Reverse-Engineering Your Course

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CATS Collaboration of Astronomy Teaching Scholars
An NSF Funded Center for Astronomy Education (CAE) Program

How do you know what you know?

- Metacognition
  - thinking about thinking

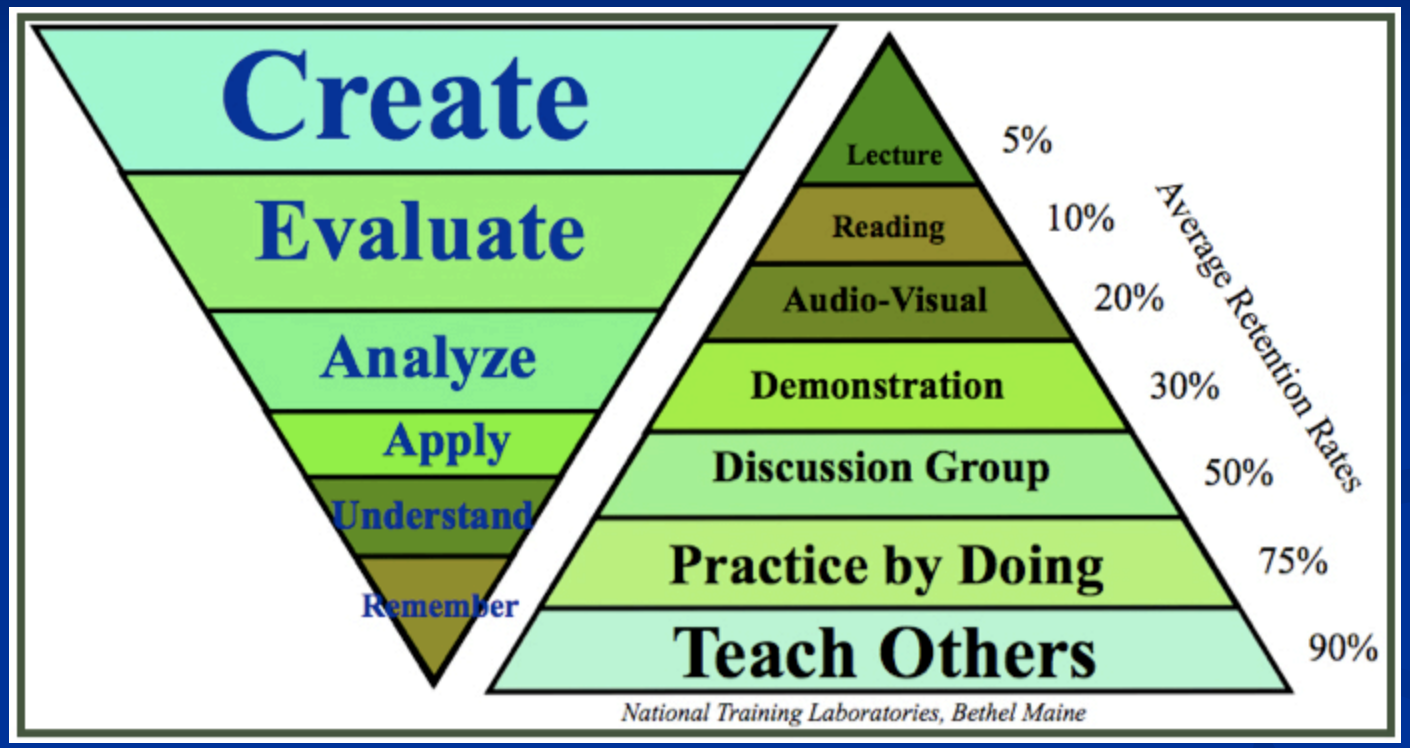
Critical Components

- Know your audience.
- Explain yourself
  - social engineering & setting tone
  - student buy-in
- Practice what you preach
- Deciding what to cover and how
- The student voice is very powerful

Critical Questions

- What are your beliefs about teaching and learning and how do they guide your instruction?
- How do you want your students to be different as a result of the experiences you design?
- What do you know about the research on how people learn?
- What strategies and resources are available that are proven to actively engage students and improve their understanding?
- What evidence would you accept that you students have made significant gains in conceptual understanding, as well as attitudinal and skill domains?

Some Perspective



Pedagogical vs. Social Engineering

- Clearly articulate the goals for your course...then let the students in on it!
- How/when will you set the tone for your class?
- Will you practice what you preach?
- You must get student buy-in, otherwise your efforts are in vain.

How do you create learning sequences that motivate students to learn what we want them to know?

