

THE LAUNCESTON PLANETARIUM

QUEEN VICTORIA MUSEUM

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ECLIPSES

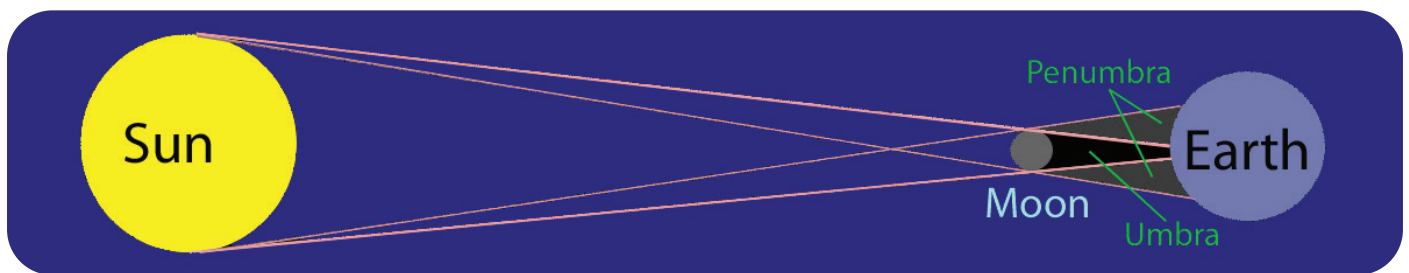
An *eclipse* happens when one celestial body enters the shadow cast by another — cutting off its source of light — or is obscured from view by a body passing in front of it (although certain of these events, such as the Moon obscuring distant stars, are more correctly called occultations). From Earth, we see two types of eclipses related to the Sun and the Moon: solar eclipses and lunar eclipses.

SOLAR ECLIPSES

A solar eclipse occurs when the Moon passes in front of the Sun as seen from Earth, blocking part or all of its light. Remarkably, the Sun and the Moon appear almost exactly the same size to us; this is because although the Moon is about 400 times smaller than the Sun, it is also about 400 times closer. This means that under ideal circumstances, the Moon can completely cover the Sun, but only briefly.

Some solar eclipses are *central*, which means that

the Moon and Sun are seen in exactly the same direction, with the Sun being completely hidden (a *total* solar eclipse) or the Moon's silhouette appearing completely within the Sun's disc (an *annular* solar eclipse). Central solar eclipses take place on average every 7.8 months, but are seen from along a relatively narrow path across Earth's surface. An observer in the *penumbra* (the lighter part) of the shadow witnesses only a partial eclipse; this region covers a far larger area. Most people miss out on being along the path of totality or annularity.



Mechanism of a total solar eclipse. Totality occurs along a narrow path on Earth where it intersects with the umbra (darkest part) of the Moon's shadow. In an annular solar eclipse, the umbral shadow cone ends before it reaches Earth, and a ring of Sun is seen around the silhouetted Moon. Angles, sizes and distances are for diagrammatic purposes only.

Sometimes, a solar eclipse is not central from anywhere on Earth, meaning that nowhere do the centres of the Sun and Moon appear close enough to produce a total or an annular eclipse. In these events, regions of high latitude in either the northern or the southern hemisphere will experience *only* a partial eclipse.

From any given location, a solar eclipse of some

kind will be seen, on average, every few years. However, central (total or annular) eclipses *from a particular place* are quite rare, so most solar eclipses people experience are partial eclipses. The longest possible duration for the total part of a solar eclipse is seven and a half minutes; typically, it is much shorter. However, the partial phases, before and after totality, each last for about an hour.



Without prior knowledge of the event, most partial solar eclipses would pass unnoticed. This is because during partial eclipses, or during the partial phases of total eclipses, some of the Sun's disc is still visible. Our eyes adjust to the slowly changing light conditions, so usually there seems to be no difference compared with a normal sunny day. However, if the Moon covers about 80% or more of the Sun's diameter, the change in light is perceptible, and it becomes quite noticeable when it is over 90%.

During a total solar eclipse, the illumination on the ground is similar to that experienced during bright twilight. There is enough light to see to walk around, but the drop in the light level is quite remarkable, and several bright stars and planets

