

The phases of the Moon

Astronomy 101
Syracuse University, Fall 2016
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September 15, 2016

O Fortune, like the Moon you are
changeable, ever waxing and waning...



O Fortuna, velut Luna, statu variabilis,
semper crescis et decrescis...

O Fortune, like the Moon you are changeable,
ever waxing and waning; hateful life first
oppresses and then soothes as fancy takes it;
poverty and power, it melts them like ice.

O Fortuna, velut Luna, statu variabilis, semper
crescis aut decrescis; vita detestabilis nunc
obdurate et tunc curat ludo mentis aciem;
egestatem, potestatem, dissolvit ut glaciem.

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Fate, monstrous and empty, you whirling wheel,
you are malevolent: wellbeing is vain and always
fades to nothing. Shadowed and veiled you
plague me too; now through the game I bare my
back to your villainy.

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Sors immanis et inanis, rota tu volubilis, status
malus: vana salus, semper dissolubilis.
Obumbrata et velata michi quoque niteris; nunc
per ludum dorsum nudum fero tui sceleris.

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So at this hour without delay pluck the vibrating
strings: since Fate strikes down the strong,
everyone weep with me!

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Hac in hora sine mora corde pulsum tangite;
quod per sortem sternit fortem, mecum omnes
plangite!

From *Carmina Burana*, a 13th-century manuscript found in an abbey south of Munich. This manuscript contained poetry written in Latin and German by clergy in their off-duty hours, when they were decidedly not being holy!

Set to music by Carl Orff (1937).

Other movements talk about springtime, sexuality, satire of the corrupt, drunkenness, and more sexuality; the work both opens and closes with this movement.

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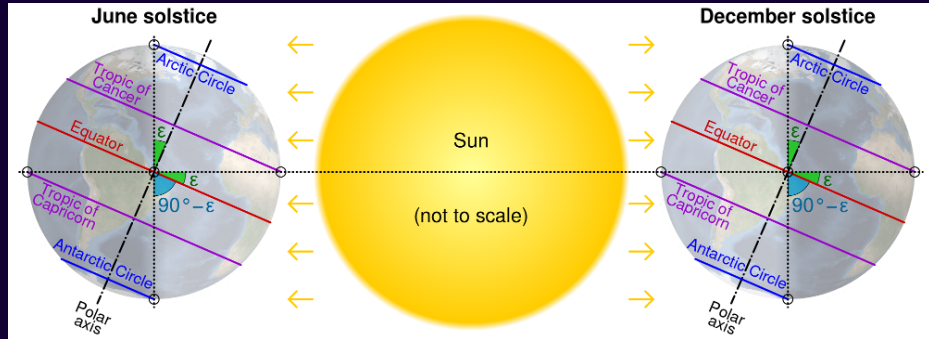
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Performance by Symphoria (the Syracuse symphony orchestra) on November 5...

... your professor and lead TA will be in the choir, along with many Syracuse University students!

- Next *Mastering Astronomy* homework set will be posted tonight
 - It will help you review for your exam next Thursday
 - It will be due next Wednesday.
- I've cancelled my trip to catch up on work and help students; help session will be held tomorrow
- My coaches will be holding clinic hours next week to help you all study
- I will be holding extended office hours (in my office) next Wednesday to help you study

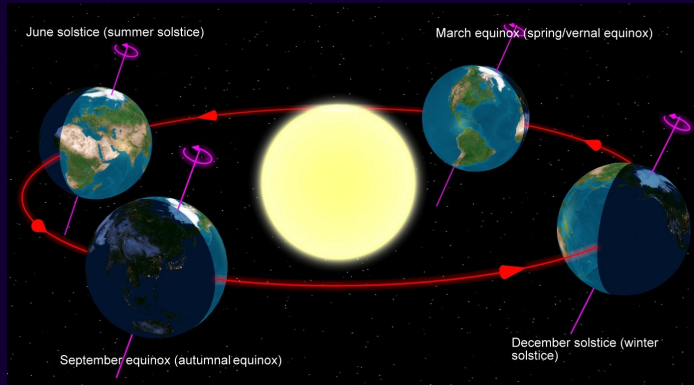
Complete Lecture Tutorials pp. 93-98.



What if the Earth's axial tilt were increased to 30° from 23° ?

- A: Syracuse would have hotter summers
- B: Syracuse would have colder winters
- C: More of Earth would be in the tropics
- D: More of Earth would be in the arctic
- E: All of the above

The seasons



Axial tilt is why the Earth is hotter in summer.
It has **nothing** to do with the distance from the Sun!

We now understand the motion of the stars, and the combined effects of the Earth's axial tilt, rotation, and orbit have on the seasons.

Our goal in this first segment of the course was to understand the night sky. What's left?

