

# ASTR 111

## Introductory Astronomy: The Solar System Clicker question solutions



*CLICKER: Which faculty do you belong to?*

- (a) *Sci & Tech*
- (b) *Arts & Humanities*
- (c) *Social Sci*
- (d) *other*

*CLICKER: How did you hear about this course?*

- (a) *VIU calendar*
- (b) *recommended (by advisor, friend, etc.)*
- (c) *course website or poster on campus*
- (d) *other*

*CLICKER: If Earth was the size of a basketball & the Moon a tennis ball, they would be roughly... ?*

- (a) *1 foot apart*
- (b) *5 feet apart*
- (c) *25 feet apart*
- (d) *100 feet apart*

## The Universe

- ...is **expanding** (it was **smaller** in the past!)

*CLICKER: How old is the universe?*

- (a) *thousands of years*
- (b) *millions of years*
- (c) *billions of years*
- (d) *trillions of years*

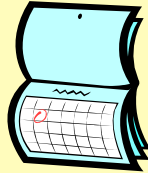


- ...is ~**13.7 billion years old**
- originated in the **Big Bang** (“**primordial fireball**”)
- **Sun & solar system** formed **much** later
- ~ **4.6 billion years ago**

## A Sense of Time...

Represent **Big Bang** to **present** on **12 month calendar**:

- **Big Bang** took place **Jan 1st**
- **Milky Way** formed in **February**
- **Earth** formed around **mid-August**



**CLICKER:** When did abundant, **complex** life appear?

- (a) late August
- (b) early October
- (c) mid December
- (d) late December

**CLICKER:** What is it **specifically** that disqualifies astrology from being considered a "science"?

- (a) deals with phenomena beyond the Earth
- (b) astrology has never been tested
- (c) UBC does not offer a degree in astrology
- (d) does not adhere to the scientific method

**CLICKER:** The separation between the pointer stars in the Big Dipper is  $5^\circ$ . What is this separation in arcminutes?

- (a) 60
- (b) 300
- (c) 3600
- (d) 18,000

**CLICKER:** Which of the following distances are best measured using astronomical units (AU)?

- (a) distances on the Earth
- (b) distances within our solar system
- (c) distances between stars in our galaxy
- (d) distances between galaxies

# History of Modern Astronomy



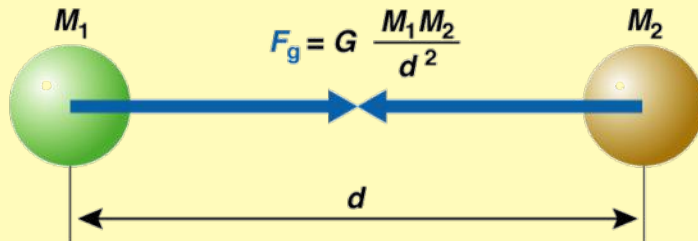
3. The *time* for a planet to orbit the Sun (*period, P*) depends on its *average distance from the Sun (a)*:

$$P^2 = a^3$$

• *period* measured in *years* & *semi-major axis (a)* measured in *astronomical units (AU)*

(eg) Jupiter:  $a = 5$ ,  $P = \sqrt{5^3} = \sqrt{125} \approx 11$  years

**CLICKER:** For Saturn,  $a \approx 10$ , so  $P$  is roughly  
(a) 5 years (b) 10 years (c) 30 years (d) 1000 years



**CLICKER:** What is the effect on the force of gravity if two objects are moved twice as far apart?

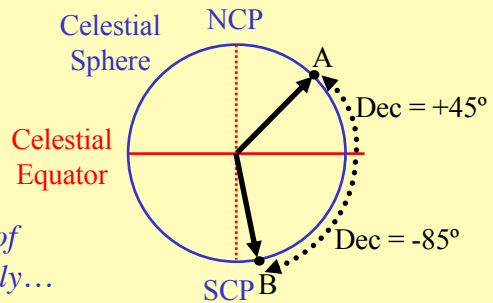
- (a) the force is one quarter as big
- (b) the force is cut in half
- (c) the force is doubled
- (d) no impact (gravity is a constant)

