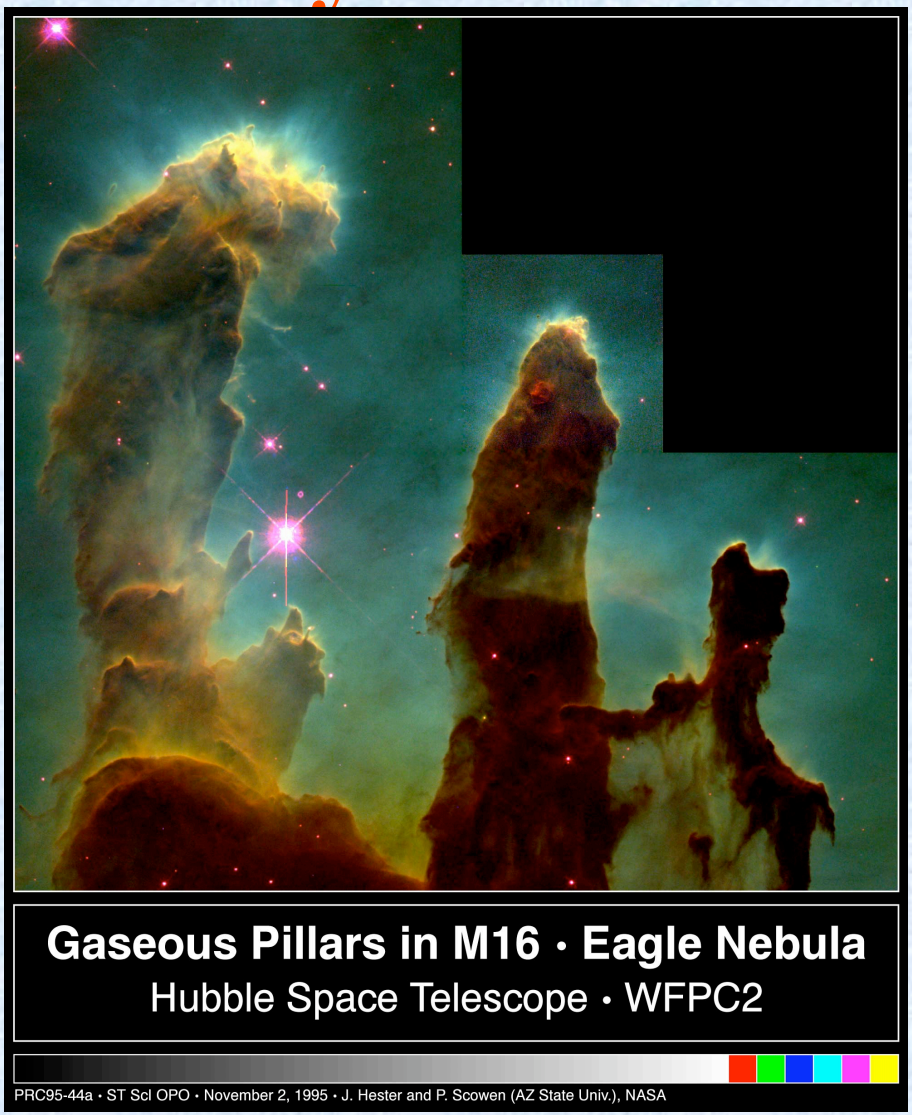
Astronomy 1 – Winter 2011



Lecture 3; January 7 2011

Previously… on Astro-1

- Powers of Ten
  - Familiarize yourself with this notation
- Units
  - We use the IS… expect when we don't
  - Dimensional analysis is a very useful tool
- Measuring Angles
  - What is a degree? An (arc)minute?
- The night sky
- Seasons
  - Why is it colder in winter?

Next week we start with iClickers

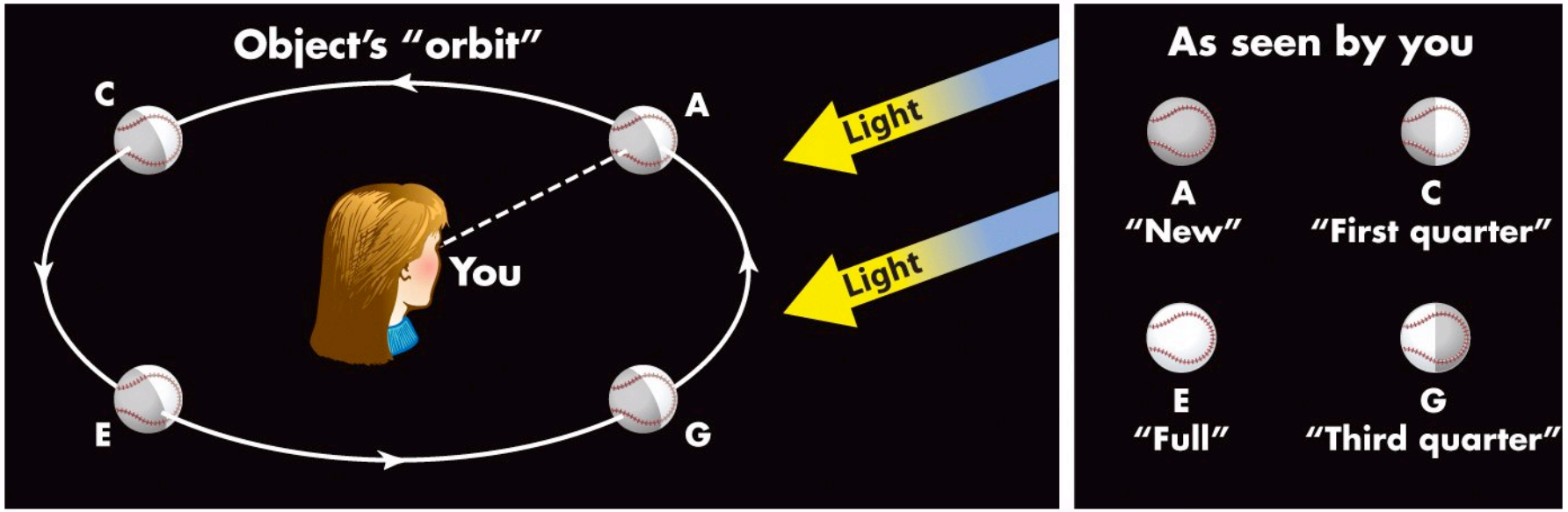
- Make sure to register your iclicker and bring it to class every time!

Today on Astro-1

- The moon's orbit
- Lunar eclipses
- Solar eclipses
- Ancient studies of moon and sun's orbit

Figure 3-1
Universe, Eighth Edition

This picture of the Earth and the Moon was
taken in 1992 by the *Galileo* spacecraft on its way toward Jupiter.