- The Moon (today)
- The planets (Tuesday)
- Oddities: comets, meteors, novas, eclipses... (Tuesday)

The phases of the Moon

As in *O Fortuna*, the Moon has often been a symbol of change.

That change is regular, though: every 29.5 days, the pattern of phases repeats.

This is orderly enough that it is the basis of many calendars:

- Hebrew calendar
- Traditional Chinese calendar
- Babylonian calendar

... but not the traditional calendars of Europe. (Why might that be?)

The phases of the Moon

Everything else in the sky seems to be a constant size and shape, but the Moon waxes and wanes. Why?

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The Moon differs from the stars in that it doesn't make its own light.

It orbits the Earth 400,000 km (1/500 AU!) away, once every 29 days or so, orbiting counterclockwise when looking down at the North Pole.

What consequences does this have?

Which is true?

A: The phases of the Moon happen because the Moon's motion around the Earth causes it to receive different amounts of light from the Sun, varying from completely lit (full moon) to not lit at all (new moon)

B: The phases of the Moon happen because half of the Moon is always lit by the Sun, but our perspective changes how much of that half we see

C: The phases of the Moon happen because the Earth blocks part of the light from the Sun, resulting in a shadow on the Moon's face

D: The phases of the Moon happen because the Earth moves around the Moon each day, and we see a different part of the Moon

Let's look at this two different ways:

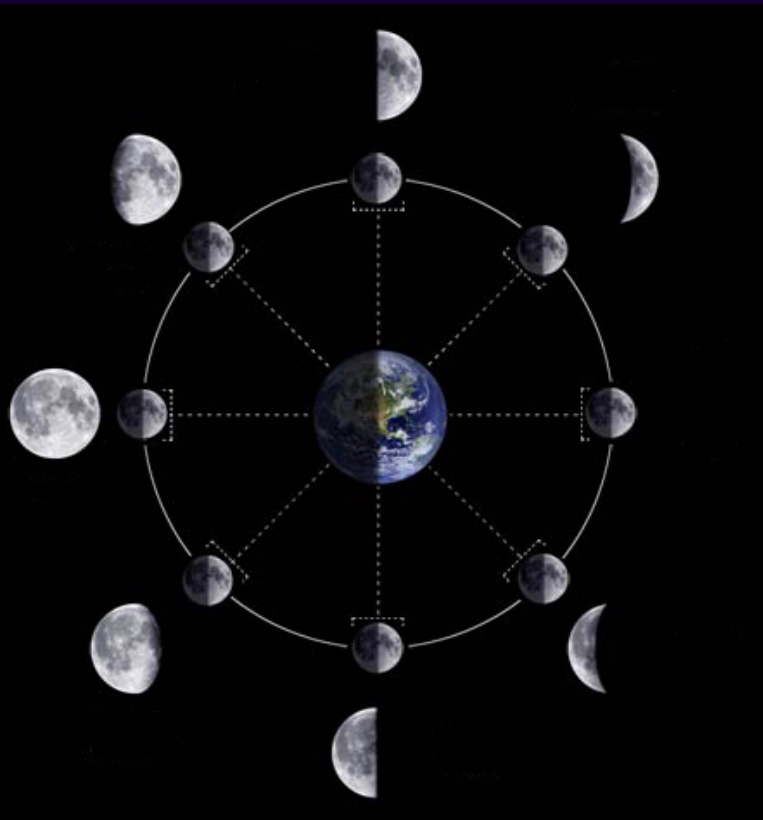
- With *Celestia*
- With things in this room

Some new words for the moon phases...

- New moon: nothing visible
 - Crescent: less than half visible
 - Half moon: half of the moon's surface is visible
 - Gibbous: more than half visible
 - Full moon: all visible
-
- Waxing: Tomorrow the Moon will be lit more than today
 - Waning: Tomorrow the Moon will be lit less than today

Notice:

- Half of the Moon is always sunlit
- Sometimes that half is pointed toward us: full moon!
- Sometimes that half is pointed away from us: new moon!



You can figure all of this out by drawing pictures.

Do this on warmup problems, tutorials, exams...

My desk is covered with little cartoons I drew preparing for today's class!

Complete *Lecture Tutorials* pp. 81-84.

When the full moon is high in the sky, it is closest to:

A: 6AM

B: Noon

C: 6PM

D: Midnight

What phase of the moon is mostly seen during the day?

A: Crescent

B: Full

C: Half

D: Gibbous

Complete *Lecture Tutorials* pp. 85-88.

When the waxing half moon is just rising over the horizon, it is closest to:

A: 6AM

B: Noon

C: 6PM

D: Midnight

As seen in the Northern Hemisphere, which part of a waning crescent moon will be lit?

A: The right part

B: The left part