# The Sky



**CLICKER:** the declination of point A is roughly...

- (a)  $0^\circ$
- (b)  $+45^\circ$
- (c)  $-45^\circ$
- (d)  $+75^\circ$

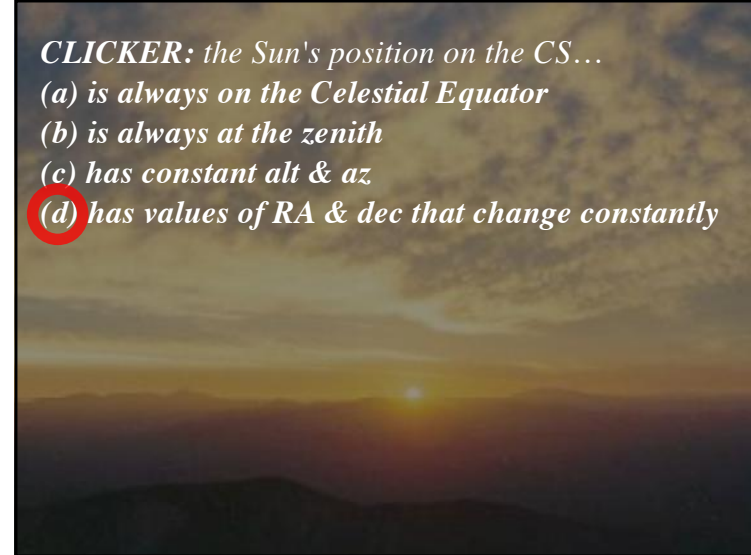


**CLICKER:**  
the declination of point B is roughly...

- (a)  $0^\circ$
- (b)  $+90^\circ$
- (c)  $-45^\circ$
- (d)  $-85^\circ$

**CLICKER:** the Sun's position on the CS...

- (a) is always on the Celestial Equator
- (b) is always at the zenith
- (c) has constant alt & az
- (d) has values of RA & dec that change constantly

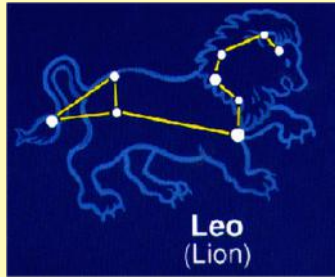


**CLICKER:** Which location below would be **closest** to the location of the time-lapse sky image above?

- (a) Nanaimo
- (b) South Pole
- (c) Equator
- (d) Vernal Equinox

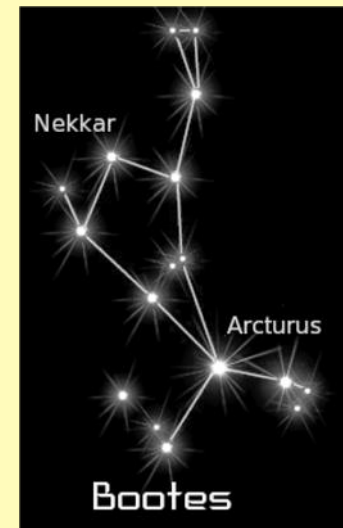
## Navigating the Sky





**CLICKER:** Which of the following statements about constellations is false?

- (a) constellations are patterns of stars in the sky
- (b) there are 88 official constellations
- (c) some are visible from both N & S hemispheres
- (d) some are visible in both winter & summer

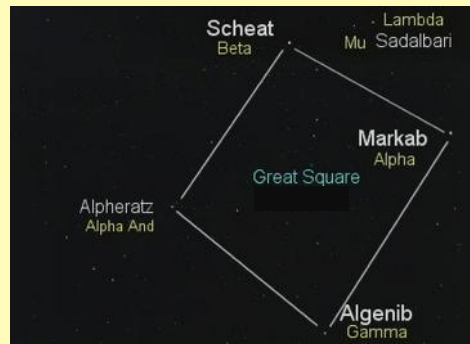


**CLICKER:** What does Boötes look like to you?

- (a) herdsman
- (b) kite
- (c) necktie
- (d) other

**CLICKER:** The Great Square is located in... ?

- (a) Cassiopeia
- (b) Pegasus
- (c) Andromeda
- (d) Ursa Minor



## The Seasons





*CLICKER: Where on Earth would you be for the Sun to be at the zenith on the autumnal equinox?*

- (a) on the Greenwich meridian
- (b) at the equator**
- (c) at the north pole
- (d) at the south pole



*CLICKER: You awake on winter solstice & notice that the Sun did not set. Where might you be?*