Box 3-1
Universe, Eighth Edition

What you see from earth

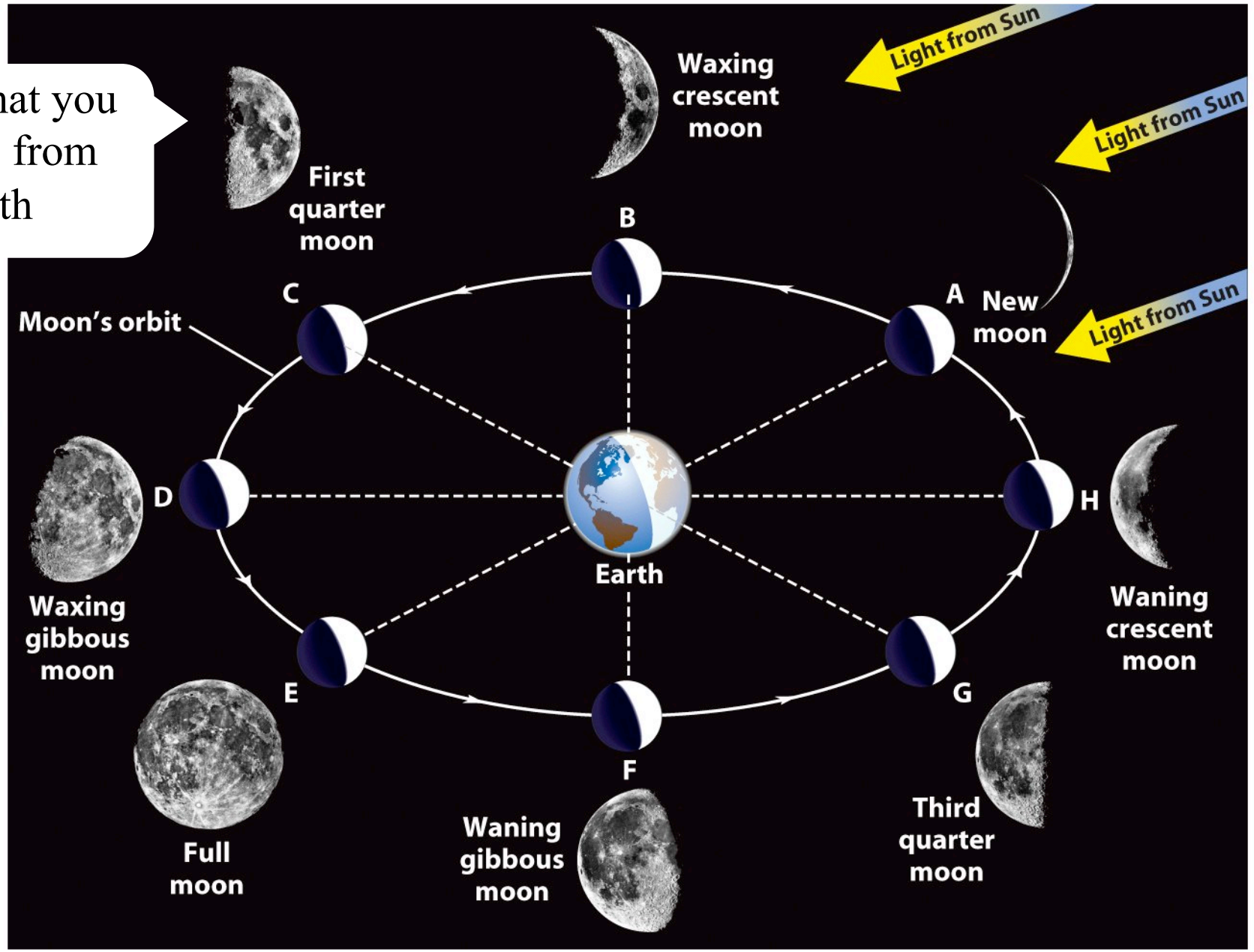


Figure 3-2
Universe, Eighth Edition

Figure 3-3
Universe, Eighth Edition

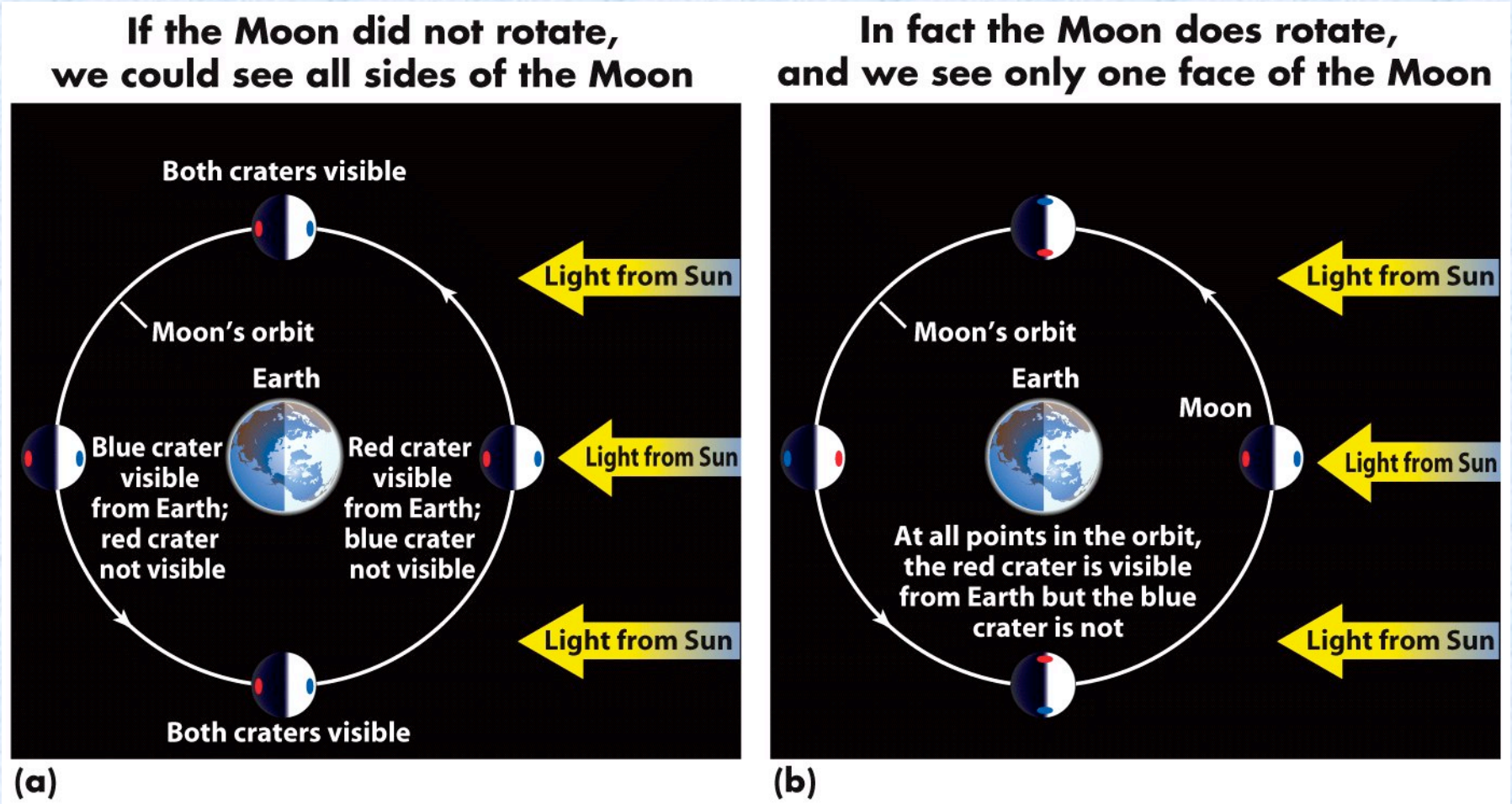


Figure 3-4
Universe, Eighth Edition

Pink Floyd:
The Dark Side of the Moon

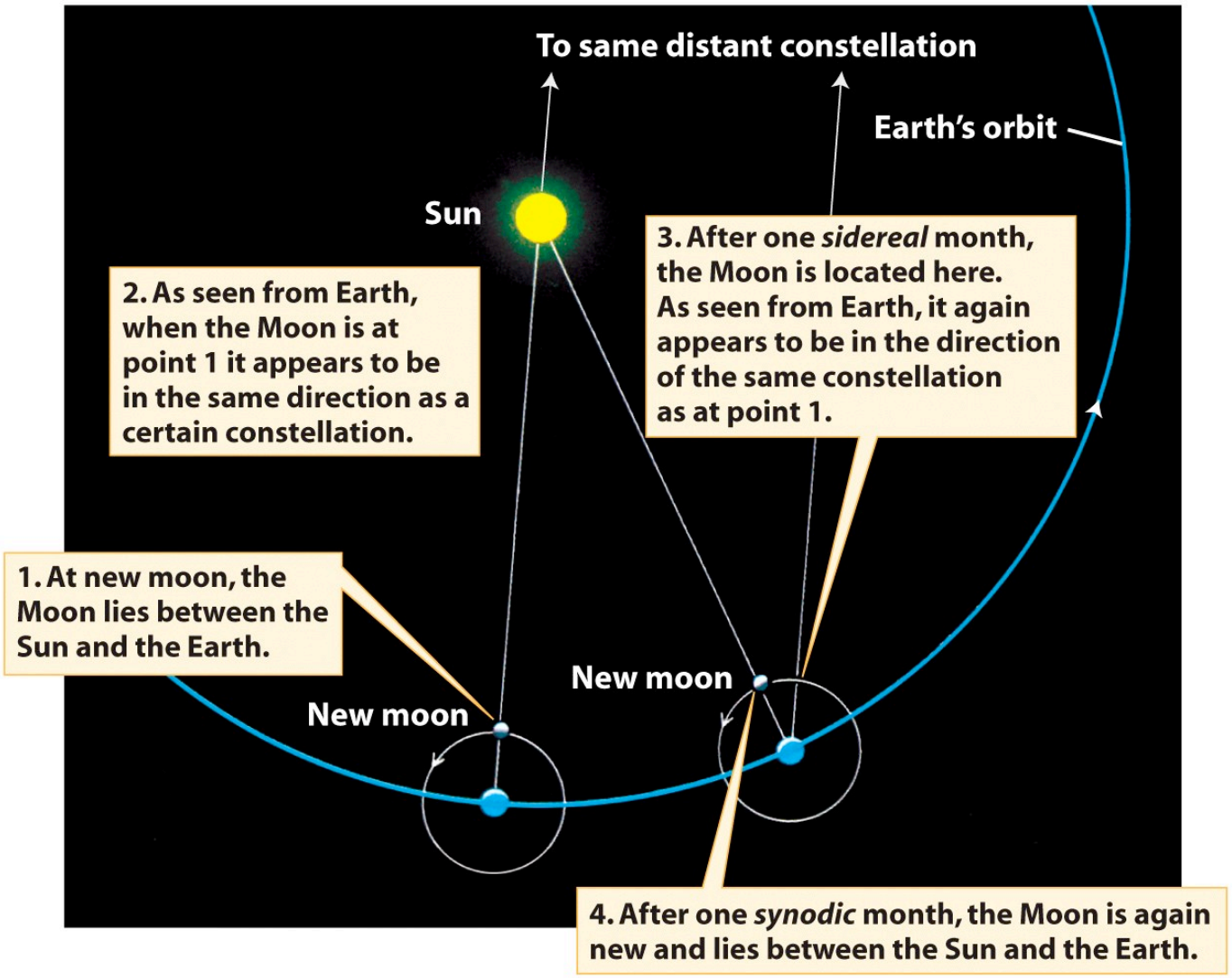


Figure 3-5
Universe, Eighth Edition

Sidereal month: the time the Moon takes to complete one full revolution around the Earth with respect to the background stars: 27.32 days

Synodic (lunar) month: Time from one new moon to the next: 29½ days.