Creating the learner-centered environment.

Critical Questions

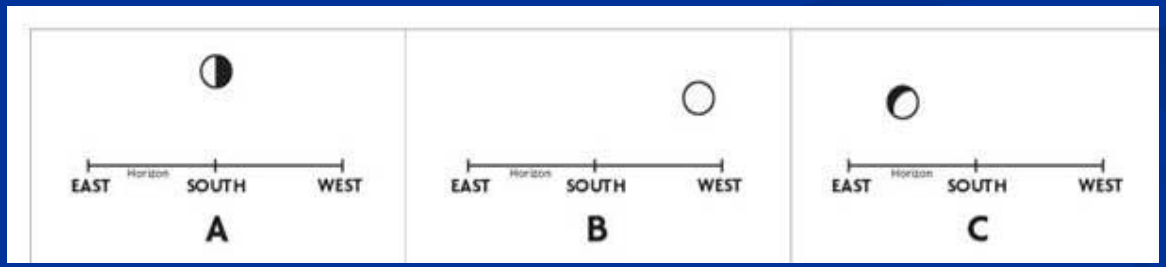
- How do you decide what to teach, out of all that could be covered?
- How do you choose which learning strategies to integrate into your class to make it meaningful for the students?

Consider the following:

- What is(are) the highest level question(s) you want your students to be able to answer? Choose one or more questions that would demonstrate that they really understand.
- What activities and experiences do your students need to engage in, in order to develop their understanding?
- What feedback do you and your students need to guide your instruction and determine when you both know you are ready for the next steps?
- What limited lecturing do you need to do to lay the groundwork for students to have successful learning experiences with their activities?

Topic: Moon Phases

- What is(are) the highest level question(s) you want your students to be able to answer? Choose one or more questions that would demonstrate that they really understand.
  - Which of the situations shown below occurs at a time closest to sunset?



Consider the following:

- What activities and experiences do your students need to engage in, in order to develop their understanding?
  - "Interactive" lecturing
  - Lecture Tutorials
  - Ranking Tasks
  - Think-Pair-Share Questions
  - Writing prompts
  - Group work
  - Case studies
  - Computer simulations & laboratory exercises
  - Others???

Feedback

- What feedback do you need to guide your instruction?
- What feedback do you and your students need so you both know you are ready for the next steps?

Sample Learning Sequence

http://astro.unl.edu/ - Lunar Cycles - Road Runner High Speed Online

ClassAction

Select a Question: 2 - Limb of the Moon

A drawing similar to the one below appeared in an advertisement in a magazine. What is wrong with this drawing?

Animations | Images | Outlines

Lunar Cycles

What causes lunar phases?

Explain your reasoning.

Lunar Phases

- new
- waxing crescent
- first quarter
- waxing gibbous
- full
- waning gibbous
- third quarter
- waning crescent

Lunar Phases Animation:

http://antwrp.gsfc.nasa.gov/apod/image/9911/lunation_ajc.gif

View of Moon

Hide Moon

Perspective

- From Earth
- From Sun
- From Space

Animation Speed

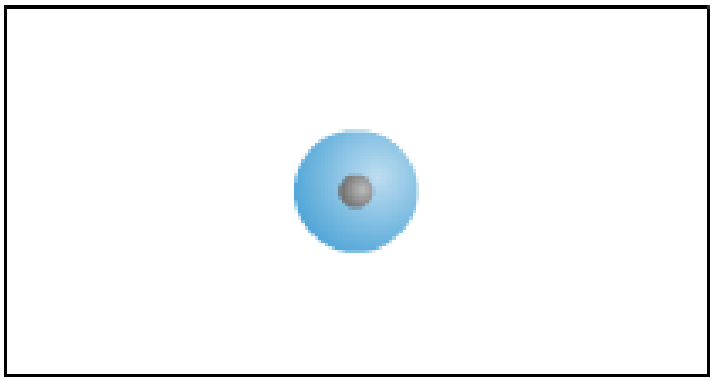
Slow — Fast

Run Animation

Restart

ClassAction

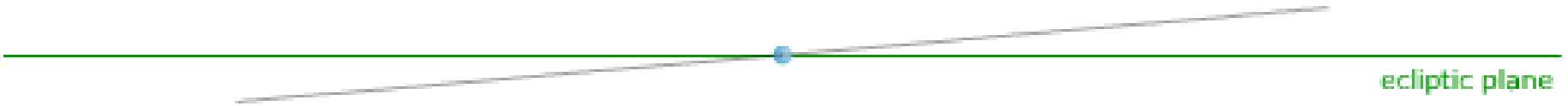
enlargement



speed (days/sec) 2.5

0 30

- [x] show orbital path
- [ ] exaggerate body sizes
- [x] show ecliptic plane
- [x] animate



