

# Phases of the Moon

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Space Science for Teachers

# Earth Moon System

- The average distance from the Moon to the Earth is 384,404 km.
  - Closest approach is 356,334 km.
  - Farthest is 406,610 km.
  - 30 times the diameter of the Earth.
- Diameter of the Moon is 3475.9 km = 0.27 diameter of the Earth (12756 km)
- Mass is 1/81.3 of Earth.
- Volume 1/49 of the Earth.

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PHASES OF THE MOON

# The Moon

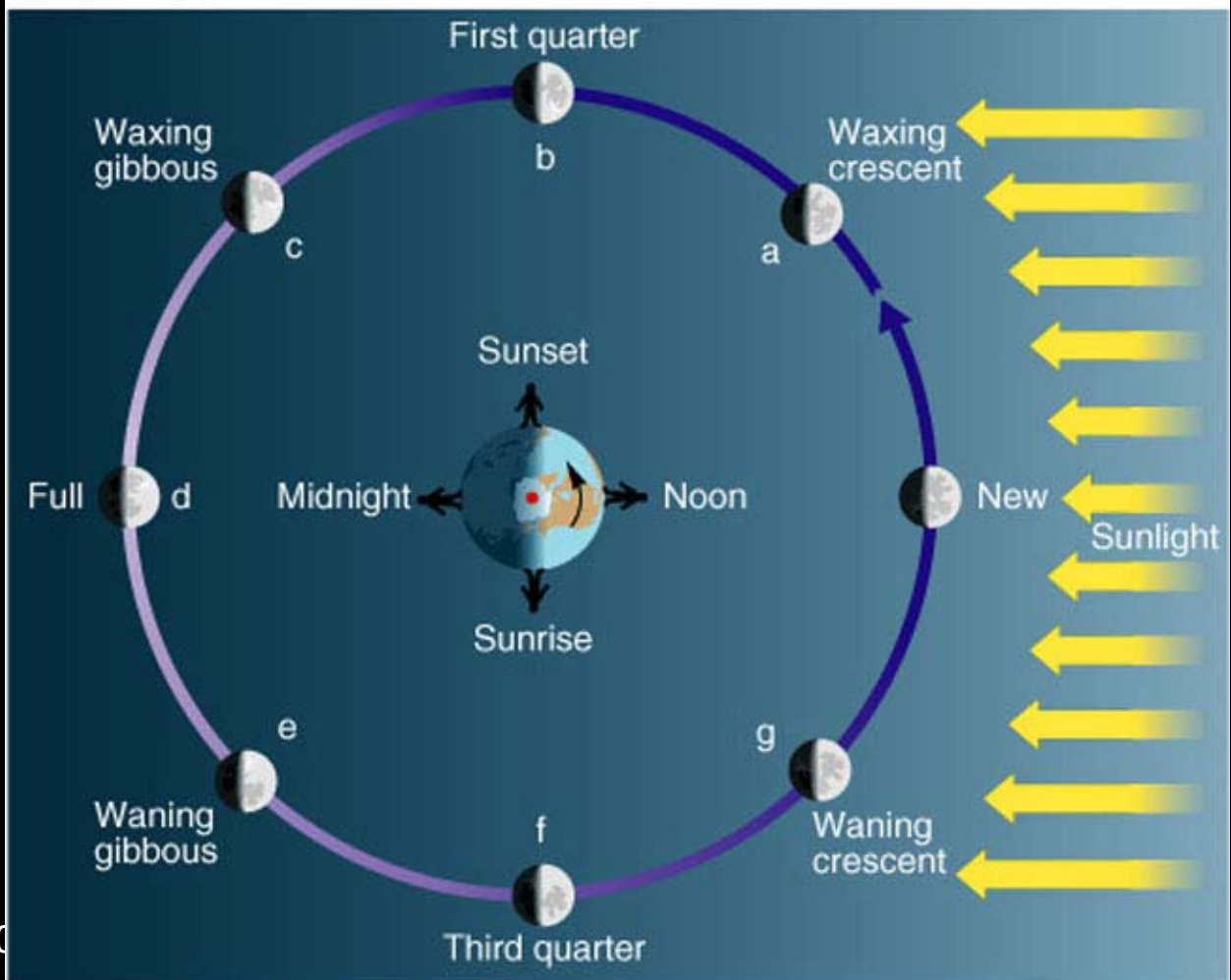
- **The Moon shines by reflected sunlight.**
  - On average, it reflects about 7% of the incident sunlight.
  - The Moon appears about 400,000 times fainter than the Sun in the sky.
- The phases of the Moon are the result of varying viewing angles throughout the month.
  - A common misconception is that the phases of the Moon are caused by the shadow of the Earth.