Why don't we have eclipses every month?

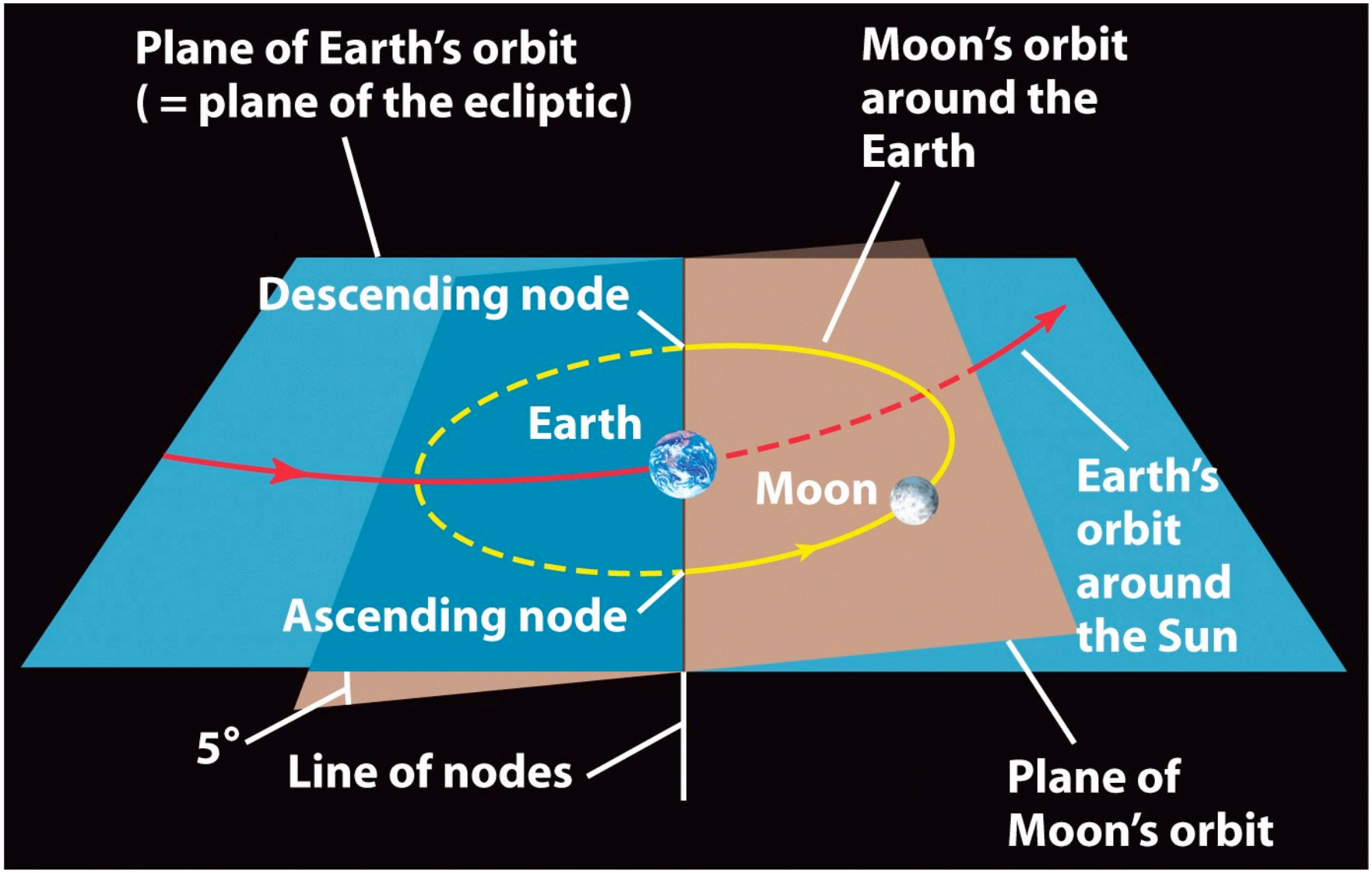


Figure 3-6
Universe, Eighth Edition

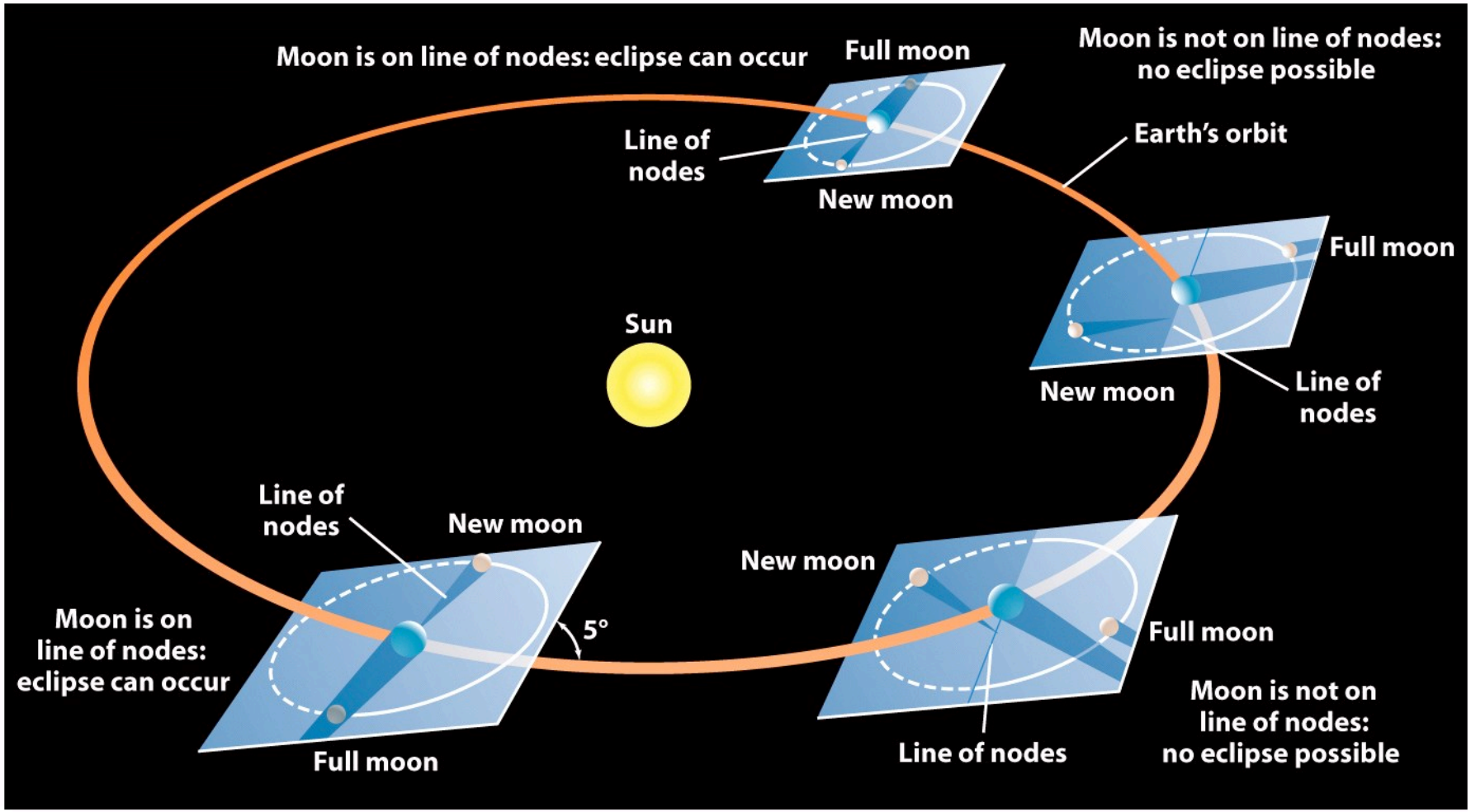


Figure 3-7
Universe, Eighth Edition

Lunar eclipse: Moon is in the shadow of the Earth

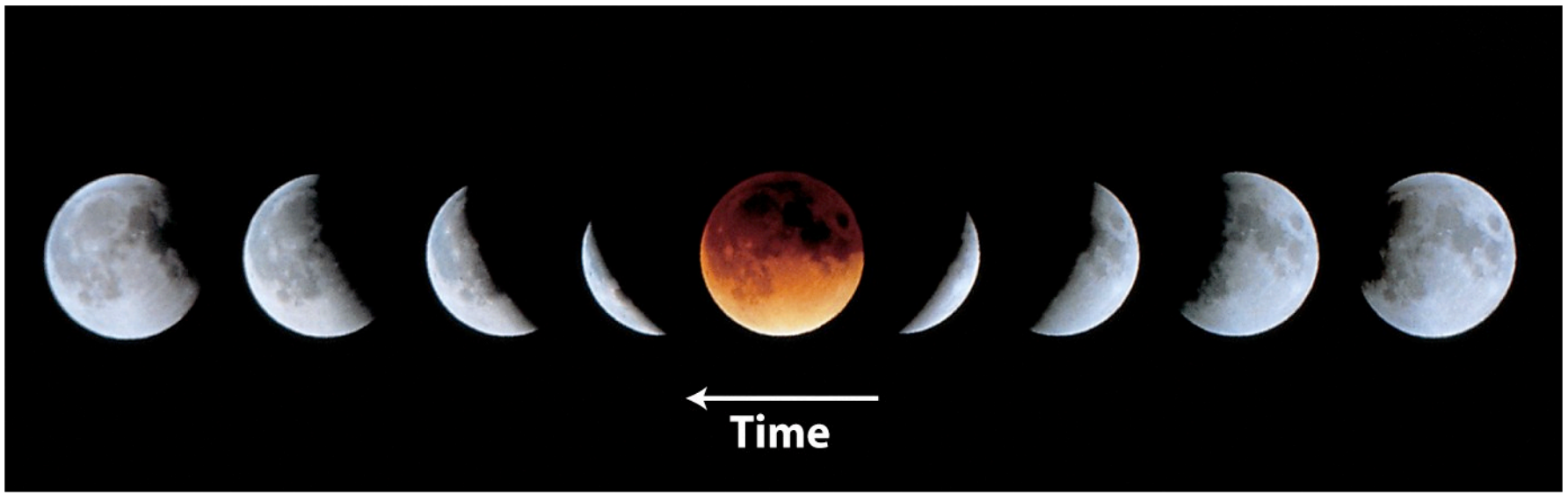


Figure 3-9
Universe, Eighth Edition

Lunar eclipse: three types