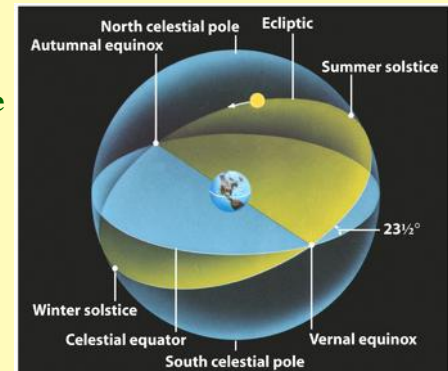
- (a) Antarctica**
- (b) Yukon
- (c) Florida
- (d) Ecuador

## Phases of the Moon



*CLICKER: Where is the Full Moon located on the celestial sphere if it is the first day of spring for the northern hemisphere?*

- (a) autumnal equinox**
- (b) vernal equinox
- (c) winter solstice
- (d) summer solstice
- (e) zenith



**CLICKER:** You look up in the sky at sunset and see the moon at its highest point in the sky. What phase must the Moon be in?

- (a) New Moon
- (b) Full Moon
- (c) Third Quarter
- (d) First Quarter

\*\* the picture is only decorative – don't go by the phase shown! \*\*



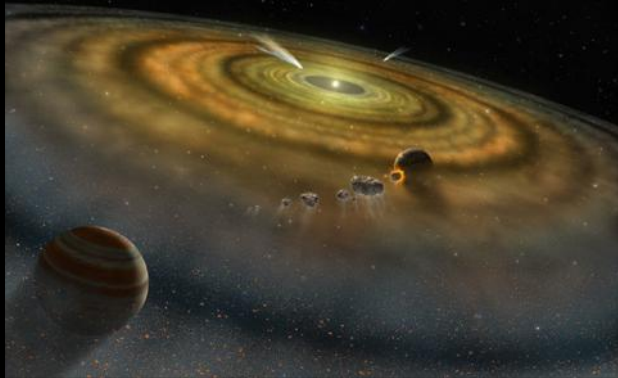
**CLICKER:** A friend tells you they saw the Moon rise right before the Sun did. What phase must the Moon have been in?

- (a) New Moon
- (b) Full Moon
- (c) Third Quarter
- (d) First Quarter
- (e) Waning Crescent
- (f) Waxing Gibbous

\*\* the picture is only decorative – don't go by the phase shown! \*\*

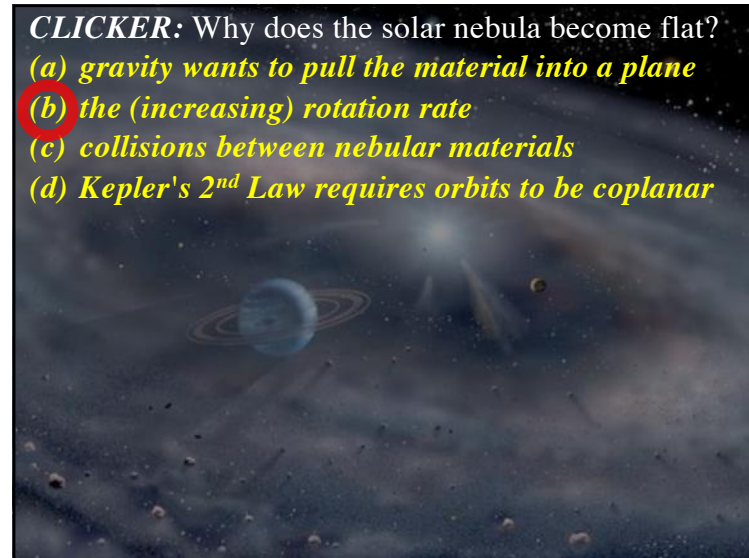


## Formation of the Solar System



**CLICKER:** Why does the solar nebula become flat?

- (a) gravity wants to pull the material into a plane
- (b) the (increasing) rotation rate
- (c) collisions between nebular materials
- (d) Kepler's 2<sup>nd</sup> Law requires orbits to be coplanar