As seen from Earth



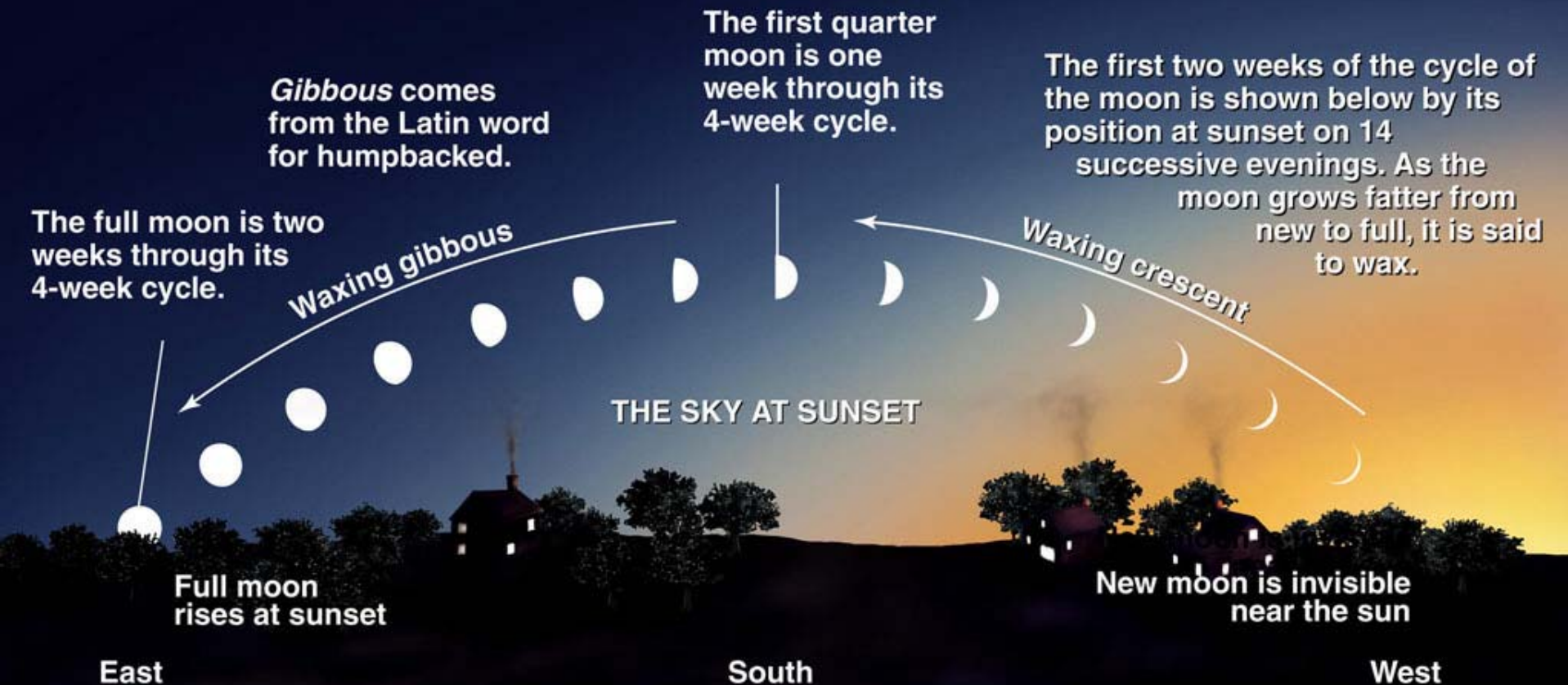