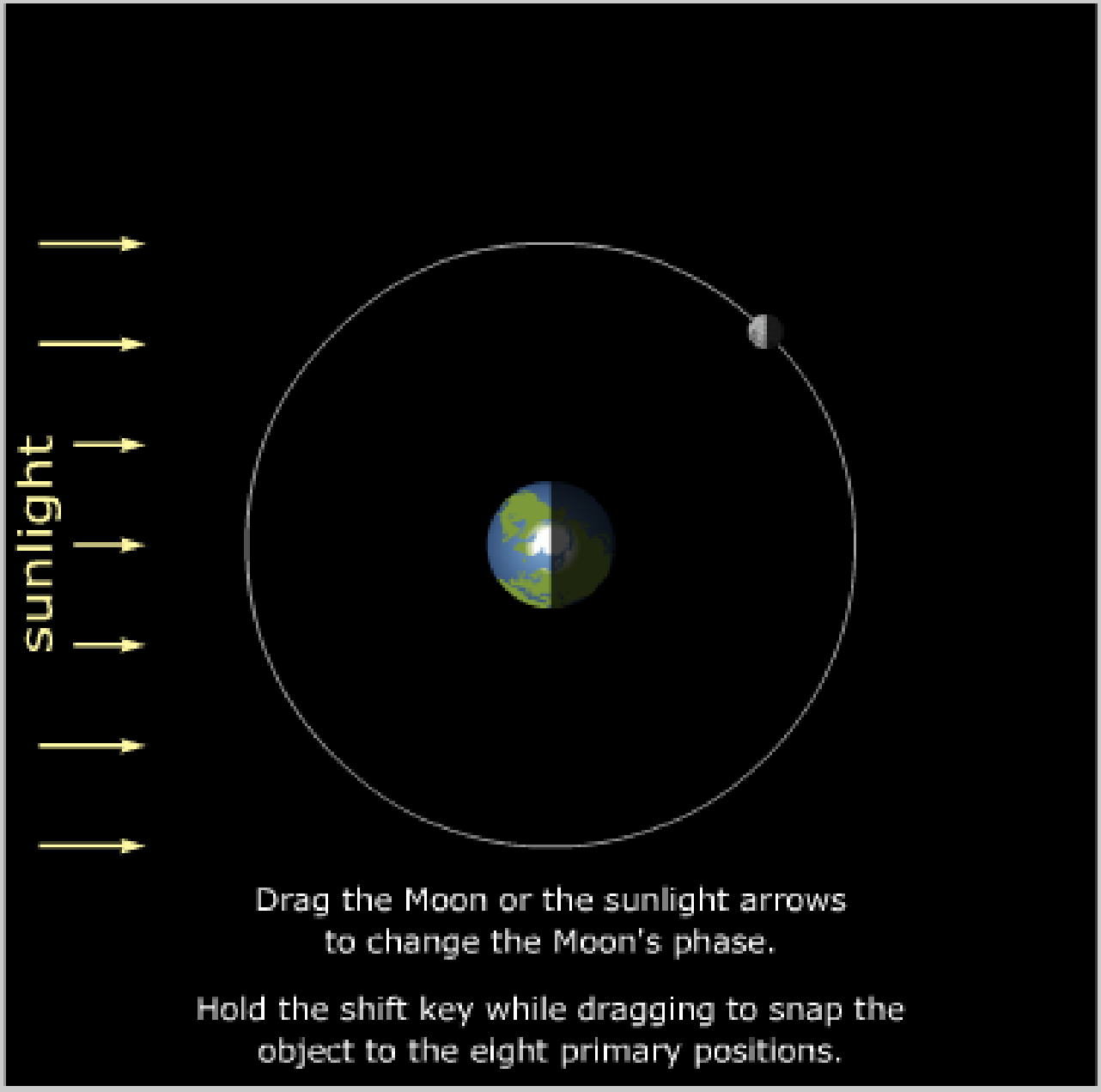
now

May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug

eclipse season

eclipse season

eclipse season



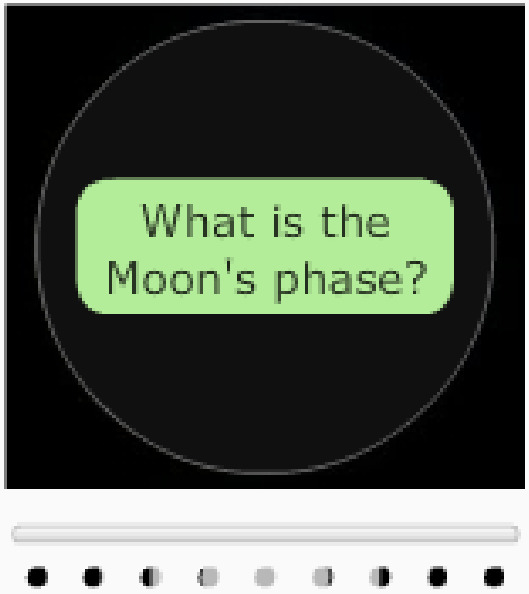
Question Chooser

Choose a question to test your understanding of how the Earth-Moon-Sun geometry determines the phases of the Moon.

- ○ Where is the Sun?
- ○ Where is the Moon?
- ◉ What is the Moon's phase?

show answer

Moon's Appearance



How long does it take to complete a cycle of lunar phases?

A. about a day
B. about a week
C. about a month
D. about a year
E. none of the above

If tonight the phase is full when the moon rises, what will be the phase when the moon sets?

A. none
B. all
C. exactly half
D. it depends upon the phase

At any given time, how much of the Moon's surface is illuminated?

A. none
B. all
C. exactly half
D. it depends upon the phase

http://astro.unl.edu/ - Lunar Cycles - Road Runner High Speed Online

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Select a Question: 1 - Identify Phase from Picture

Change Phase

In the picture to the right,
the phase of the moon is ...