**CLICKER:** Nebular Theory is able to explain...

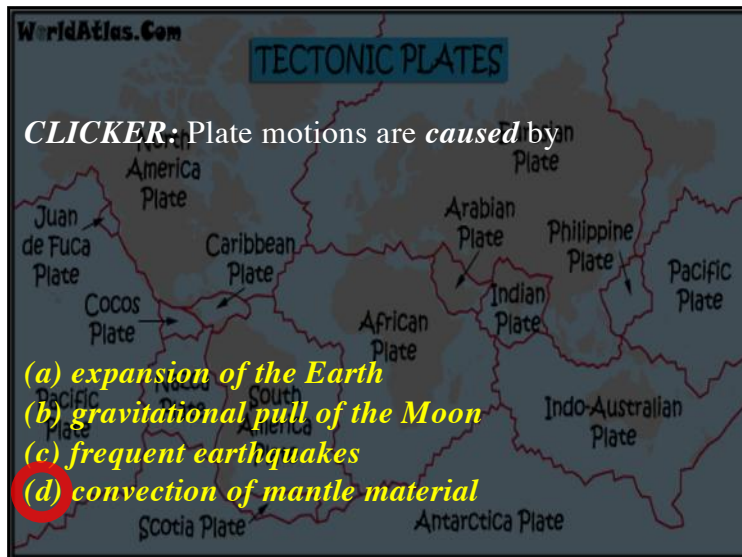
- (a) (nearly) common orbital plane of the planets
- (b) common direction of orbital motion
- (c) variations in size of the planets
- (d) variations in composition of the planets
- (e) all of the above**

**Earth  
(Terra)**



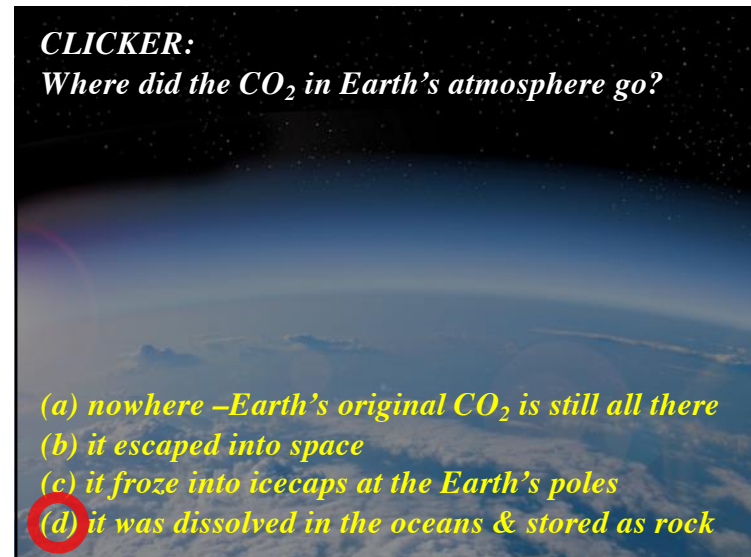
**CLICKER:** Plate motions are *caused* by

- (a) expansion of the Earth
- (b) gravitational pull of the Moon
- (c) frequent earthquakes
- (d) convection of mantle material**



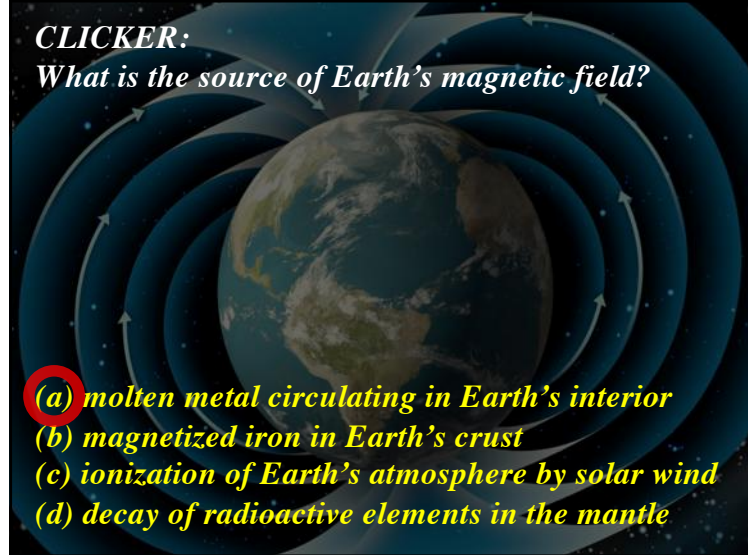
**CLICKER:**  
Where did the  $\text{CO}_2$  in Earth's atmosphere go?

- (a) nowhere –Earth's original  $\text{CO}_2$  is still all there
- (b) it escaped into space
- (c) it froze into icecaps at the Earth's poles
- (d) it was dissolved in the oceans & stored as rock**





**CLICKER:**  
*What is the source of Earth's magnetic field?*

A diagram showing the Earth with blue magnetic field lines looping around it. The lines are denser near the poles and spread out at the equator. Arrows on the lines indicate the direction of the magnetic field.