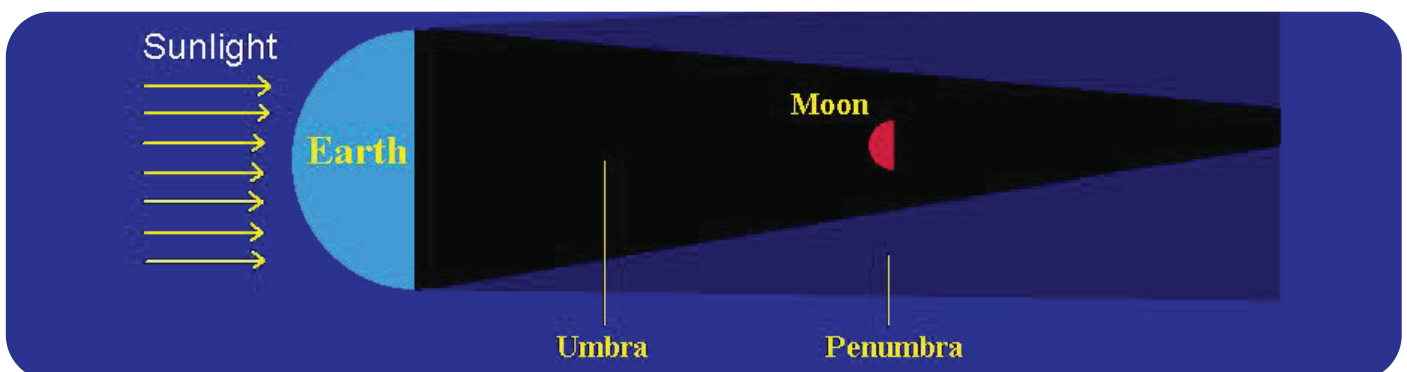
can typically be seen in the sky. Reading settings on cameras can be difficult. The most spectacular sight is the view of the Sun's outer atmosphere called the corona, which is visible without special equipment only during a total solar eclipse.

Viewing any part of the Sun directly at any time — eclipse or no eclipse — is very dangerous, because the Sun's light and heat can cause permanent eye damage. This, therefore, includes all times at which a solar eclipse is only partial or annular. Viewing a solar eclipse during totality is quite safe (and spectacular!), but it is important to know when this brief period will begin and end, as even a small amount of direct sunlight can damage the eye.

LUNAR ECLIPSES

Lunar eclipses occur when the Moon passes into Earth's shadow. A *total* lunar eclipse occurs when the Moon passes completely within the umbra of the shadow; if it does not become completely immersed in the umbra, the event is called a *partial* lunar eclipse. During a total eclipse, the

Moon does not disappear completely, because some sunlight is bent in Earth's atmosphere and falls onto the Moon. The Moon then appears red, because more red light than blue passes through the atmosphere. Unlike the partial phases of solar eclipses, all lunar eclipses are quite safe to observe because they do not involve looking at the Sun.



Mechanism of a lunar eclipse. When the Moon enters Earth's umbral shadow, it is cut off from direct sunlight and is dramatically darkened. However, a small amount of red light passes through Earth's atmosphere and falls onto the Moon, rendering it visible. Angles and distances are for diagrammatic purposes only.



A total lunar eclipse. Image: Martin George



A partial lunar eclipse. Image: Martin George

There is another type of lunar eclipse, called a *penumbral* lunar eclipse. This is when the Moon enters only the penumbra (the light part) of Earth's shadow. In these events, no part of the Moon is cut off from direct sunlight, but a slight uneven shading may be noticed by keen observers during events in which the Moon passes deeply into the penumbra. These events are rarely publicised, because they are so difficult to observe. During such an event, an observer on the Moon would see Earth partly covering the Sun, rather like

THE FREQUENCY OF ECLIPSES

Eclipses can occur only at the lunar phases of new moon or full moon, and then only if the Moon is, at the time, passing through the plane of Earth's orbit. Eclipses do not happen every month, because of the tilt of the Moon's orbit. An observer must be in the right place to see an eclipse: for a lunar eclipse to be seen, the Moon must be above the horizon, and for a solar eclipse to be seen, the observer must be in the Moon's shadow.

There are always between four and seven eclipses in any one year, at least two (and at most five) of which must be solar eclipses. This figure includes both umbral and penumbral lunar eclipses.

a partial eclipse of the Sun (mentioned before) as seen from Earth.

A lunar eclipse can be seen from anywhere on Earth that has a direct view of the Moon, so more than half of Earth will face the Moon at some stage during the event. The total part of a lunar eclipse can last more than 90 minutes, and its partial phases last about an hour each. As with solar eclipses, a lunar eclipse which is only partial (i.e. not total at any time) can last for a much shorter overall period.

However, because penumbral lunar eclipses are quite difficult to observe, it is sometimes stated that there are years with only two eclipses, both solar.

Of lunar eclipses, 29% are total, 35% partial and 36% penumbral, so only about 64% of lunar eclipses involve the Moon entering Earth's umbral shadow.

Of solar eclipses, 32% are total (a small number of these are a mixture of total and annular, called *hybrid*), 33% are annular and 35% are partial. Note that any particular place on Earth will experience a total solar eclipse about once per 400 years, on average. The most recent one seen from Tasmania was in May 1910, and the next will be in June 2131.

ECLIPSES THAT WILL BE VISIBLE FROM TASMANIA, 2021-2022

Date	Eclipse Type	Details
26 May 2021	Total Lunar	Visible in its entirety from Tasmania: duration of totality 78 min.
19 November 2021	Partial Lunar	98% of Moon's diameter in shadow but Moon rises after maximum; only later stages visible from Tasmania
4 December 2021	Partial Solar	Minor eclipse with only 17% of the Sun's diameter covered
8 November 2022	Total Lunar	Visible in its entirety from Tasmania: duration of totality 86 min.

No eclipses will be visible from Tasmania during 2020.