's Morrison Planetarium has served the community as a valuable resource for astronomy education and skywatching information. It was the first major planetarium in the U.S. to build its own optomechanical star projector, which was considered at the time to be the world's finest simulator of the night sky. Now updated with state-of-the-art digital technology, the Planetarium immerses audiences in fulldome imagery based on actual scientific data, from the smallest living cells to the surfaces of distant planets and immense clusters of galaxies.

CALIFORNIA ACADEMY OF SCIENCES

Home to Morrison Planetarium, Steinhart Aquarium, Kimball Natural History Museum, Osher Rainforest, and world-class research and education programs, the California Academy of Sciences is the world's greenest museum and one of San Francisco's "must-see" destinations. Explore the depths of a Philippine coral reef, view a rainforest canopy amid swarms of butterflies, and blast off to the outer reaches of the Universe, all under one living roof. Daily interactions with animals, educators, and biologists within immersive, hands-on exhibits offer discovery and wonder for visitors of all ages.

SEASONS AND THE SUN

The terms below apply to the Northern Hemisphere. South of the equator, the seasons are reversed.



**SPRING
EQUINOX**

MAR 20

2:24 PM PT



**SUMMER
SOLSTICE**

JUN 21

7:58 AM PT



**AUTUMN
EQUINOX**

SEP 22

11:50 PM PT



**WINTER
SOLSTICE**

DEC 21

7:27 PM PT

PERIHELION

(Earth closest to the Sun):

JAN 4—0.98329 AU

APHELION

(Earth farthest from the Sun):

JUL 6—1.01668 AU

AU = Astronomical Unit, the average distance from Earth to the Sun (150,000,000 km or 93,000,000 mi)

DAYLIGHT SAVING TIME

(clocks set one hour ahead of Standard Time): MAR 12–NOV 5

Times and dates in this Pocket Almanac are given in Pacific Time. Calendars using anything other than Pacific Time may list certain events as occurring on the following day, because the conversion to other time zones occasionally crosses midnight, thus advancing the date.

PLANET-WATCHING

Five planets can be seen in the sky with the unaided eye. They are generally brighter than most stars and typically don't twinkle. Over time, they can be seen to change their positions against the constellations, which is why the ancients referred to them as "wandering stars."

PLANET	MORNING SKY	EVENING SKY	CONJUNCTION	OPPOSITION
Mercury	JAN 7-MAR 17 MAY 1-JUNE 30 SEP 6-OCT 19 DEC 22-DEC 31	JAN 1-JAN 7 MAR 17-MAY 1 JUNE 30-SEP 6 OCT 19-DEC 22	JAN 7 (<i>inf</i>) MAR 17 (<i>sup</i>) MAY 1 (<i>inf</i>) JUNE 30 (<i>sup</i>) SEP 6 (<i>inf</i>) OCT 19 (<i>sup</i>) DEC 22 (<i>inf</i>)	
Venus	AUG 13-DEC 31	JAN 1-AUG 13	AUG 13 (<i>inf</i>) OCT 22 (<i>sup</i>)	
Mars	JAN 1-NOV 17	NOV 17-DEC 31	NOV 17	
Jupiter	APR 11-NOV 2	JAN 1-APR 11 NOV 2-DEC 31	APR 11	NOV 2
Saturn	FEB 16-AUG 27	JAN 1-FEB 16 AUG 27-DEC 31	FEB 16	AUG 27

Visibility ranges above may vary slightly with latitude and are based on conjunction dates, and a planet may become increasingly washed from view in the Sun's glare as conjunction approaches.

CONJUNCTIONS—A conjunction occurs when a planet is in line with the Sun as observed from Earth and is crossing from the morning to the evening sky (or vice-versa). In the case of Mercury and Venus, *inferior* conjunction is when the planet is on the same side of the Sun as Earth

and located between them, while *superior* conjunction is when the planet and Earth are on opposite sides of the Sun (planets farther from the Sun than Earth never come between the two and so are never seen at inferior conjunction).

OPPOSITIONS—Opposition is the best time to observe an outer planet, when it's *opposite* the Sun in the sky. This means it rises at sunset and is visible all night, appearing largest and brightest as seen from Earth. Being inside Earth's orbit, Mercury and Venus are never seen at opposition.

ECLIPSES

This year, the Sun, Earth, and the Moon line up four times, producing two lunar eclipses and two solar eclipses that occur in pairs six months apart. The times when eclipses are possible are called eclipse seasons.

APRIL 20—The year's first eclipse is a very short **total solar eclipse** whose central path runs from the southern Indian Ocean to the southeast Pacific. This path touches little land as it covers Trealla Hill, Bundera Bundera, and Barrow Island in Western Australia, the eastern tip of East Timor Island and the western end of Papua, New Guinea. From these locations, observers see **totality**, when the Sun's disk is completely hidden from view, and the pale outer atmosphere, or **corona**—but only for about a minute. Away from this line, from Indonesia and the coasts of southeastern Asia to Tasmania and Fiji, some degree of partial eclipse is seen. No part of this eclipse is visible from the U.S.