(a) molten metal circulating in Earth's interior  
(b) magnetized iron in Earth's crust  
(c) ionization of Earth's atmosphere by solar wind  
(d) decay of radioactive elements in the mantle

# The Earth & Moon System

A photograph of the Earth and the Moon in space. The Earth is on the right, showing its blue oceans and white clouds. The Moon is on the left, appearing as a smaller, grey sphere.A photograph of the Moon in space, showing its grey surface and dark maria. The Earth's horizon is visible at the bottom of the frame.

**CLICKER:** The *lowest* high tides occur during a...

(a) Full Moon  
(b) New Moon  
(c) 1<sup>st</sup> Quarter Moon  
(d) Waning Gibbous Moon

- **nearside:** side of Moon *facing* Earth
- **farside:** side of Moon *facing away from* Earth
- **darkside:** *unlit* side of Moon

**CLICKER (T/F):** The *farside* is *always* dark.

# The MOON

*(Luna)*



*CLICKER: Why do the lunar highlands have many more craters than the lunar maria?*

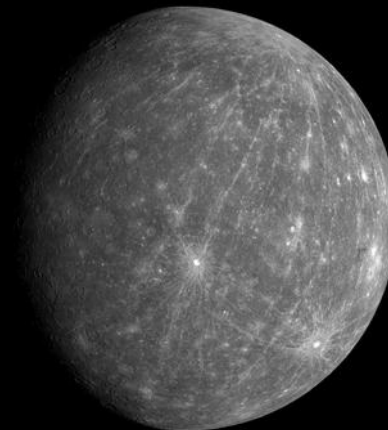
- (a) *lava flooded the maria after their creation, covering many existing craters*
- (b) *highlands are only on the side facing away from Earth & are easier to hit with debris*
- (c) *the lunar highlands are younger*
- (d) *maria are composed of much harder rocks*

*CLICKER: Do you accept that humans went to the Moon nearly 50 years ago? (eg. NASA's Apollo)*

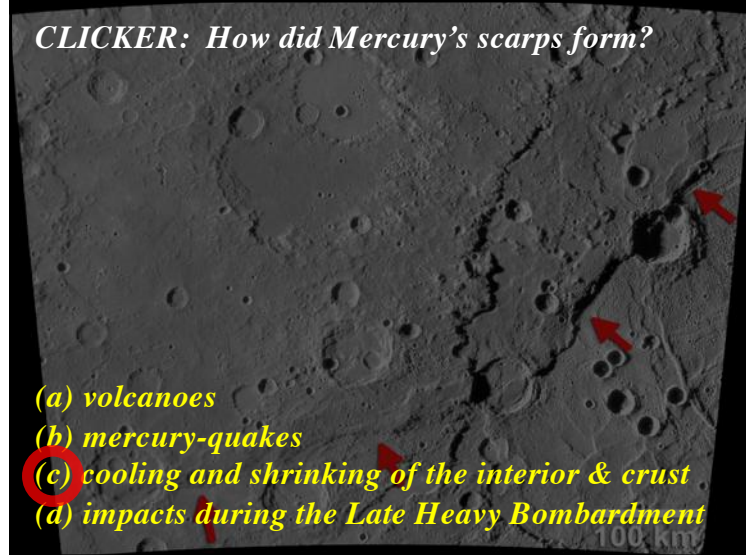
- (a) *yes*
- (b) *no*
- (c) *undecided*



