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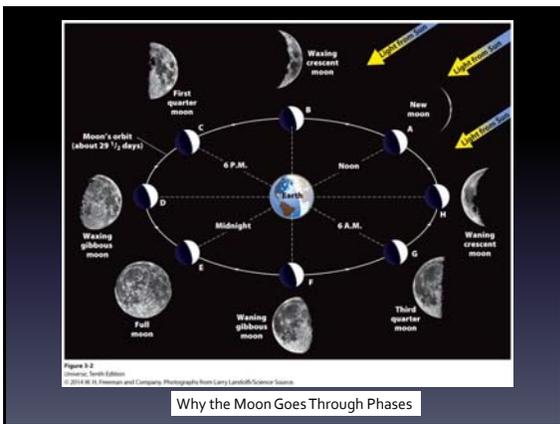
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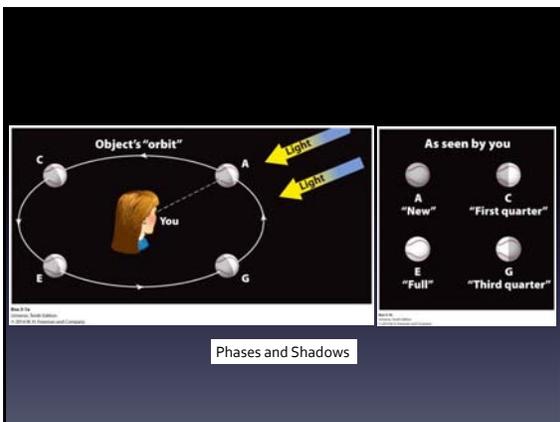
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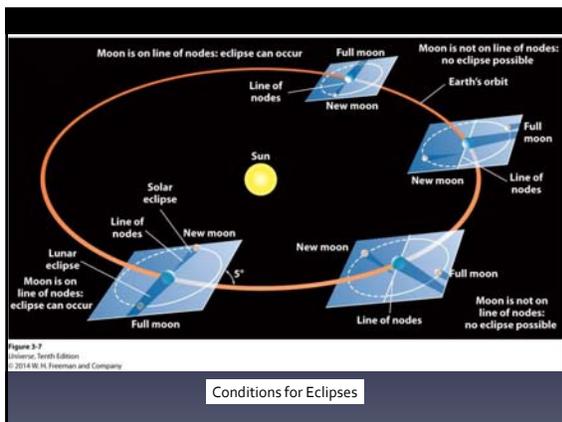
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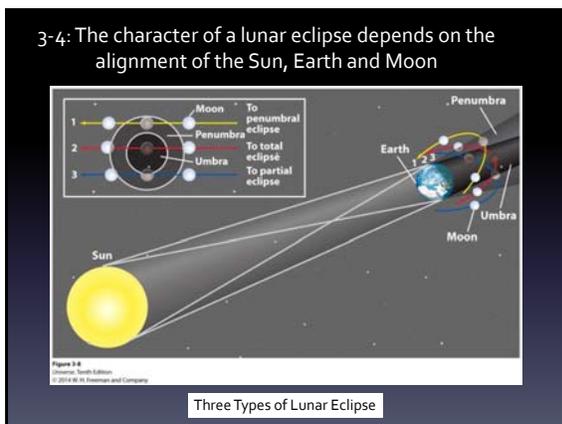
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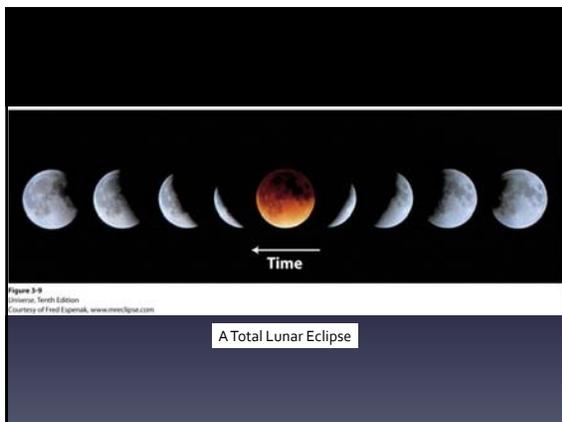
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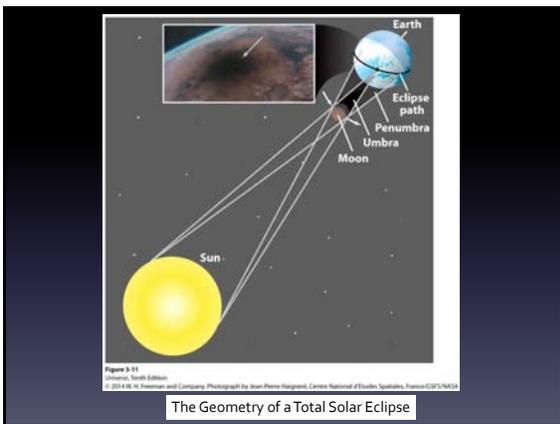
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The Geometry of a Total Solar Eclipse

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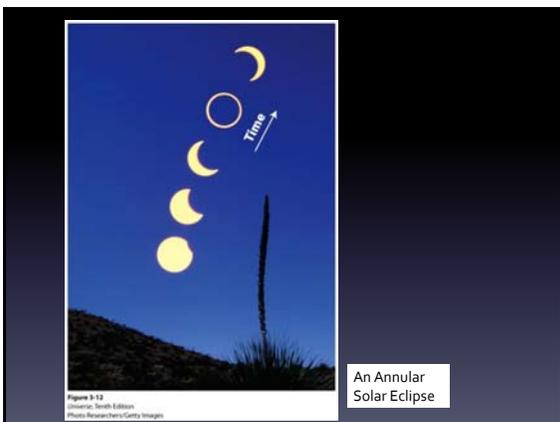
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An Annular Solar Eclipse