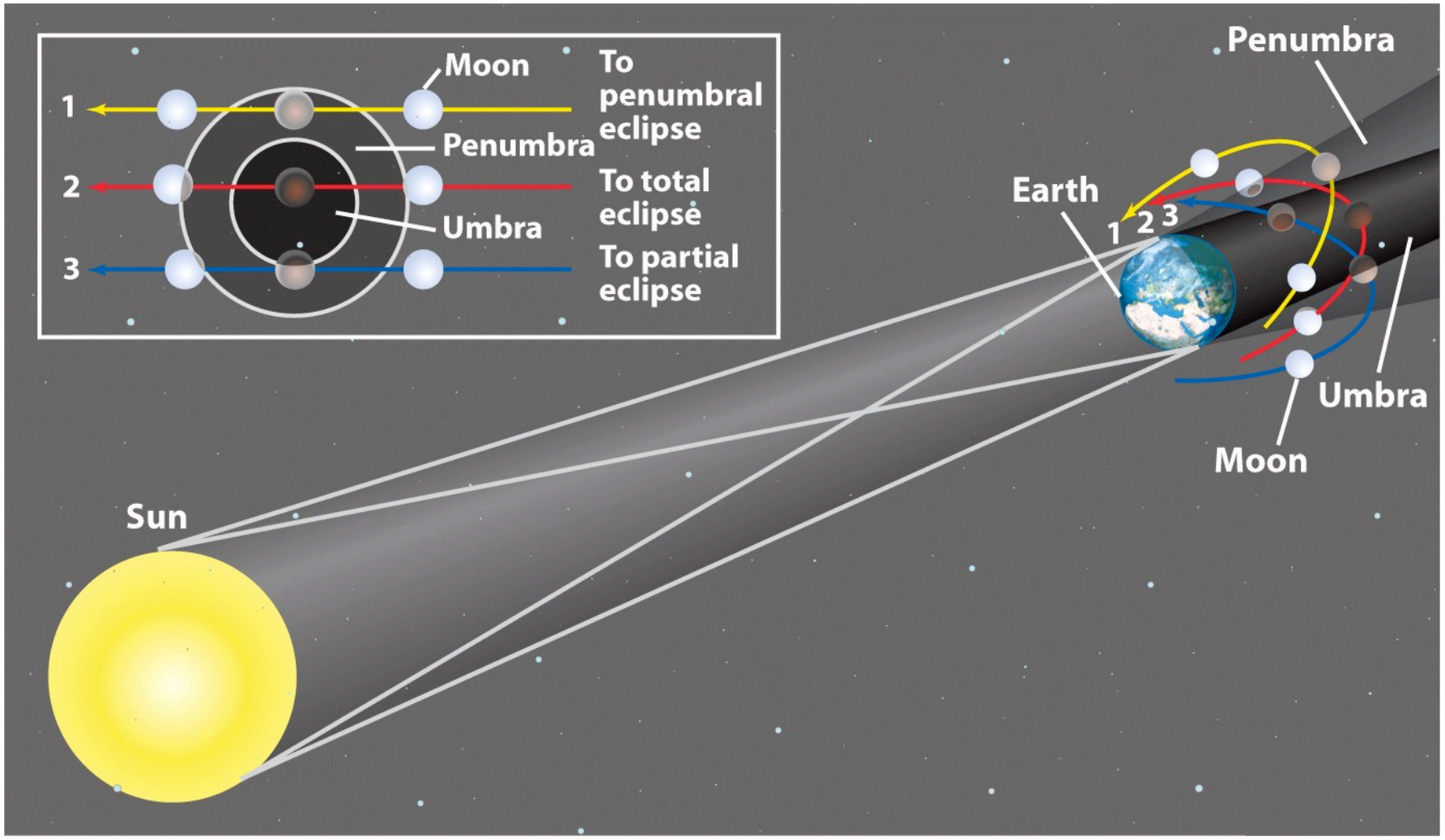


Figure 3-8
Universe, Eighth Edition

The Moon moving through the Earth's umbra over 3 hours.

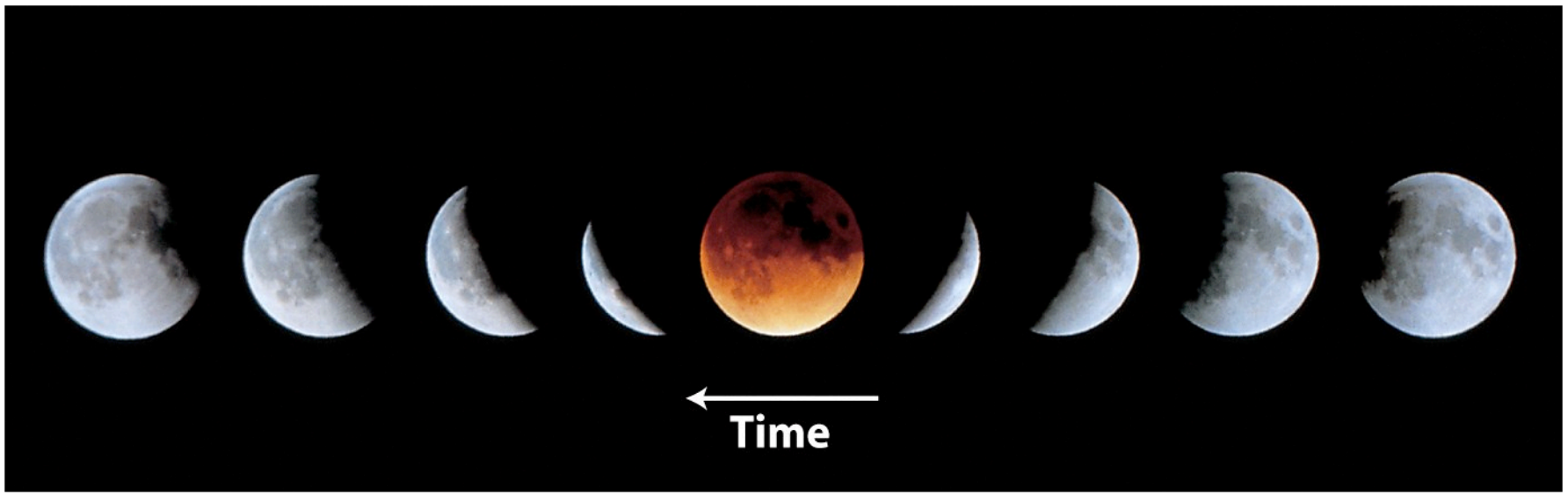


Figure 3-9
Universe, Eighth Edition

On average, two or three lunar eclipses occur in a year. Of all lunar eclipses, roughly one-third are total, one-third are partial, and one-third are penumbral.