# Mercury



*CLICKER: How did Mercury's scarps form?*

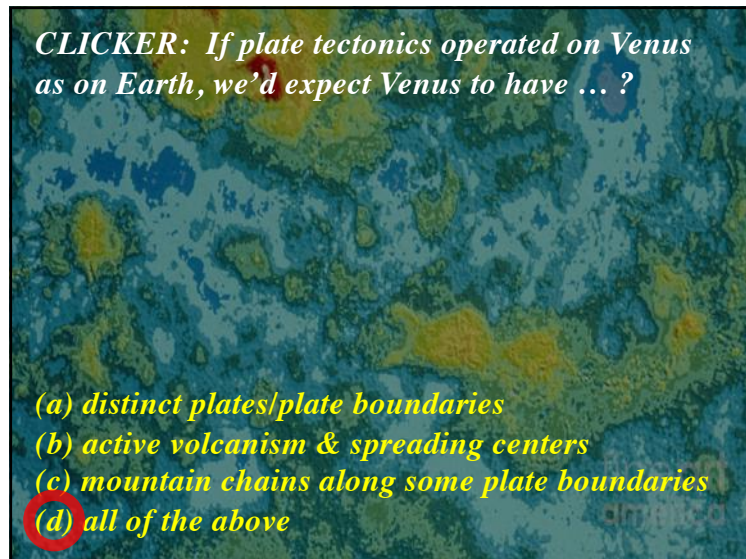


- (a) volcanoes
- (b) mercury-quakes
- (c) cooling and shrinking of the interior & crust
- (d) impacts during the Late Heavy Bombardment

**Venus**  
(in UV light)

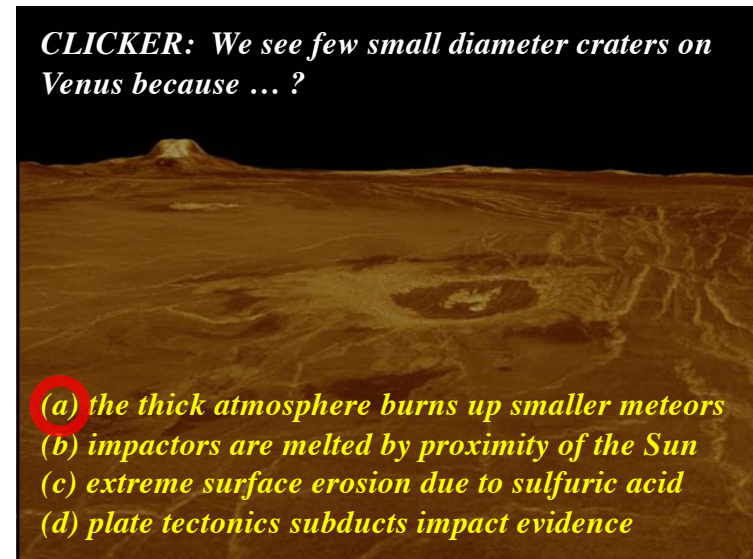


*CLICKER: If plate tectonics operated on Venus as on Earth, we'd expect Venus to have ... ?*



- (a) distinct plates/plate boundaries
- (b) active volcanism & spreading centers
- (c) mountain chains along some plate boundaries
- (d) all of the above

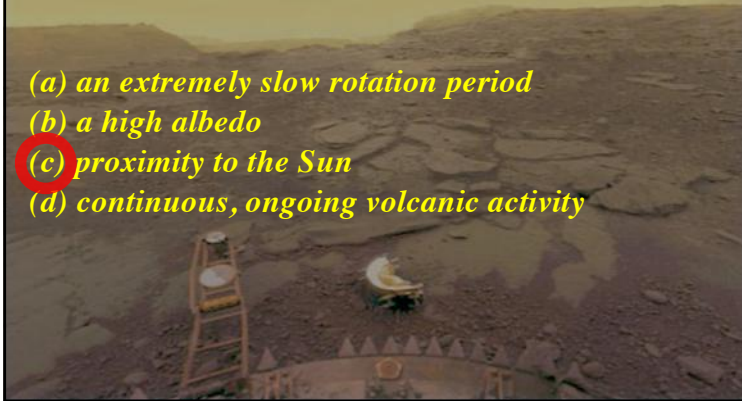
*CLICKER: We see few small diameter craters on Venus because ... ?*



- (a) the thick atmosphere burns up smaller meteors
- (b) impactors are melted by proximity of the Sun
- (c) extreme surface erosion due to sulfuric acid
- (d) plate tectonics subducts impact evidence

*CLICKER: The very high surface temperatures on Venus are due to a “runaway” greenhouse effect. Why did this process begin on Venus?*

- (a) an extremely slow rotation period*
- (b) a high albedo*
- (c) proximity to the Sun*
- (d) continuous, ongoing volcanic activity*