(A) last quarter
(B) waxing crescent
(C) waxing gibbous
(D) waning crescent
(E) full

Show Answer

Animations | Images | Outlines

Lunar Cycles

Lecture Tutorial

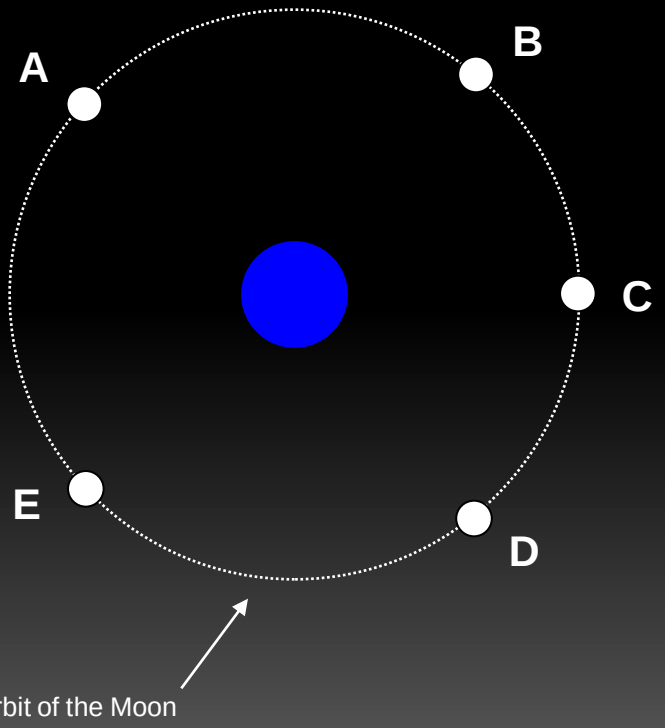
- The Cause of Moon Phases (pp. 79–81)

- **Work in pairs or threes.**
- **Read the instructions and questions carefully.**
- **Talk to each other and discuss your answers.**
- **Come to a consensus answer everyone agrees on and write it down.**
- **Answer the questions IN ORDER.**
- **If you get stuck or are not sure, ask another group.**
- **If you get really stuck or don't understand what the Lecture Tutorial is asking, ask for help.**

During the new phase, how much of the Moon's surface is illuminated?

A. none
B. all
C. exactly half
D. it depends upon the phase

Which position (A–E) for the Moon, shown in the diagram below, best corresponds with this lunar phase?



Not to scale!

http://astro.unl.edu/ - Lunar Cycles - Road Runner High Speed Online

ClassAction

Select a Question: 1 - Identify Phase from Picture

Change Phase

In the picture to the right,
the phase of the moon is ...