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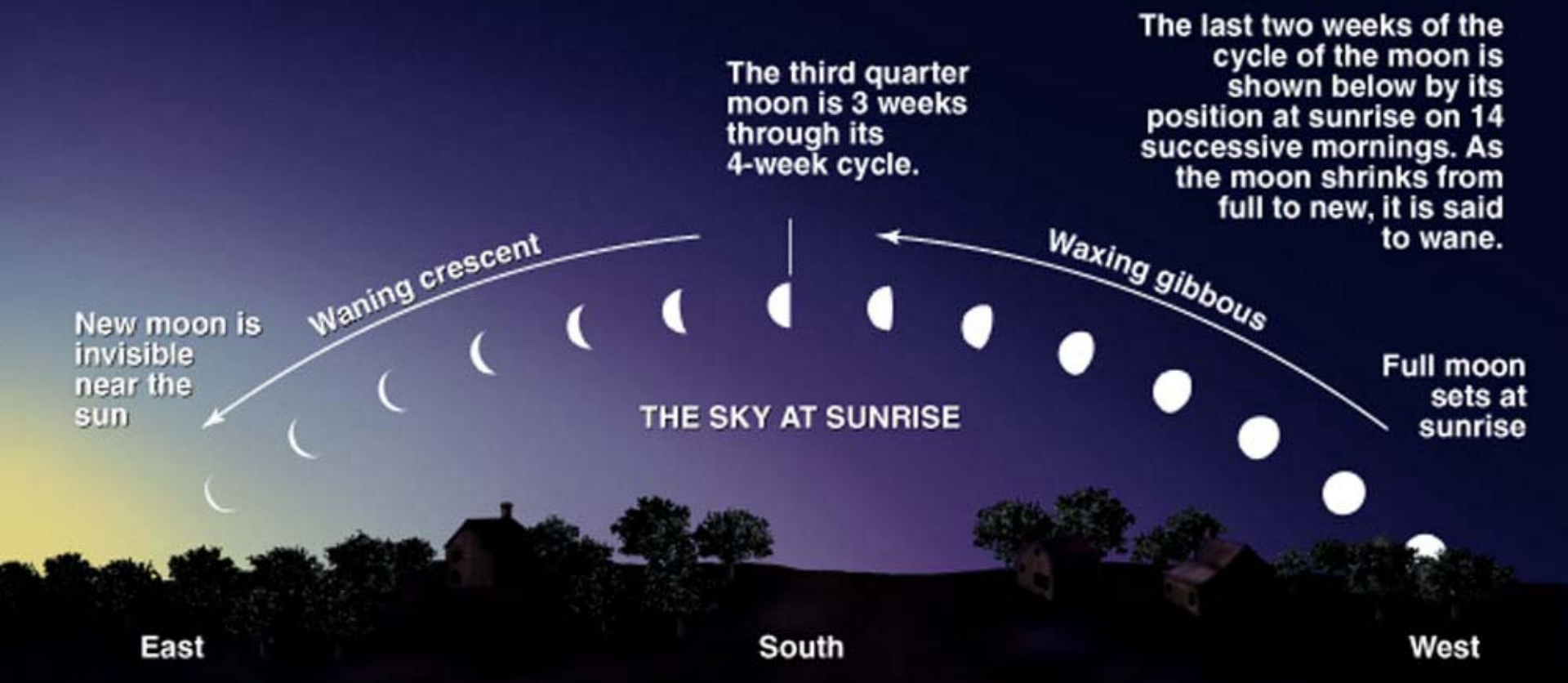