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# Annular Eclipse May 20, 2012



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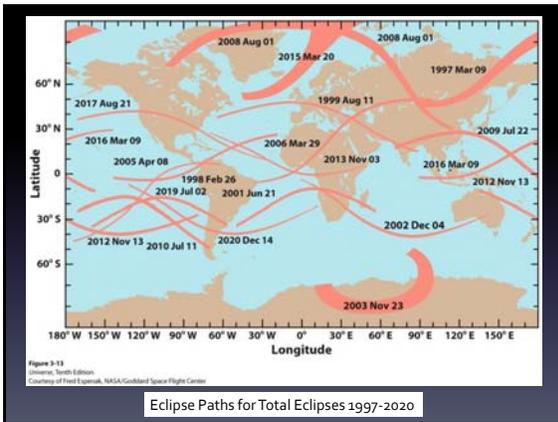
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Eclipse Paths for Total Eclipses 1997-2020

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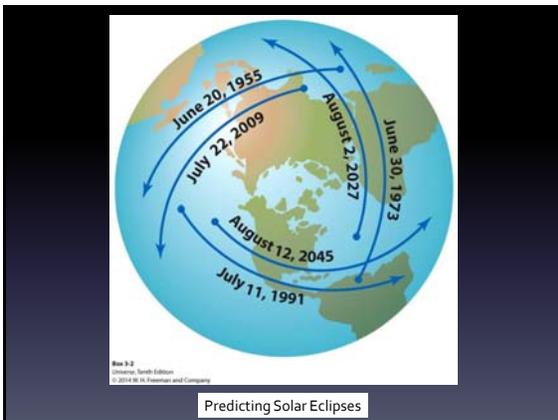
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Predicting Solar Eclipses

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# Aristarchus




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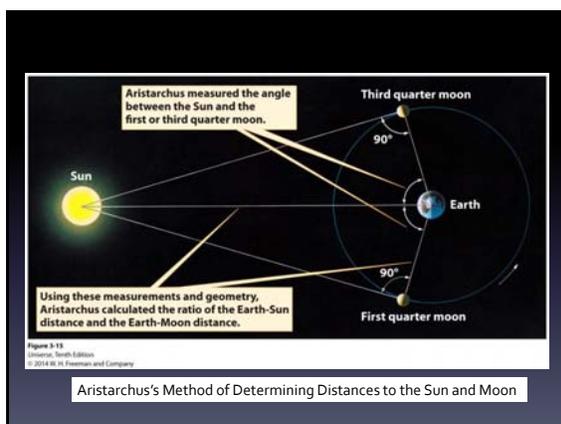
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**TABLE 3-3 Comparison of Ancient and Modern Astronomical Measurements**

	Ancient (km)	Modern (km)
Earth's diameter	13,000	12,756
Moon's diameter	4,300	3,476
Sun's diameter	$9 \times 10^4$	$1.39 \times 10^6$
Earth-Moon distance	$4 \times 10^5$	$3.84 \times 10^5$
Earth-Sun distance	$10^7$	$1.50 \times 10^8$

Table 3-3  
University, Sixth Edition  
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## Key Ideas

- **Lunar Phases:** The phases of the Moon occur because light from the Moon is actually reflected sunlight. As the relative positions of the Earth, the Moon, and the Sun change, we see more or less of the illuminated half of the Moon.
- **Length of the Month:** Two types of months are used in describing the motion of the Moon.
- With respect to the stars, the Moon completes one orbit around the Earth in a sidereal month, averaging 27.32 days.
- The Moon completes one cycle of phases (one orbit around the Earth with respect to the Sun) in a synodic month, averaging 29.53 days.
- The Moon's Orbit: The plane of the Moon's orbit is tilted by about  $5^\circ$  from the plane of the Earth's orbit, or ecliptic.

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## Key Ideas

- The line of nodes is the line where the planes of the Moon's orbit and the Earth's orbit intersect. The gravitational pull of the Sun gradually shifts the orientation of the line of nodes with respect to the stars.
- **Conditions for Eclipses:** During a lunar eclipse, the Moon passes through the Earth's shadow. During a solar eclipse, the Earth passes through the Moon's shadow.
- Lunar eclipses occur at full moon, while solar eclipses occur at new moon.
- Either type of eclipse can occur only when the Sun and Moon are both on or very near the line of nodes. If this condition is not met, the Earth's shadow cannot fall on the Moon and the Moon's shadow cannot fall on the Earth.

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## Key Ideas

- **Umbra and Penumbra:** The shadow of an object has two parts: the umbra, within which the light source is completely blocked, and the penumbra, where the light source is only partially blocked.
- **Lunar Eclipses:** Depending on the relative positions of the Sun, Moon, and Earth, lunar eclipses may be total (the Moon passes completely into the Earth's umbra), partial (only part of the Moon passes into the Earth's umbra), or penumbral (the Moon passes only into the Earth's penumbra).

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## Key Ideas

- **Solar Eclipses:** Solar eclipses may be total, partial, or annular.
- During a total solar eclipse, the Moon's umbra traces out an eclipse path over the Earth's surface as the Earth rotates. Observers outside the eclipse path but within the penumbra see only a partial solar eclipse.
- During an annular eclipse, the umbra falls short of the Earth, and the outer edge of the Sun's disk is visible around the Moon at mid eclipse.
- **The Moon and Ancient Astronomers:** Ancient astronomers such as Aristarchus and Eratosthenes made great progress in determining the sizes and relative distances of the Earth, the Moon, and the Sun.

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