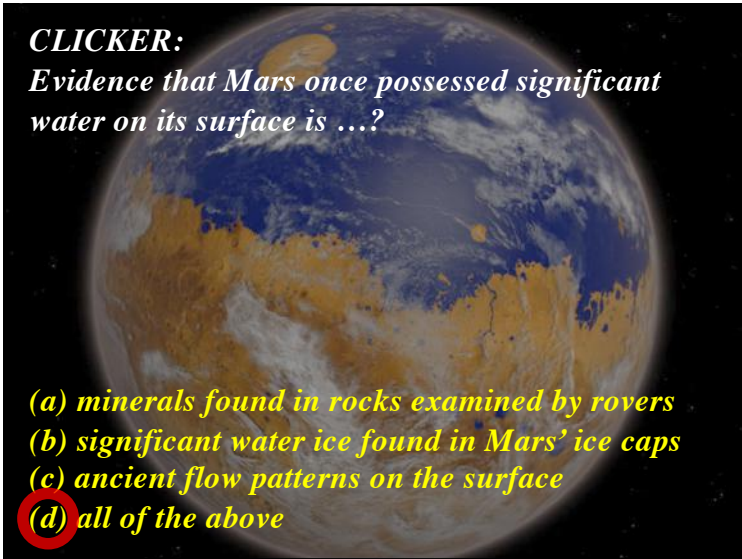


**Mars**  
**(HST)**



*CLICKER: Evidence that Mars once possessed significant water on its surface is ...?*

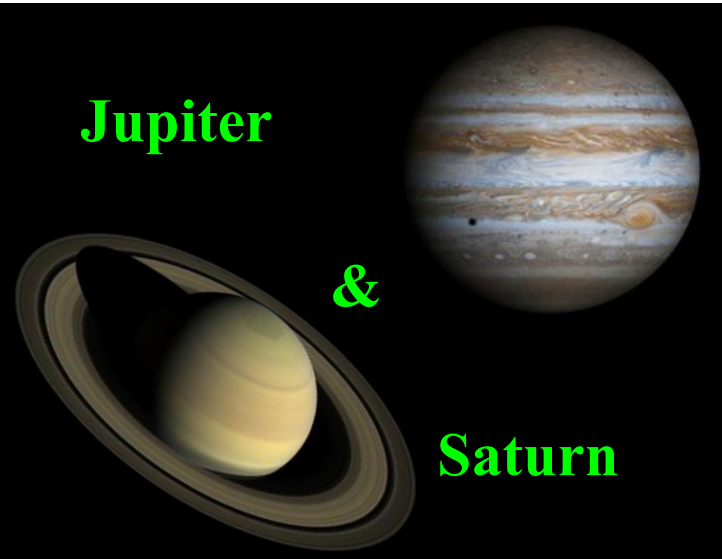
- (a) minerals found in rocks examined by rovers*
- (b) significant water ice found in Mars' ice caps*
- (c) ancient flow patterns on the surface*
- (d) all of the above*