(A) full
(B) waxing gibbous
(C) waxing crescent
(D) last quarter
(E) waning gibbous

Show Answer

Animations | Images | Outlines

Lunar Cycles

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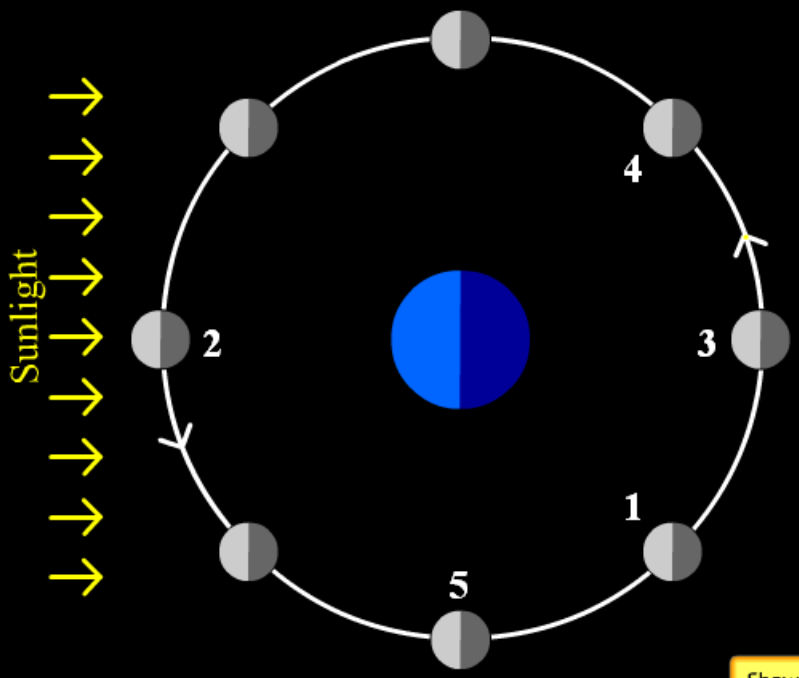
ClassAction

Select a Question: 3 - Identify Lunar Position from Phase

Change Phase | Change Sun

The diagram below illustrates the geometry of lunar phases with the moon shown in eight positions in its orbit. Which numbered position corresponds with a waxing gibbous moon?

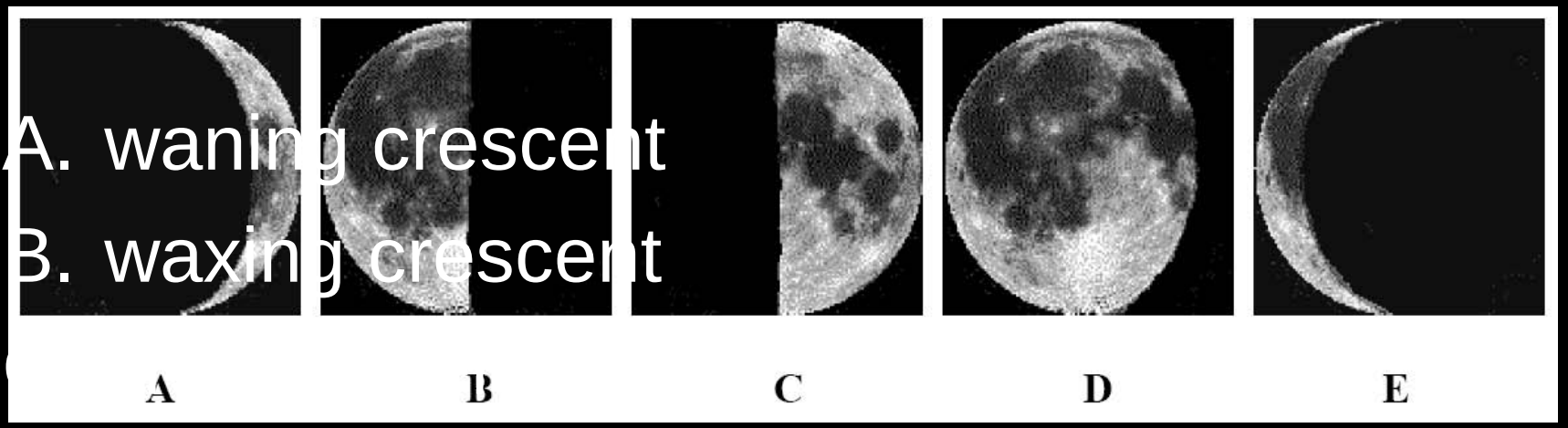


Show Answer

Animations | Images | Outlines

Lunar Cycles

You observe a third quarter moon rising. How will it appear in 6 hours?