Table 3-1 Lunar Eclipses, 2007–2011

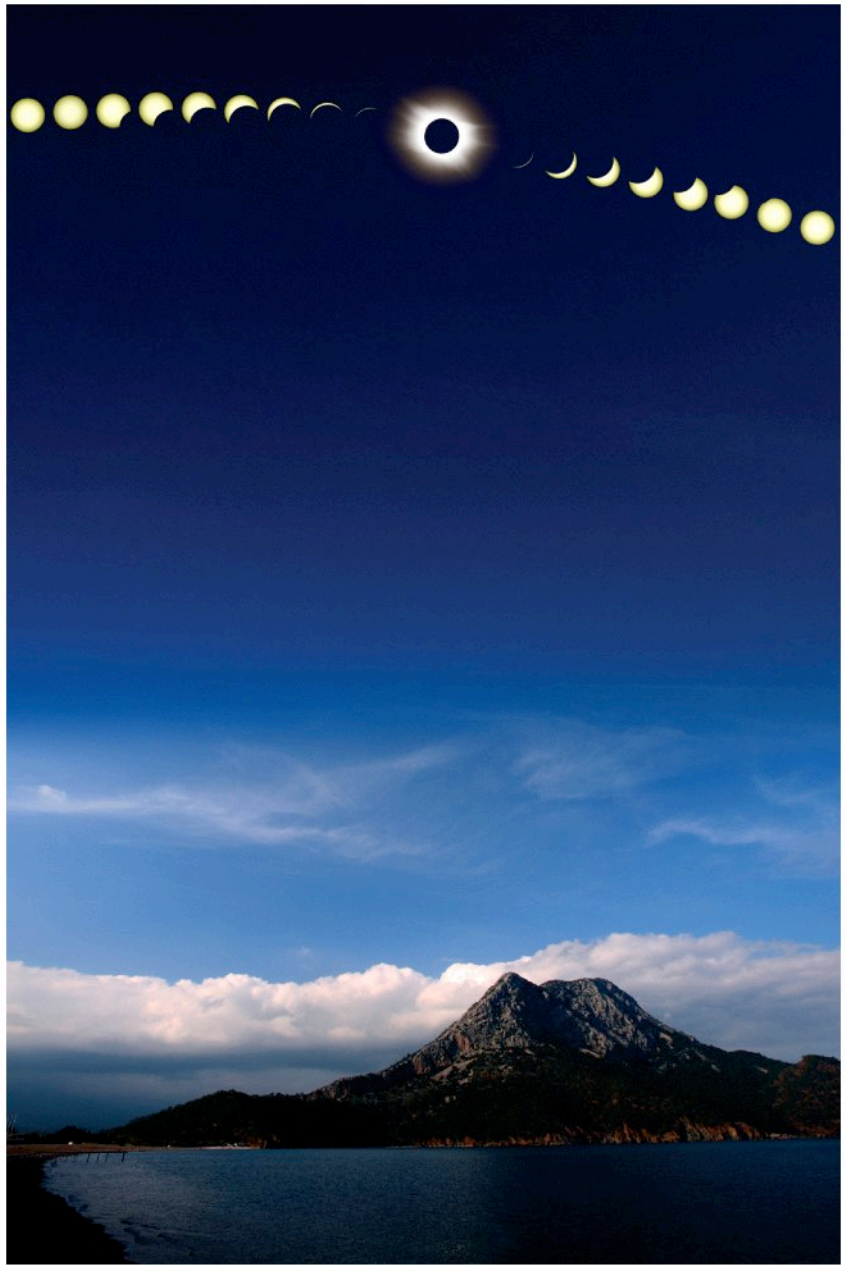
Date	Type	Where visible	Duration of totality (h = hours, m = minutes)
2007 March 3	Total	Americas, Europe, Africa, Asia	1h 14m
2007 August 28	Total	Eastern Asia, Australia, Pacific, Americas	1h 31m
2008 February 21	Total	Central Pacific, Americas, Europe, Africa	51m
2008 August 16	Partial	South America, Europe, Africa, Asia, Australia	—
2009 February 9	Penumbral	Europe, Asia, Australia, Pacific, North America	—
2009 July 7	Penumbral	Australia, Pacific, Americas	—
2009 August 6	Penumbral	Americas, Europe, Africa, Asia	—
2009 December 31	Partial	Europe, Africa, Asia, Australia	—
2010 June 26	Partial	Asia, Australia, Pacific, Americas	—
2010 December 21	Total	Asia, Australia, Pacific, Americas, Europe	1h 13m
2011 June 15	Total	South America, Europe, Africa, Asia, Australia	1h 41m
2011 December 10	Total	Europe, Africa, Asia, Australia, Pacific, North America	52m

Eclipse predictions by Fred Espenak, NASA/Goddard Space Flight Center. All dates are given in standard astronomical format: year, month, day.

Table 3-1
Universe, Eighth Edition

How did ancient astronomers discover that the Earth is round?

Solar eclipse



Chapter 3 Opener
Universe, Eighth Edition

A total solar eclipse. The moon passes in front of the sun.