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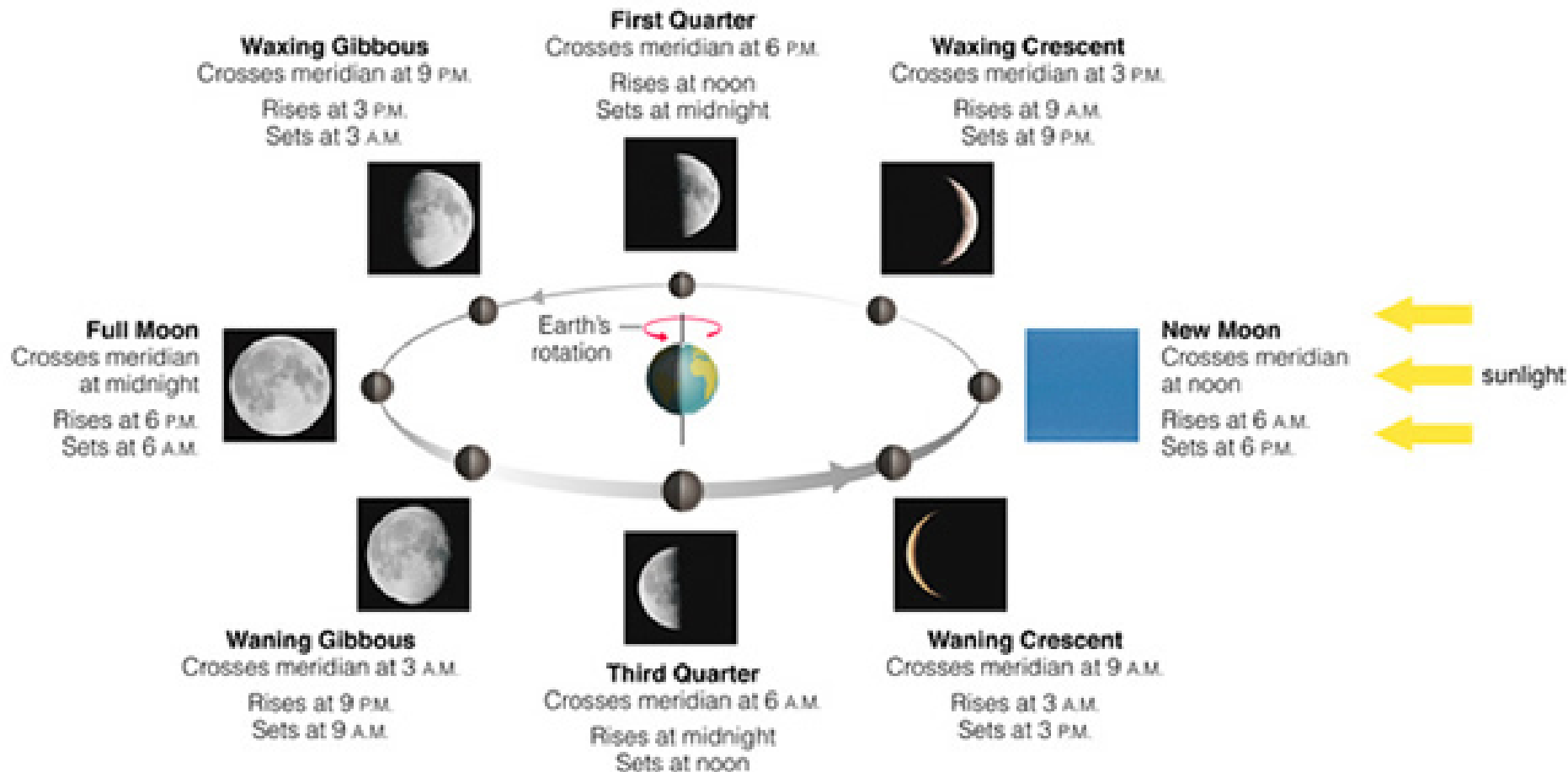