A. waning crescent
B. waxing crescent
D. waning gibbous
E. third quarter

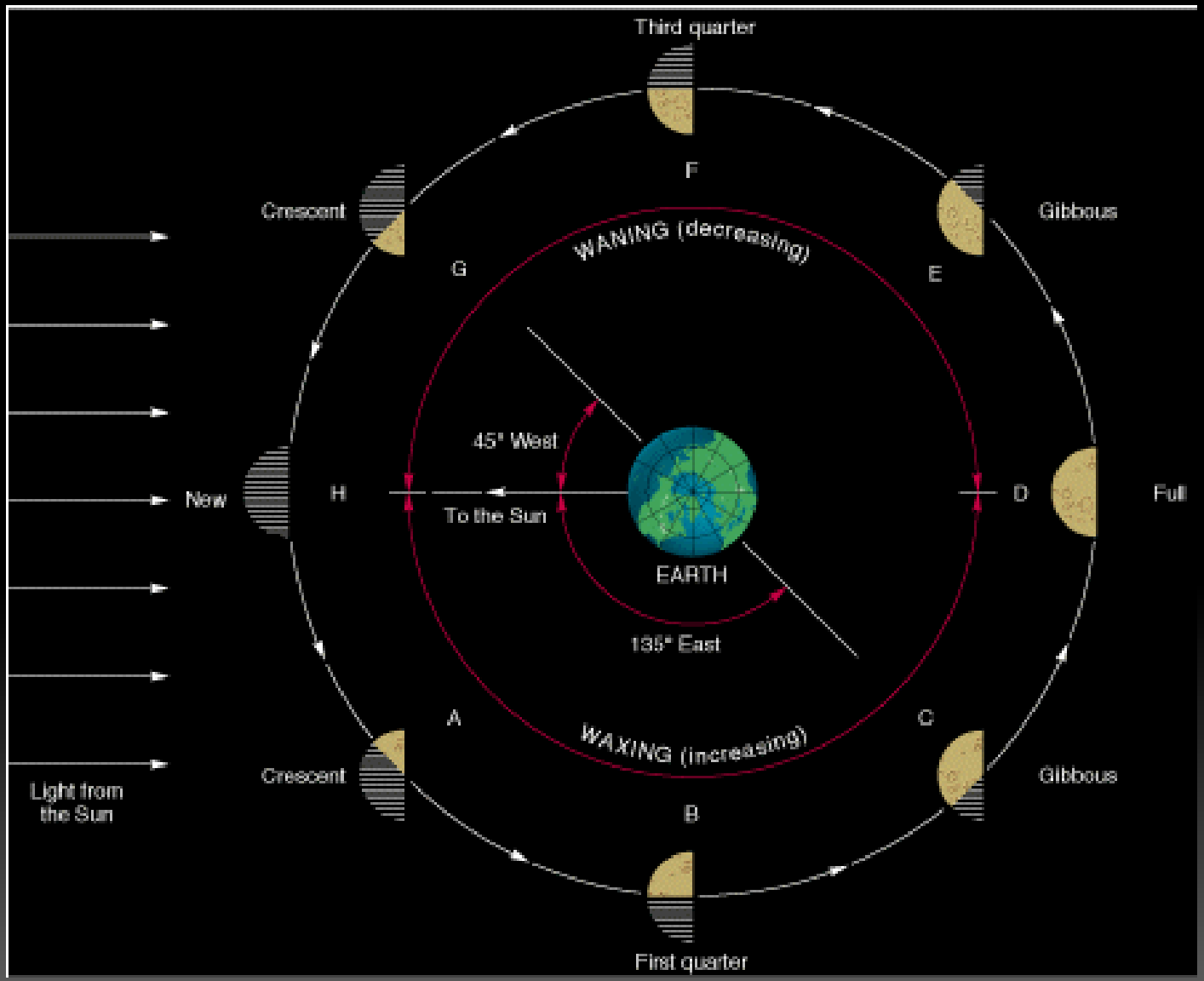
At what time will a new moon rise?

A. noon
B. 6 PM
C. 9 PM
D. midnight
E. none of the above

Construct Diagram

- Moon Phases

Moon Phase Diagrams



When would you expect to see a first quarter moon highest in the sky?

A. midnight
B. noon
C. 6 AM
D. 6 PM

When would you expect to see a waning gibbous moon highest in the sky?