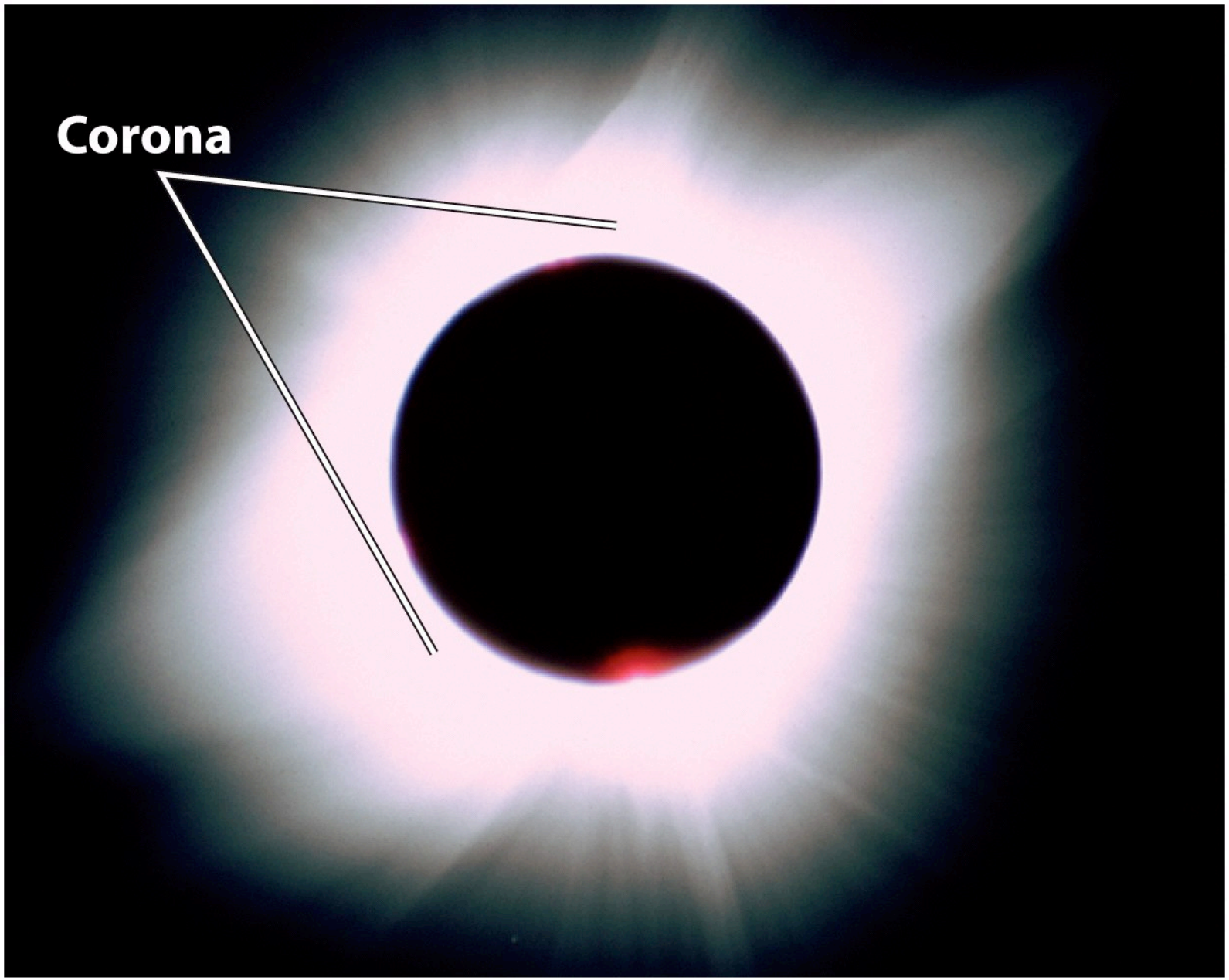


Figure 3-10b
Universe, Eighth Edition

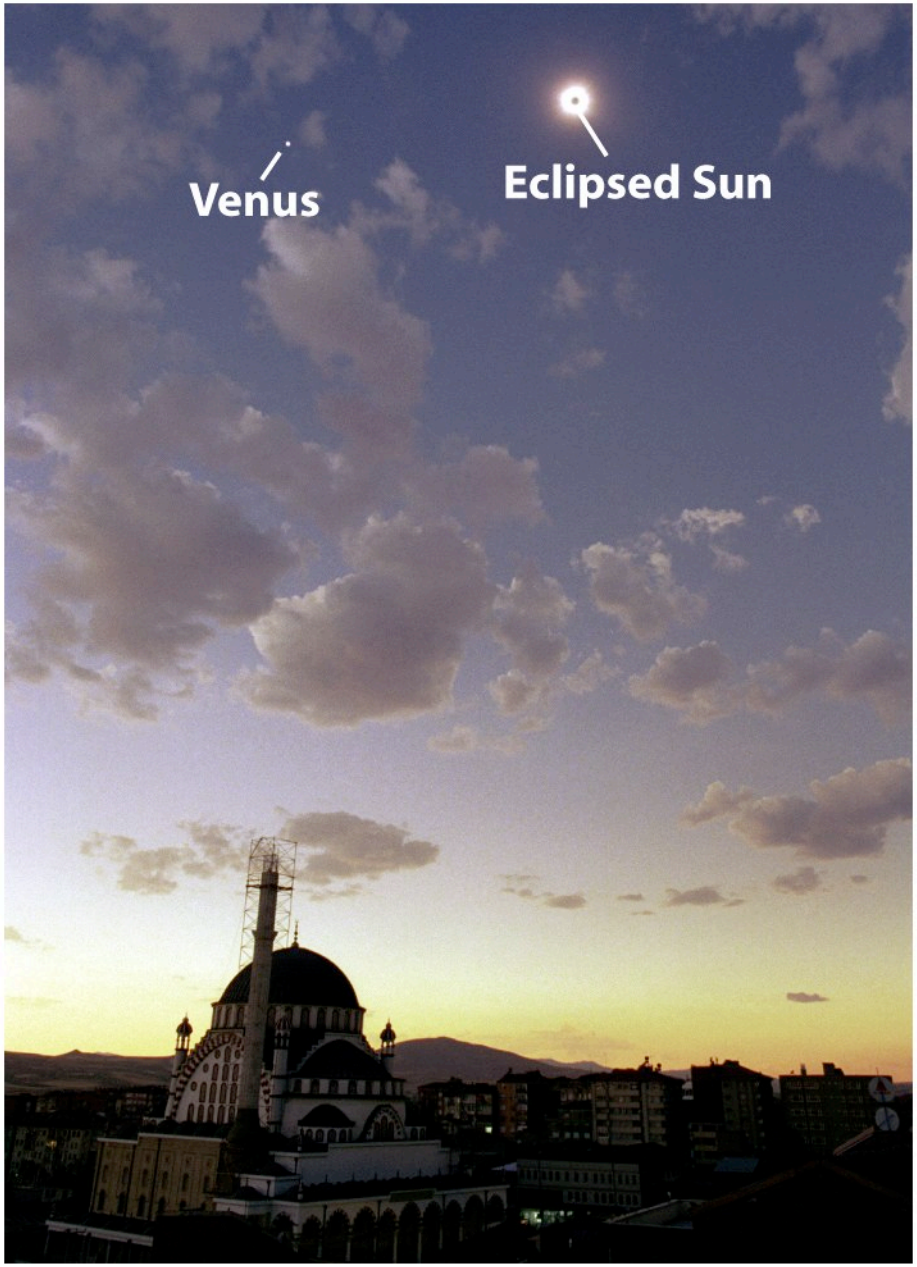


Figure 3-10a
Universe, Eighth Edition

Photo from Russian space station Mir (of same eclipse in previous 2 slides)!

During a total solar eclipse, the tip of the Moon's traces an eclipse path across the Earth's surface. People within the eclipse path see a total solar eclipse as the tip moves over them. Anyone within the penumbra sees only a partial eclipse.

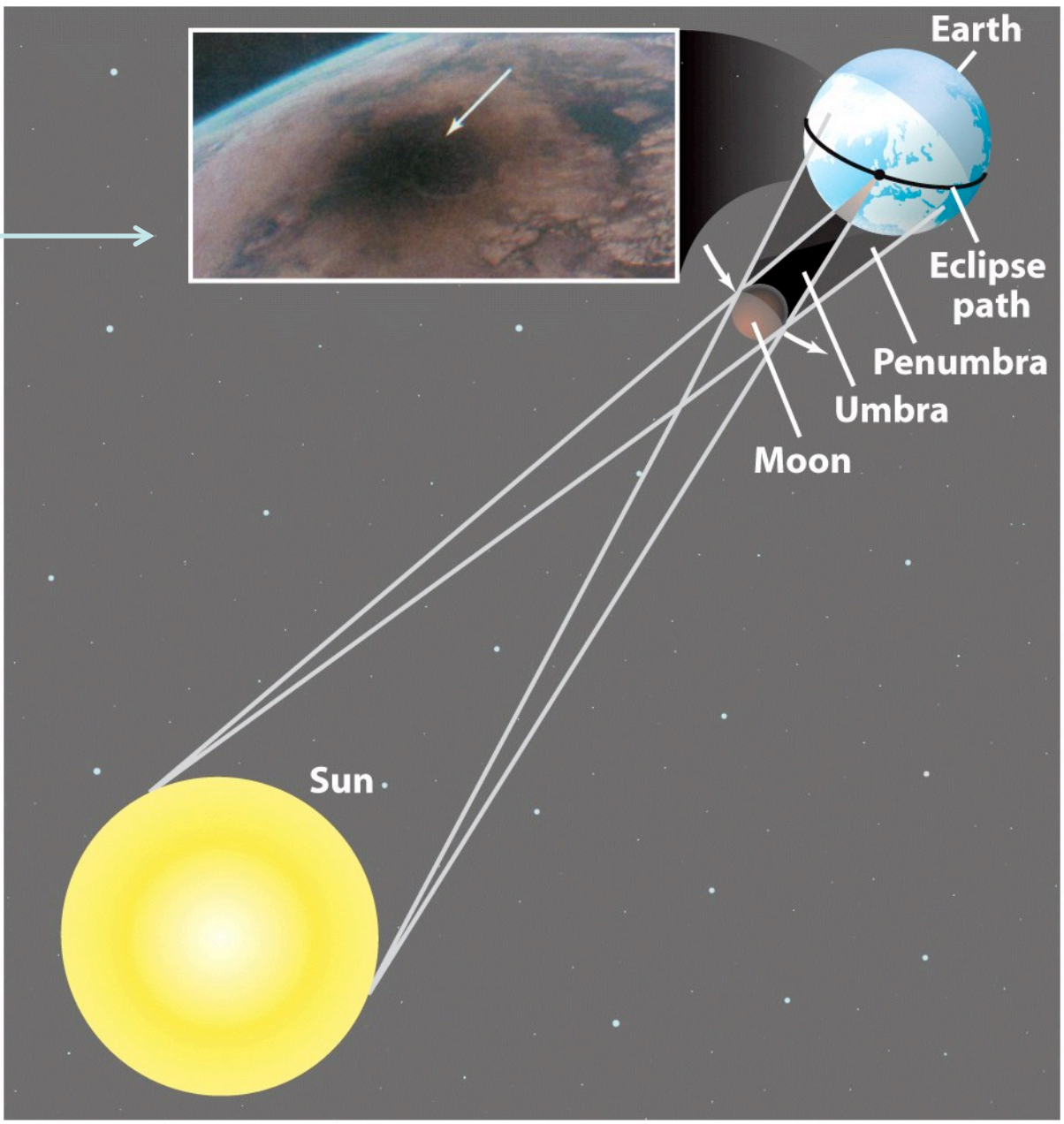


Figure 3-11
Universe, Eighth Edition

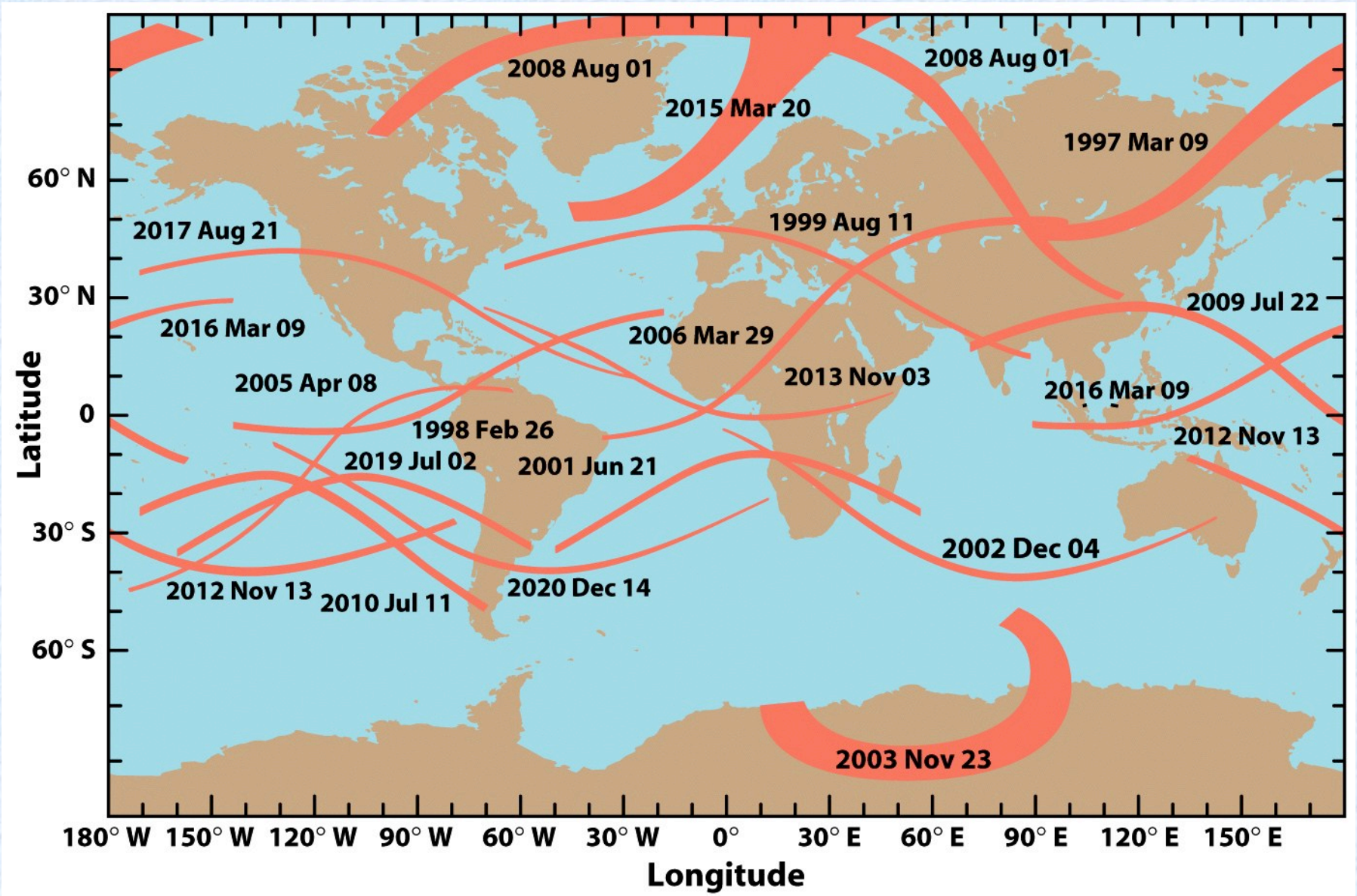


Figure 3-13
Universe, Eighth Edition

Annular solar eclipse.