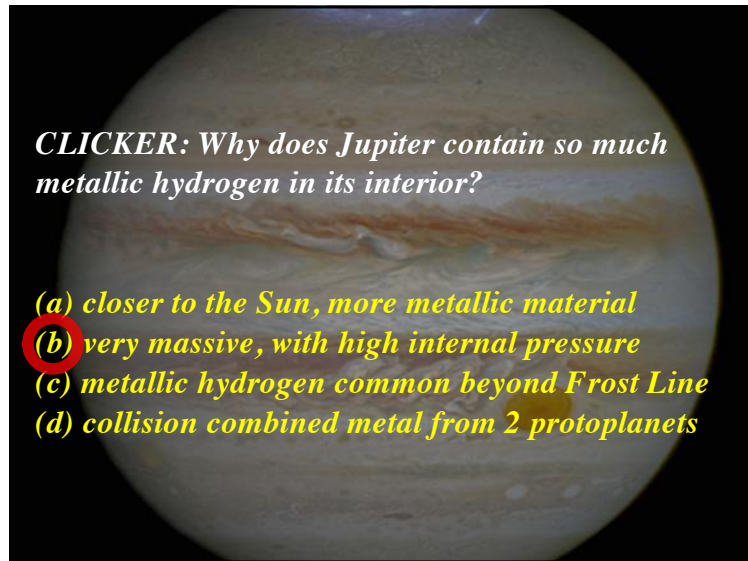


**Jupiter**

**&**

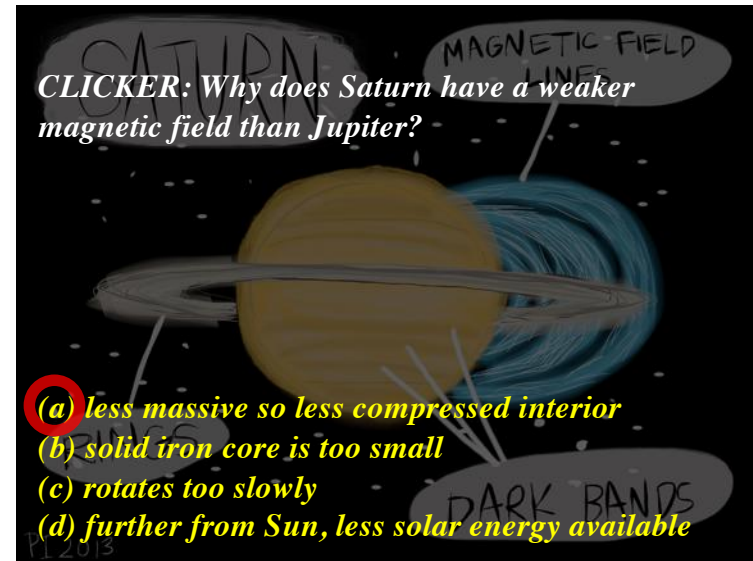
**Saturn**





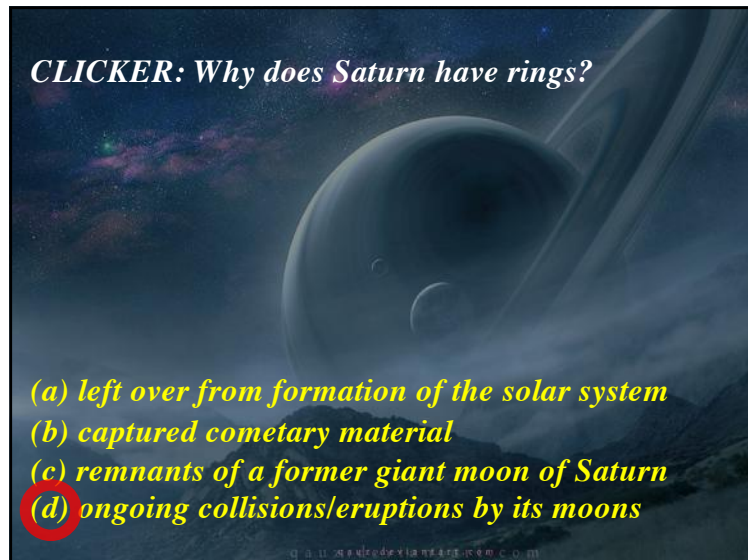
*CLICKER: Why does Jupiter contain so much metallic hydrogen in its interior?*

- (a) closer to the Sun, more metallic material
- (b) very massive, with high internal pressure**
- (c) metallic hydrogen common beyond Frost Line
- (d) collision combined metal from 2 protoplanets



*CLICKER: Why does Saturn have a weaker magnetic field than Jupiter?*

- (a) less massive so less compressed interior**
- (b) solid iron core is too small
- (c) rotates too slowly
- (d) further from Sun, less solar energy available



*CLICKER: Why does Saturn have rings?*

- (a) left over from formation of the solar system
- (b) captured cometary material
- (c) remnants of a former giant moon of Saturn
- (d) ongoing collisions/eruptions by its moons**

## The Outer Planets\*



Earth      Uranus      Neptune      Pluto

\*Not all objects depicted may be planets. IAU astronomers should beware when consuming "Outer Planets" as dwarf planets may be present. Not responsible for interactions with other astronomical bodies. Some deviation may occur in actual product from that depicted. Not for resale or where sale is void or prohibited by law. Your mileage may vary.

*CLICKER: Why was Uranus not identified as a planet much earlier?*



- (a) it moves very slowly compared to the stars
- (b) the greenish color makes it difficult to spot
- (c) extreme tilt makes viewing impossible
- (d) it is only visible with very large telescopes

## Solar System: Other Objects



*CLICKER: Asteroids in the asteroid belt...*



- (a) are typically beyond the Frost Line
- (b) take hundreds of years to orbit the Sun
- (c) orbit mostly between Jupiter & Saturn
- (d) rarely intersect the orbits of the planets

*CLICKER: A meteor is...?*



- (a) an asteroid fragment reaching Earth's surface
- (b) an asteroid fragment floating free in space
- (c) debris as it burns up in Earth's atmosphere
- (d) sunlight reflecting from metallic meteorites

*Cascade Wilderness Photography*

**CLICKER:**

*What part of a comet is always present?*

- (a) nucleus**
- (b) coma**
- (c) (ion & dust) tail**
- (d) all of the above**

