Fast-forward to 1960: Farewell to Earth

Galileo leaves Earth: NASA

So who wrote the first story to think about space-travel?

- H. G. Wells?
- Jules Verne?
- Well ...

Lucian of Samosta:

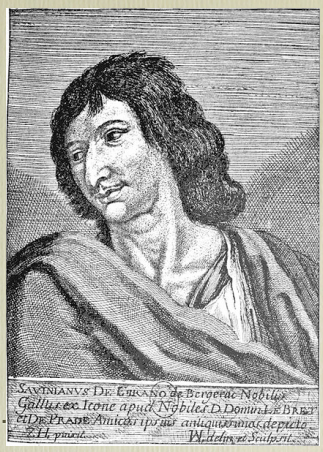
- True History" (200 AD):trip to Moon and Sun via waterspout and encounters with aliens

- That spot, he told us, which now looked like a moon to us, was the earth. “If I succeed,” says he, “in the war which I am now engaged in against the inhabitants of the sun....
- Our allies from the north were three thousand Psyllotoxotæ ...the former take their names from the fleas which they ride upon, every flea being as big as twelve elephants.

Earthrise from Apollo 8

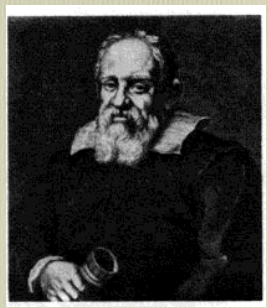
- Cyrano de Bergerac:

- 1619-1655: French writer, (with a big nose!) around whose name a number of unhistorical legends accumulated..
- "États et Empires de la Lune" (1657)
- "Histoire comique des états du Soleil" (1662)
- (yes, published posthumously).

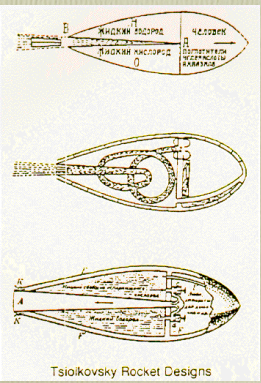


Farewell to Earth

- *Galileo to* Galileo
- *Person* to Space probe

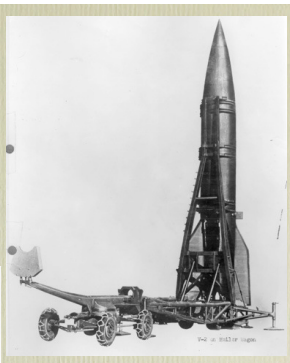


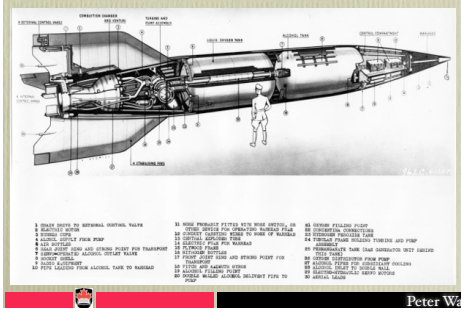
Escaping Earth



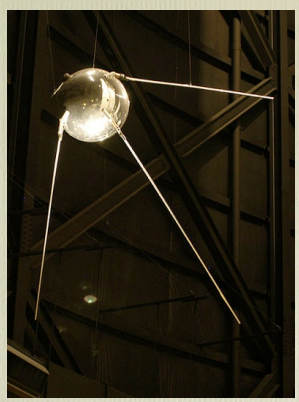
- 1920's Tsiolkovsky, Goddard
- First Liquid Fueled Rocket

- Wernher Von Braun 1944
- V2 rocket reaches space





- First artifical satellite: Sputnik 1 ("Спутник-1")
- 4 October 1957.