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# Phases of the Moon

<b>Phase</b>	<b>Moonrise</b>	<b>Transit</b>	<b>Moonset</b>
New	Sunrise	Noon	Sunset
Waxing Crescent	9 a.m.	3 p.m.	9 p.m.
First Quarter	Noon	6 p.m.	Midnight
Waxing gibbous	3 p.m.	9 p.m.	3 a.m.
Full Moon	6 p.m.	Midnight	6 a.m.
Waning Gibbous	9 p.m.	3 a.m.	9 a.m.
Third Quarter	Midnight	6 a.m.	Noon
Waning Crescent	3 a.m.	9 a.m.	3 p.m.

# Orbit of the Moon

- The time it takes the Moon to go through its phases is called the synodic period and is 29.5 days.
- The time it takes the Moon to orbit the Earth with respect to the stars is the sidereal period and is 27.3 days.
- The orbit of the Moon is inclined by 5 degrees with respect to the ecliptic.

# Lunar Lunacy

- Another common misconception is that the Moon affects the weather, the number of births, the number of arrests, and the number of emergency room admissions.

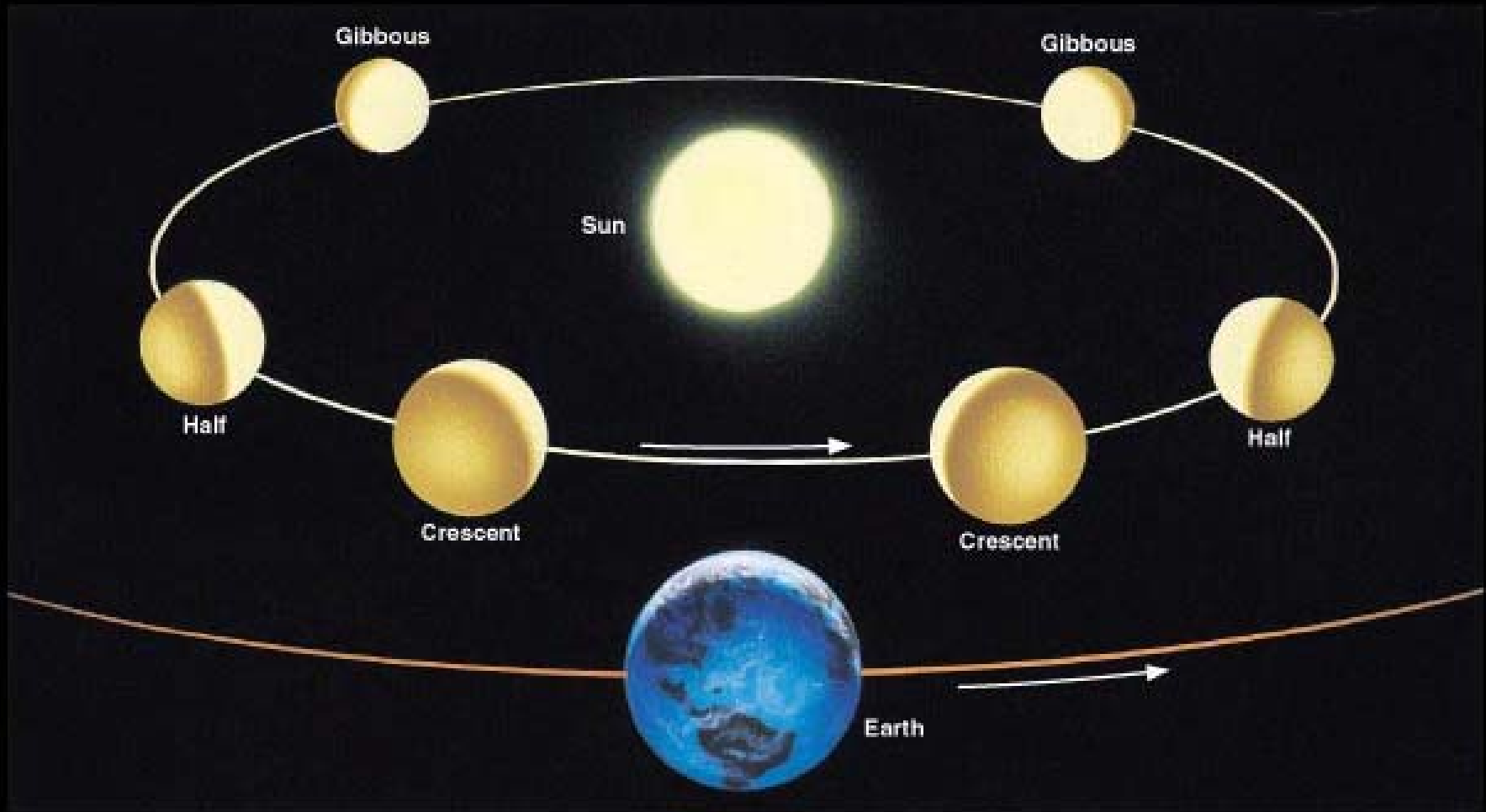
# Lunar Lunacy

- The astronomer George Abell studied the birth rate as a function of the phase of the Moon.