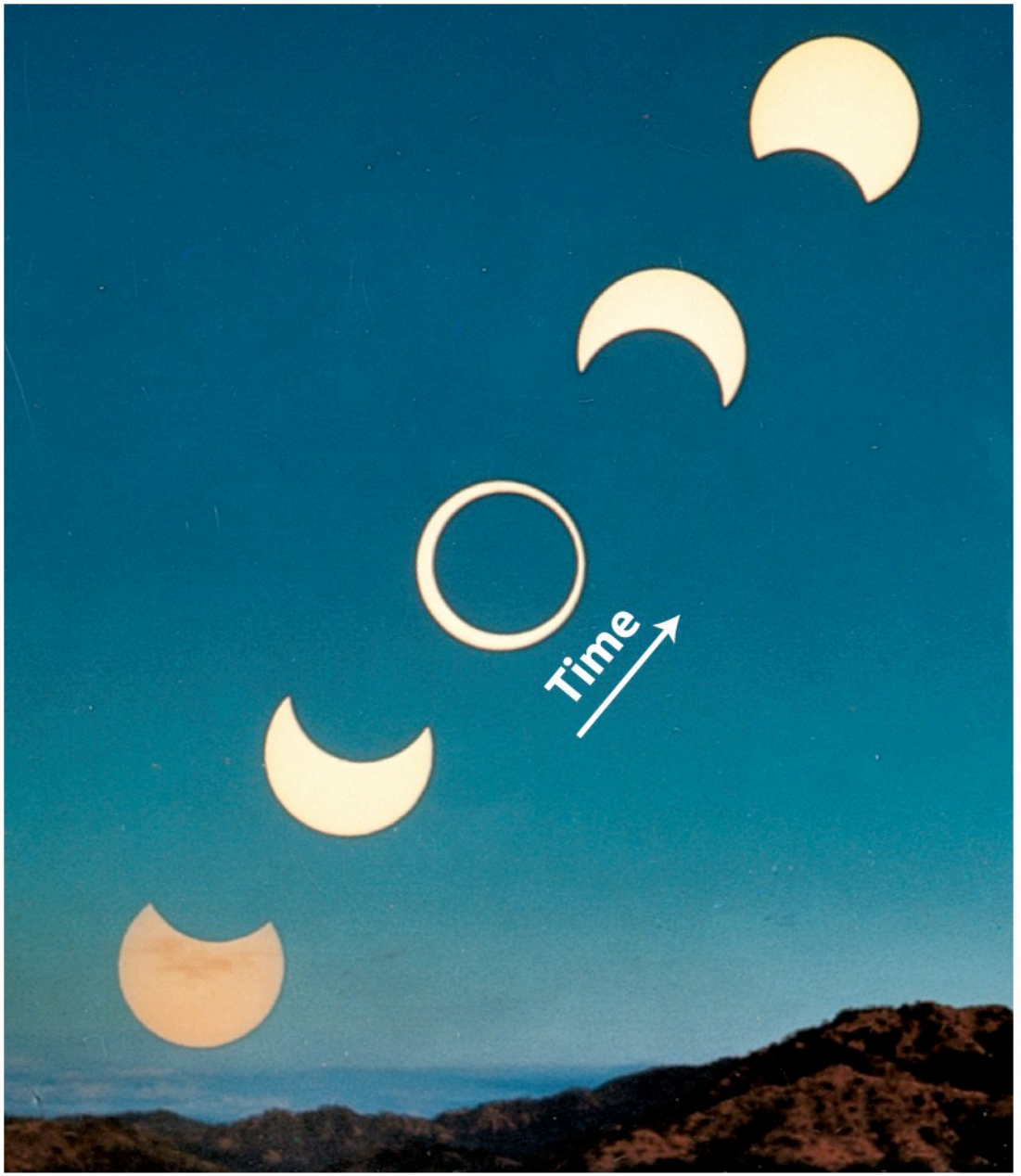


Figure 3-12
Universe, Eighth Edition

Table 3-2 Solar Eclipses, 2007–2011

Date	Type	Where visible	Notes
2007 March 19	Partial	Asia, Alaska	87% eclipsed
2007 September 11	Partial	South America, Antarctica	75% eclipsed
2008 February 7	Annular	Antarctica, eastern Australia, New Zealand	—
2008 August 1	Total	Northeast North America, Europe, Asia	Maximum duration of totality 2m 27s
2009 January 26	Annular	Southern Africa, Antarctica, southeast Asia, Australia	—
2009 July 22	Total	Eastern Asia, Pacific Ocean, Hawaii	Maximum duration of totality 6m 39s
2010 January 15	Annular	Africa, Asia	—
2010 July 11	Total	Pacific Ocean, South America	Maximum duration of totality 5m 20s
2011 January 4	Partial	Europe, Africa, central Asia	86% eclipsed
2011 June 1	Partial	Eastern Asia, northern North America, Iceland	60% eclipsed
2011 July 1	Partial	Indian Ocean	10% eclipsed
2011 November 25	Partial	Southern Africa, Antarctica, Australia, New Zealand	91% eclipsed

Eclipse predictions by Fred Espenak, NASA/Goddard Space Flight Center. All dates are given in standard astronomical format: year, month, day.

Table 3-2
Universe, Eighth Edition

There are at least two, but never more than five solar eclipses each year.

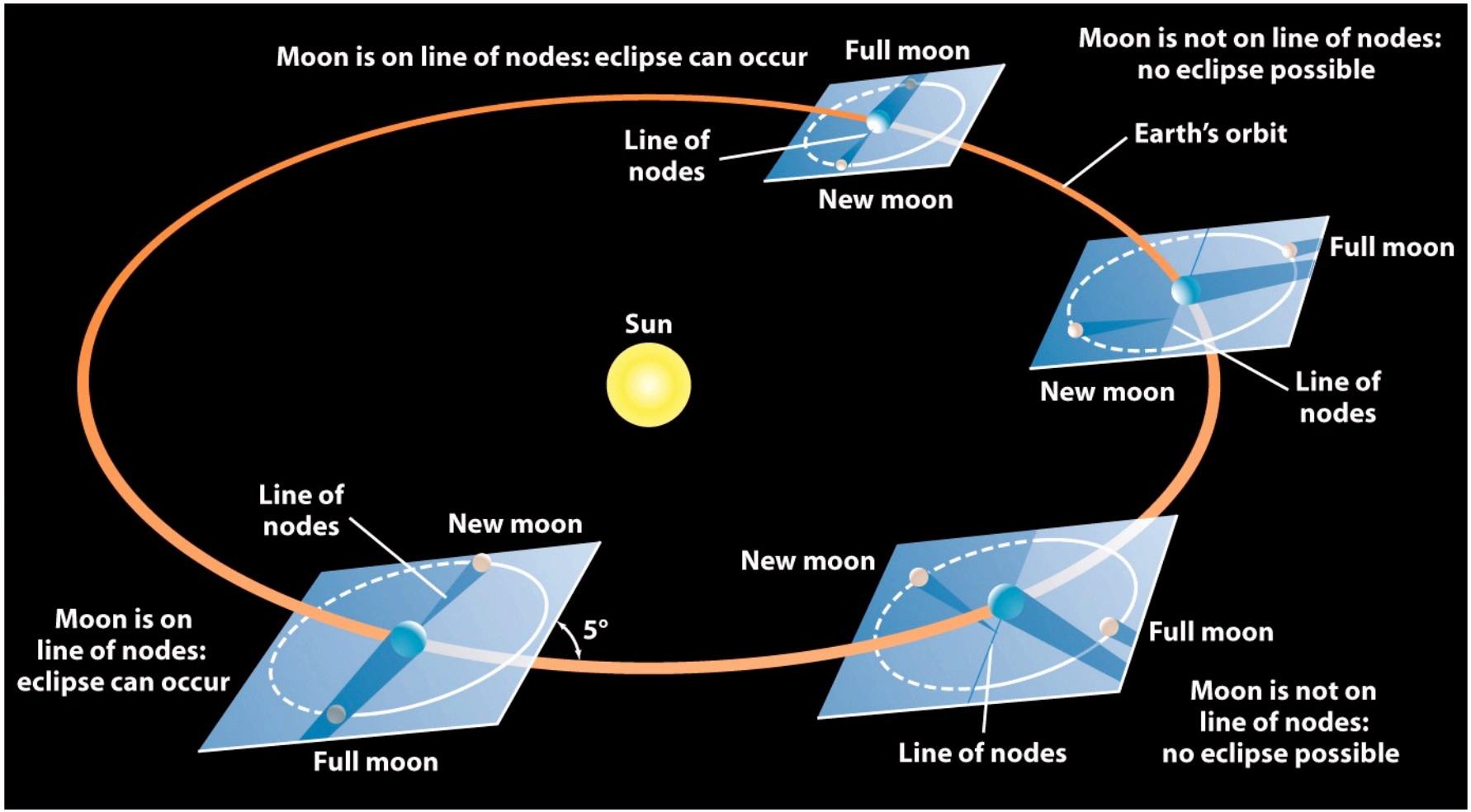


Figure 3-7
Universe, Eighth Edition

Eratosthenes's determined the diameter of the Earth around 200 B.C.!