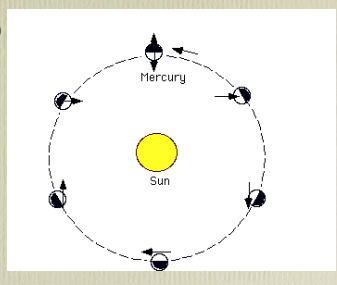


- Neil Armstrong / Buzz Aldrin 1969
- Apollo 11

Copernicus as seen by Lunar orbite

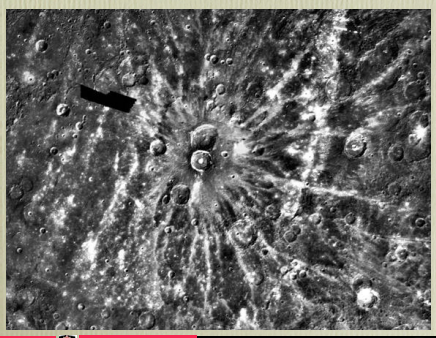
Mercury

- Hard to see, since close to sun
- Orbital period of 88 days.
- "Day" ~ 56 days

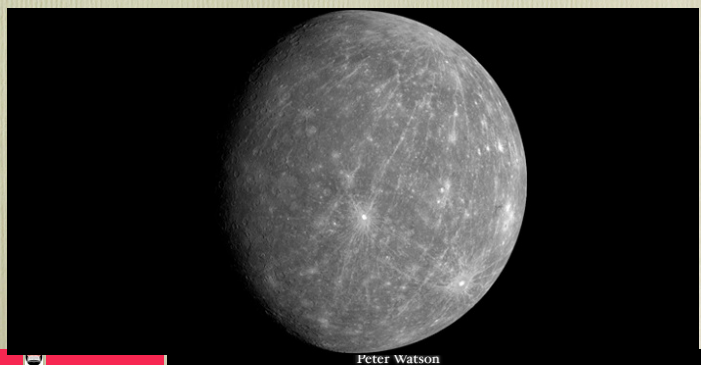


Mercury

- Always seemed to be really boring
- This is Degas crater



- Fortunately NASA has sent Messenger to Mercury
- Started orbit in March 2011
- And it IS really boring

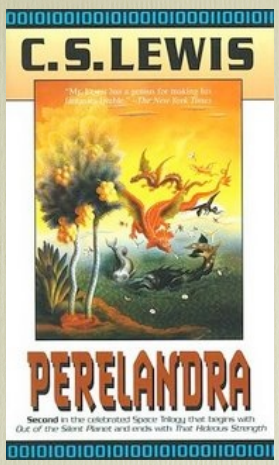


Travel Tips

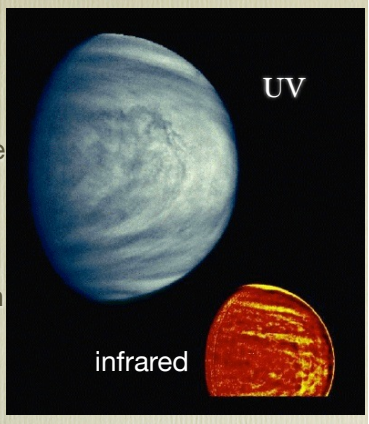
- Use plenty of sunscreen
- (SPF 50 million is recommended)
- Take lots of reading material
- (not paper, temp. is above 451 F)

Venus

- Popular with writers: e.g C. S Lewis
- So does it look like this?

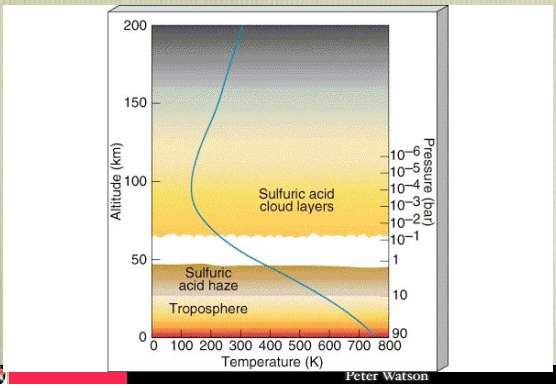


- Almost featureless in a teelescope
- Venera, Pioneer and radar showed surface for first time
- Year = 225 days.
- "Day" = 243 days backwards (so sun "rises" in the west: unknown till 1961)