A. 3 AM
B. 9 PM
C. 9 AM
D. 3 AM

Lecture Tutorial

- Predicting Moon Phases (pp. 83–85)

- **Work in pairs.**
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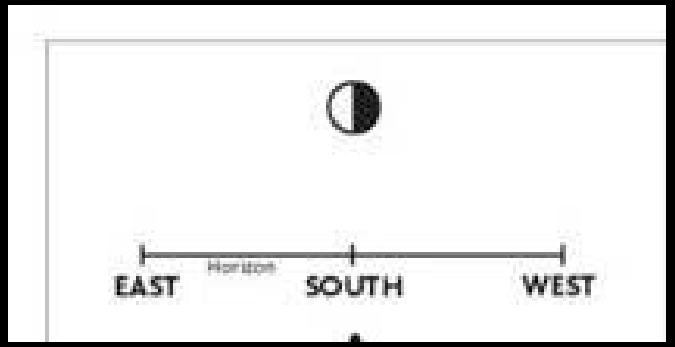


If the Moon were in the phase shown above, what phase would it be in two weeks later?

A. waxing crescent

B. waxing gibbous

C. first quarter

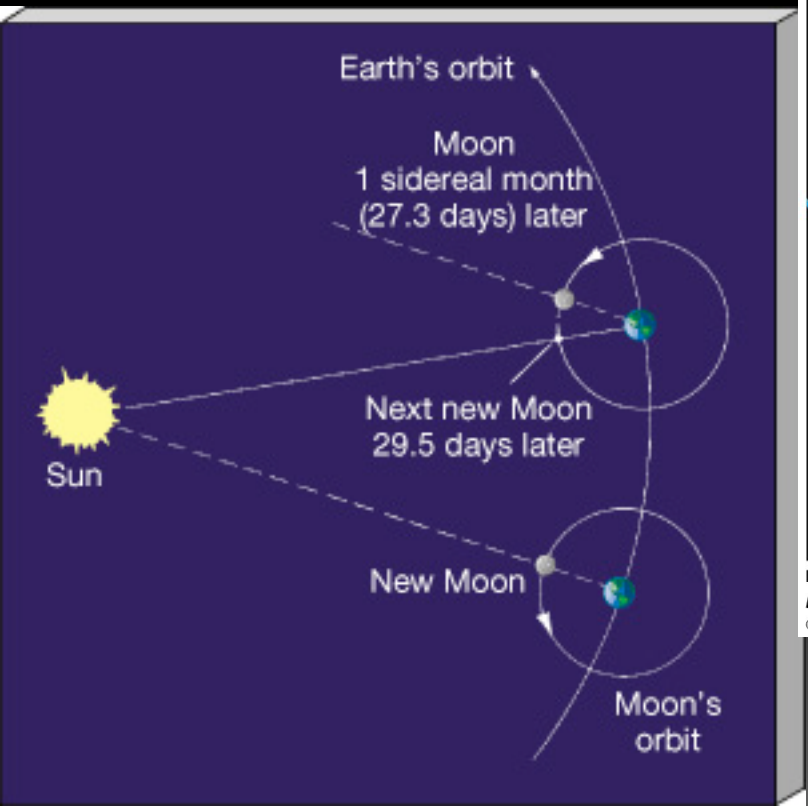
D. third quarter

E. none of the above

Ranking Tasks

- Phases of the Moon
  - 1, 2, & 3
  - download from Blackboard
  - turn in for homework