Distance from Alexandria to Syene was said to be about 5000 stades, so Earth's circumference was computed to be 50 × 5000 = 250,000 stades

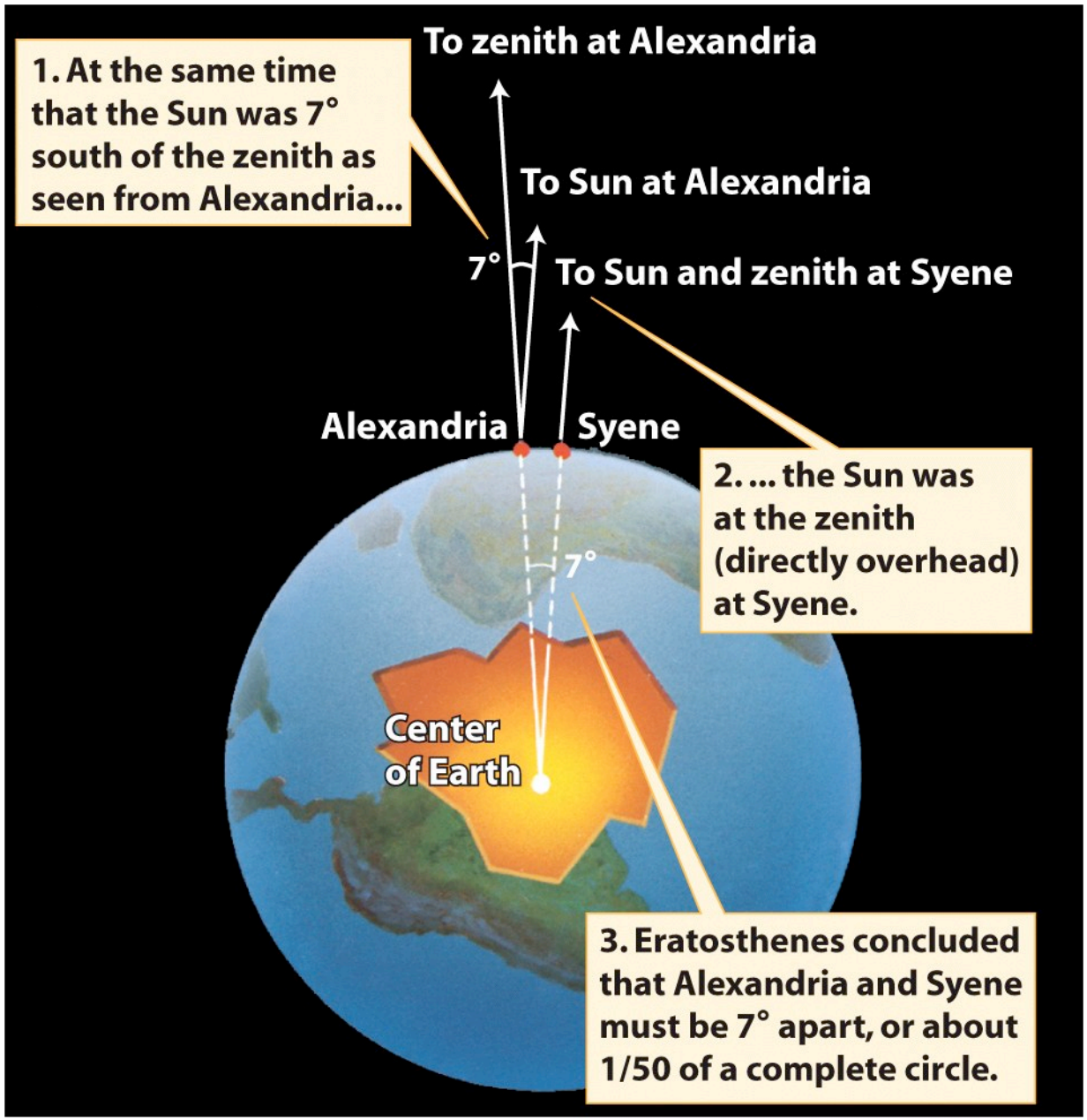


Figure 3-14
Universe, Eighth Edition

Aristarchus determined distances to sun and moon, and determined sizes of moon and sun relative to Earth around 280 B.C.! He got the answer wrong because of poor measurements, but had the right technique.

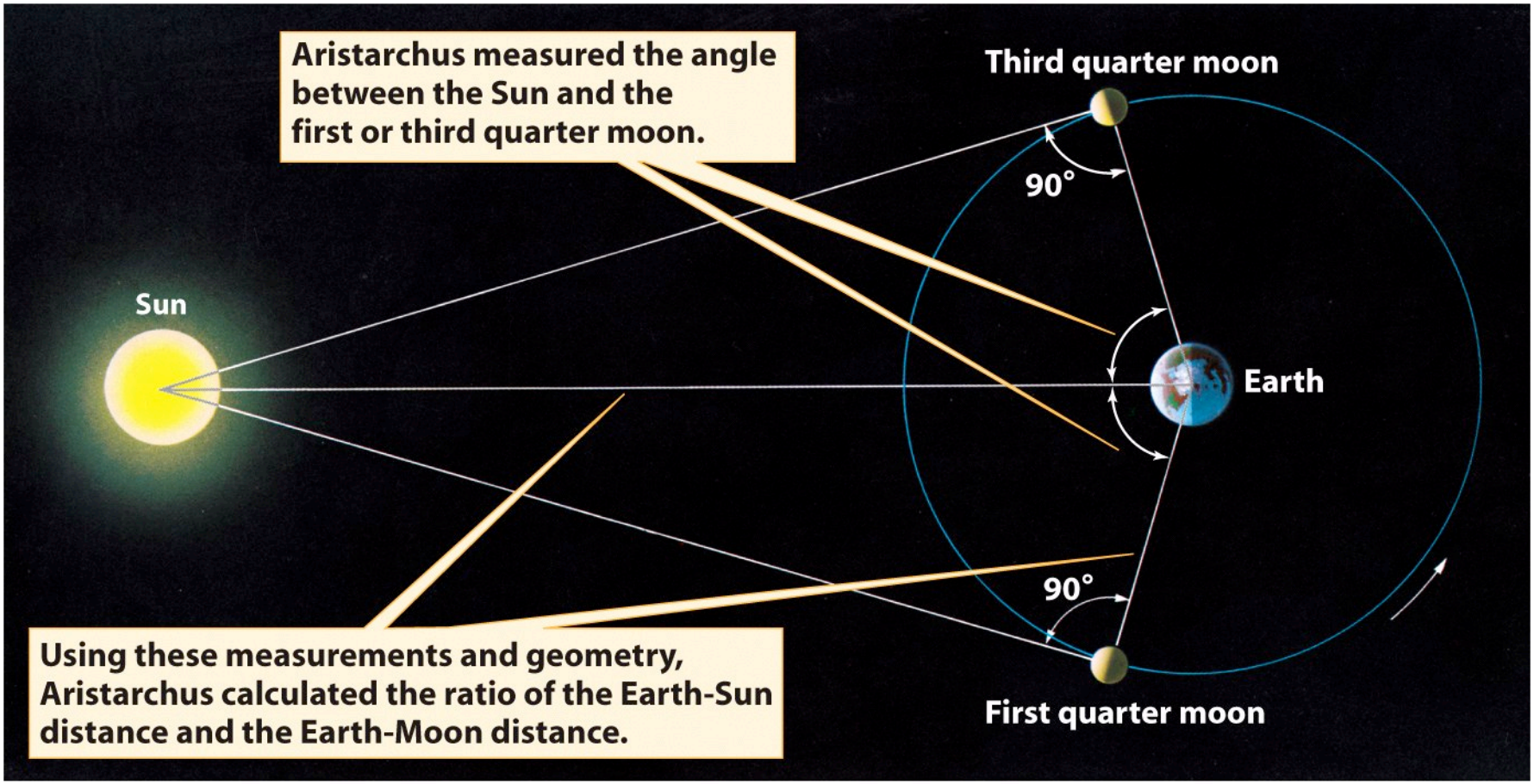


Figure 3-15
Universe, Eighth Edition

Summary

- Lunar Phases:
  - How do they arise?
- Length of the Month:
  - How long does it take for the moon to go around the Earth?
- The Moon's Orbit:
  - Why don't we have lunar eclipses every month?
- Solar eclipses
  - What kind of solar eclipses are there? When do they happen?

The End

See you on Monday!