  - He looked at 11,691 live births at the UCLA hospital between March 17, 1974 and April 30, 1978 and found no correlation.
  - He then narrowed it down to the 8,142 natural (not caesarean) births and found no correlation.

# Lunar Lunacy

- The human female menstrual cycle averages 28 days, not 29.5.
  - If it is influenced by the lunar phases, then all mammals should have the same cycle length.
    - Guinea pigs 11 days, rats and mice 5 days
    - Sheep 16 days, chimpanzees 37 days
    - Cows and horses 21 days
    - Opossum 28 days

# Phases of Venus



# Rotation of the Moon

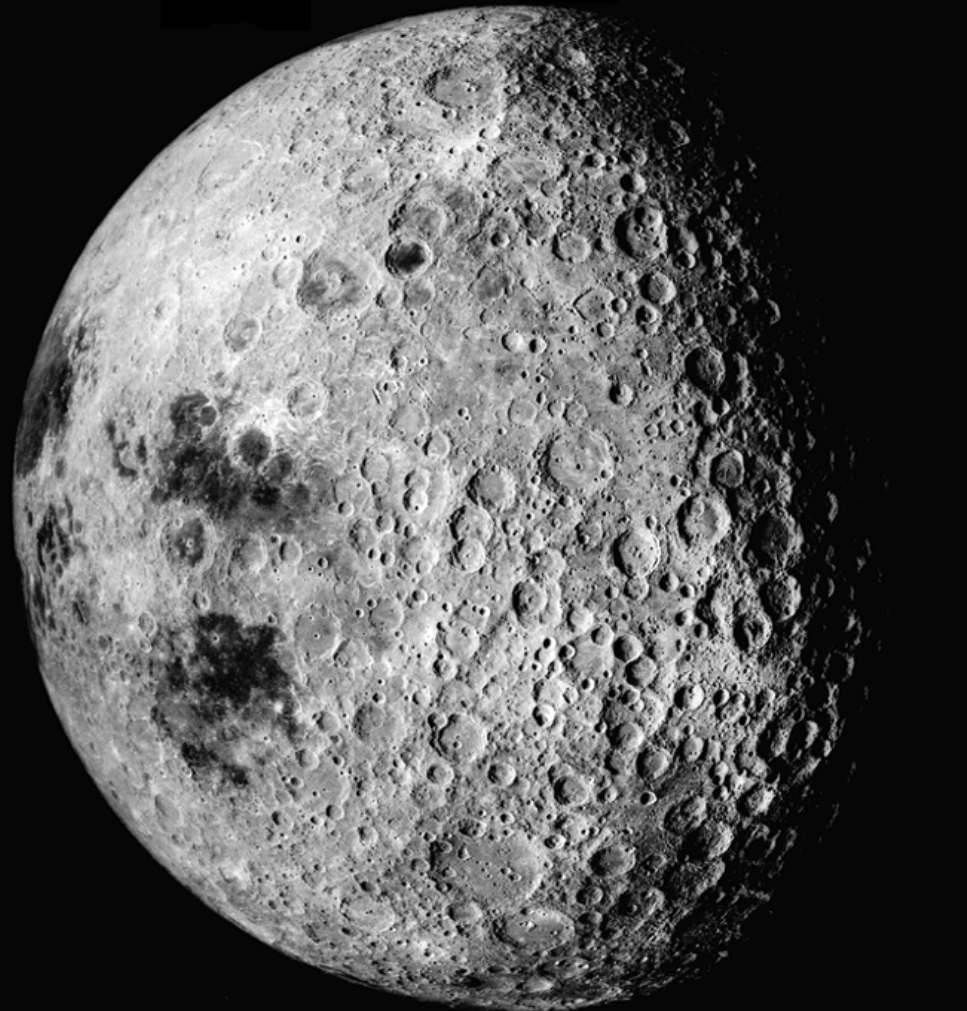
- The Moon always presents the same face towards Earth.
  - Another common misconception is that this means that the Moon does not rotate.
  - However, in order to keep the same face toward Earth, the Moon must rotate once every orbit.
  - The far side of the Moon is not dark, it gets just as much sunlight as the near side.