Synodic vs. Sidereal Month



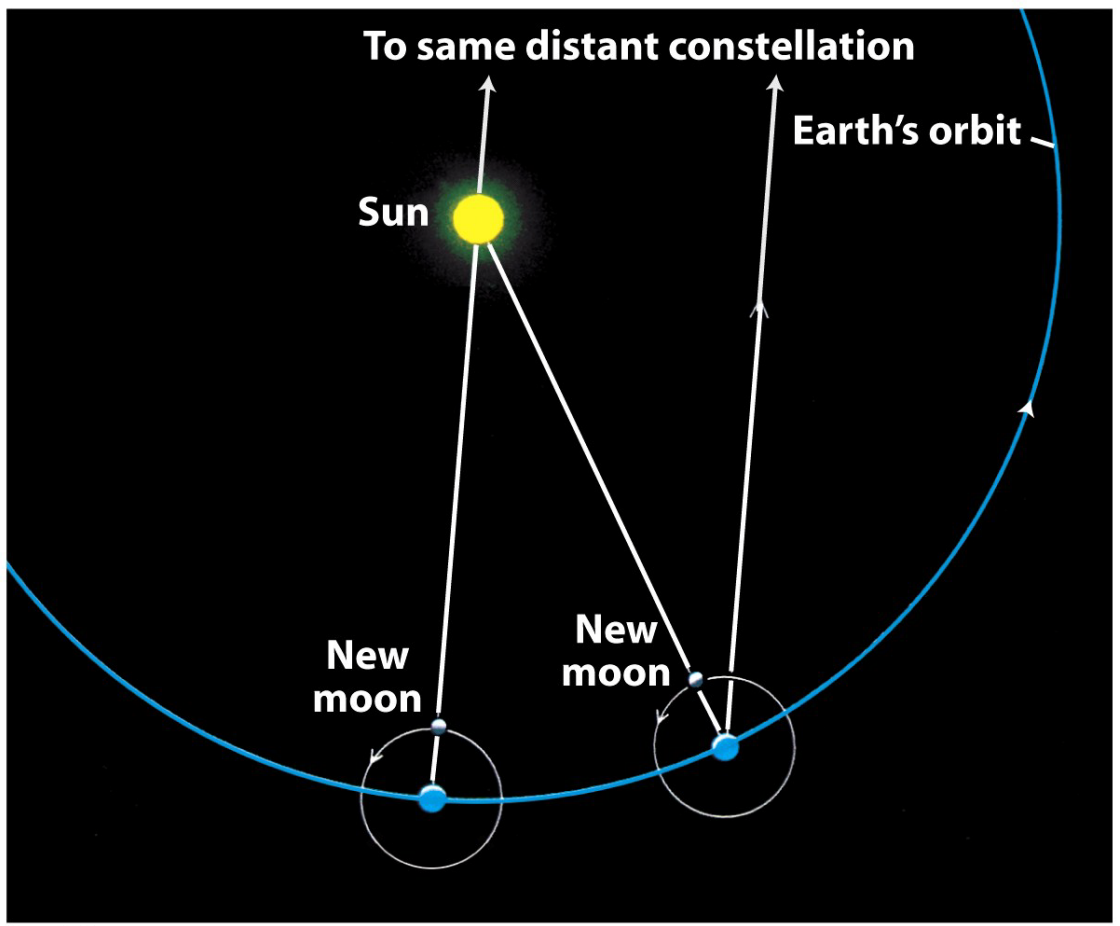


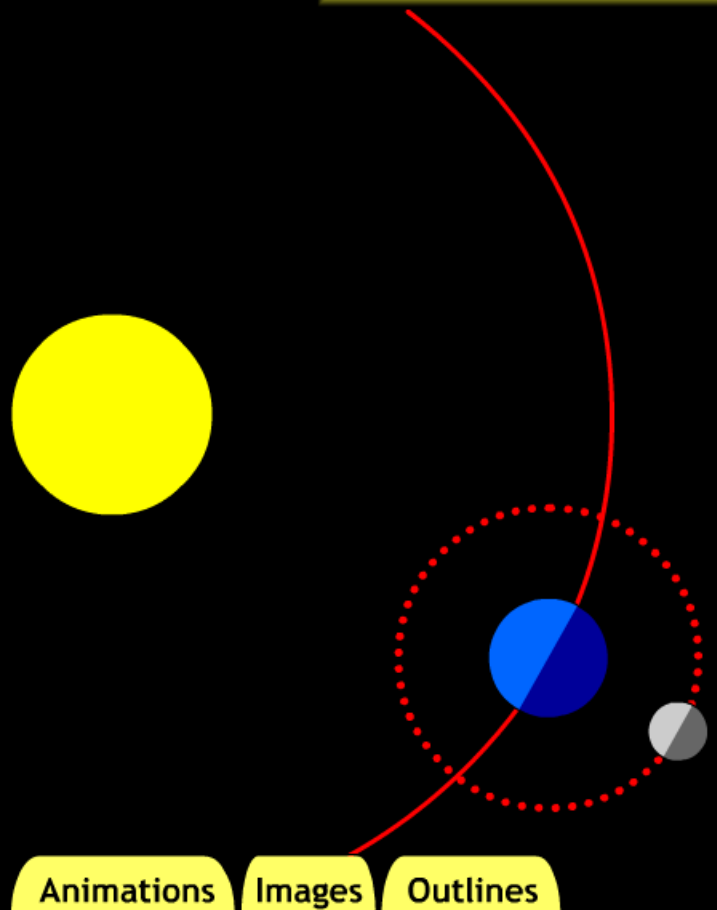
Figure 1-23
Discovering the Universe, Eighth Edition

http://astro.unl.edu/ - Lunar Cycles - Road Runner High Speed Online

ClassAction

Select a Question: 9 - Lunar Periods

Adapt Question: Animate Period 1



The time interval illustrated in the animation to the left is the moon's

A) Siderial Period
B) Synodic Period
C) Neither

Run Animation

Show Answer

Animations | Images | Outlines

Lunar Cycles

Consider the following:

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