MAY 5-6—The year's second eclipse is a hardly-noticeable **penumbral lunar eclipse**, centered over the Indian Ocean, so not visible from anywhere in the U.S. except for the Aleutian Islands and even then, only barely as the Moon sets, if at all. During a penumbral eclipse, the Moon passes through the pale, outer portion of Earth's shadow (the **penumbra**), but misses the darker central portion (the **umbra**), resulting in a subtle shading on the edge of the Moon that only keen-eyed observers can detect.

OCTOBER 14—The year's third eclipse takes place during a separate eclipse season from the first two and is an **annular solar eclipse**, in which the Moon passes precisely between Earth and the Sun. Unlike during a total eclipse, however, the Moon is slightly farther away from Earth, and its smaller apparent image doesn't completely cover the Sun. Instead, it leaves a ring of the solar disk visible around it (the **annulus**) which is bright enough to wash the faint corona from view. The narrow path of the Moon's shadow tracks across Oregon, Nevada, Utah, New Mexico, and Texas, across the Gulf of Mexico to the Yucatan Peninsula, Honduras, Nicaragua, and Panama, then through Colombia and Brazil. As seen from San Francisco, the eclipse is a morning event, beginning at 8:05 AM Pacific, with maximum at 9:19 AM, when the Moon crosses 85% of the Sun's diameter. The Moon then moves off the solar disk, and the eclipse ends at 10:42 AM.

OCTOBER 28-29—The final eclipse of the year is a very slight **partial lunar eclipse**, centered over the Middle East and visible from Europe, most of Africa, and most of mainland Asia. On this occasion, the Moon barely skims the central portion of Earth's shadow, which encroaches only 12% of the way across the Moon's disk, so many people might miss it. This is centered over the Indian Ocean and is not visible from anywhere in the U.S.

MAJOR METEOR SHOWERS

On any given night, about two to four sporadic meteors can be seen per hour and slightly more frequently toward dawn, as tiny particles of space dust burn up in Earth's atmosphere. When Earth passes through the dust trail left behind by a passing comet, more of these particles rain through the atmosphere, causing a meteor shower. Showers are named after the constellation from which meteors appear to radiate. Visibility can be affected by weather and by the Moon's brightness.

SHOWER	ACTIVE PERIOD	PEAK DATE*	RATE*	MOON PHASE
Quadrantids	JAN 1-5	JAN 3-4	40	Waxing gibbous
Lyrids	APR 16-25	APR 22-23	20	Waxing crescent
Eta Aquarids	APR 19-MAY 28	MAY 6-7	10-15	Full
Delta Aquarids	JUL 12-AUG 23	JUL 28-29	20	Waxing gibbous
Perseids	JUL 17-AUG 24	AUG 12-13	60	Waning crescent (!)
Orionids	OCT 2-NOV 7	OCT 21-22	20	First quarter
Leonids	NOV 6-30	NOV 17-18	15	Waxing crescent
Geminids	DEC 6-19	DEC 13-14	50-80	Waxing crescent
Ursids	DEC 17-25	DEC 21-22	5-10	Waxing gibbous

*The peak date of a meteor shower is when the maximum rate of meteors is expected to be observed, but it is not the only date to watch for them. Moonlight-permitting, better-than-usual rates may also be seen during the midnight-to-dawn hours a day or two before and after the peak date. Exclamation marks (!) indicate favorable prospects. Rates given are for ideal conditions (clear sky, no Moon, observing site away from bright lights, dark-adapted vision).

PHASES OF THE MOON

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
 New Moon	21	19	21	19	19	17	17	16	14	14	13	12
 First Quarter	28	27	28	27	27	26	25	24	22	21	20	19
 Full Moon	6	5	7	5	5	3	3	¹ / ₃₀	29	28	27	26
 Last Quarter	14	13	14	13	12	10	9	8	6	6	5	4

Some dates may differ by one day from those in calendars which do not correct for Pacific Time.

DIGITAL POCKET ALMANAC is downloadable at:
www.calacademy.org.

QUARTERLY SKYGUIDE, visit:
www.calacademy.org/exhibits/morrison-planetarium

MORRISON PLANETARIUM DAILY SKYWATCHING INFORMATION is provided in many news publications nationwide.

THE BENJAMIN DEAN LECTURE SERIES presents monthly talks for the general public by noted scientists in the fields of astronomy and space science, including leading cosmologists, astrobiologists, planet hunters, and principal investigators for NASA space missions. For information, please visit: www.calacademy.org/events/benjamin-dean-astronomy-lectures or call 415.379.8000.



**CALIFORNIA
ACADEMY OF
SCIENCES**

55 Music Concourse Drive
Golden Gate Park
San Francisco, California 94118
415-379.8000
www.calacademy.org