# Near Side of the Moon



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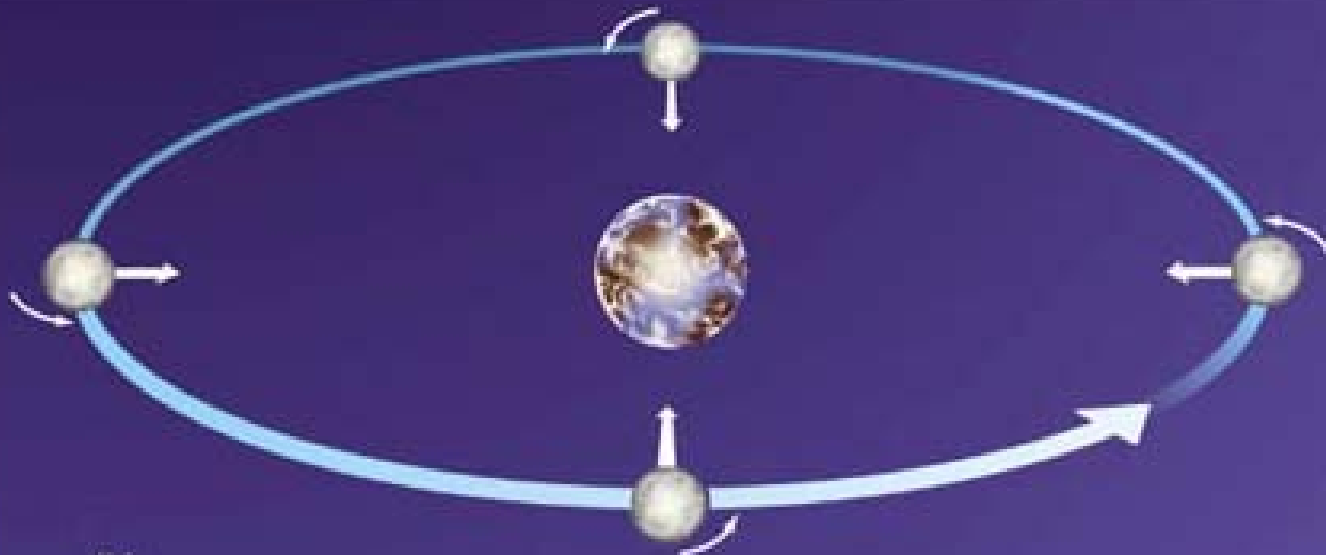
# Far Side of the Moon



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(a)



(b)

# Mark Twain

- “Everyone is a Moon, and has a dark side which he never shows to anybody.”  
– Mark Twain

# Misconception: Dark Side of the Moon

- The “Dark Side” of the Moon should really be called the “Far Side.”
  - The far side gets just as much light as the near side. For example, during a new moon, the near side of the Moon is dark, and the far side of the Moon is fully illuminated!
  - [http://www.badastronomy.com/bad/misc/dark\\_side.html](http://www.badastronomy.com/bad/misc/dark_side.html)

# Lunar Libration

- You might expect that if the Moon always keeps the same face pointed toward Earth, that we can only see 50% of the Moon.
  - However, the Moon appears to rock back and forth. This back and forth rocking is called **libration**.
    - In its elliptical orbit around Earth, the Moon moves faster when close to the Earth and slower when farther. Since its rotation is fairly constant, we get to see a little bit around each limb.
    - In addition, the orbit of the Moon is tilted with respect to the ecliptic, so we get to see somewhat beyond the poles as the Moon moves above and below the ecliptic.
- 59% of the Moon is visible to us on Earth.



# Misconception: The Size of the Rising Moon

- Many people believe the rising moon is larger than when the Moon is high overhead.
  - The Moon is actually slightly larger when it is high overhead!
  - The effect is an illusion, however, the illusion is not well understood! See these links for more details:
    - <http://www.badastronomy.com/bad/misc/moonbig.html>
    - <http://www.lhup.edu/~dsimanek/3d/moonillu.htm>

# Moonrise



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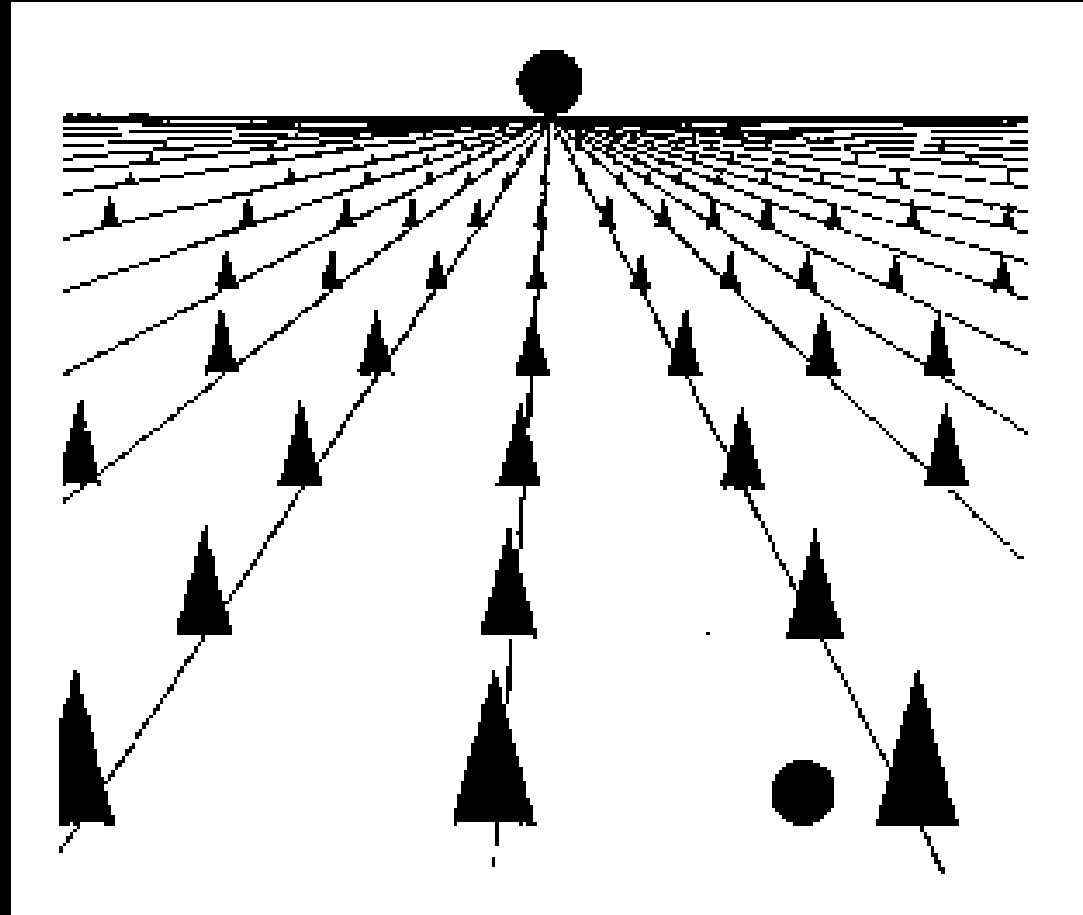
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# Moon Illusion

Which circle  
is larger?

They are  
both the  
same size!





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