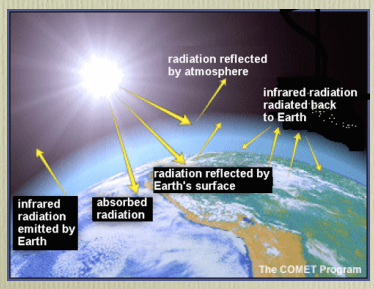
Venera 14

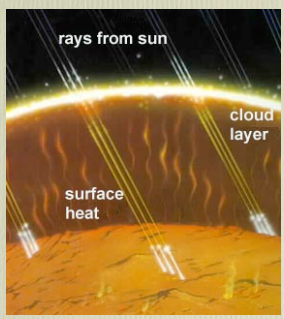
- Atmosphere very dense, mainly CO_2
- Upper clouds rotate in 4 days (~360 km/hr)
- At surface, gentle winds, but temperature ~ 700 °C



Why is "Earth's Twin" so utterly different?

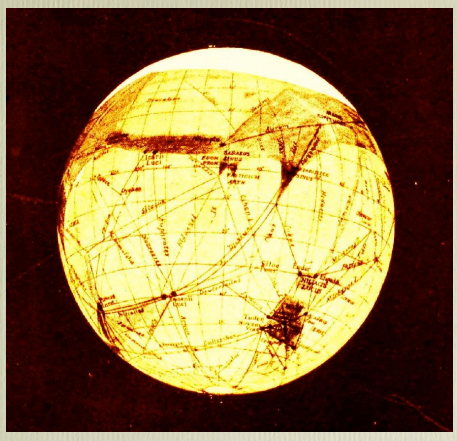
- Runaway greenhouse effect





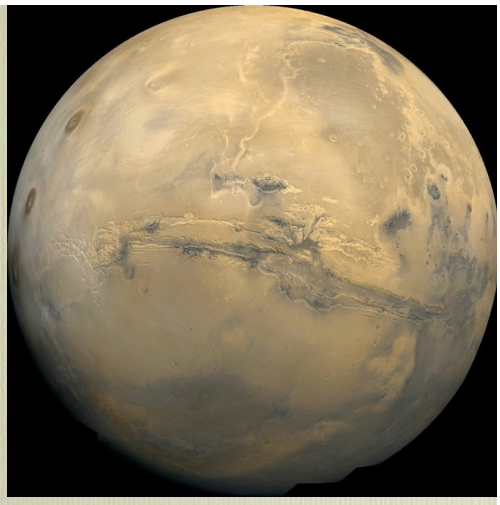
Mars

- Very popular with writers: Bradbury did it best ("Sands of Mars")
- Lowell observed canals



- Atmosphere: pressure ~1/200 earth, mostly (95%) CO_2
- Temperature range -80°C-> 30°C
- polar caps are frozen CO_2

- Valles Marineris: the "Grand Canyon" of Mars
- 3000 km long
- Up to 600 km wide
- Up to 8 km deep



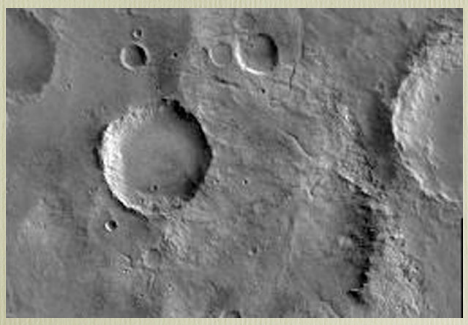
Travel Tip

- Must see…..

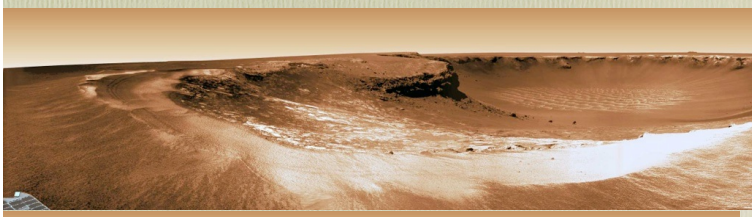
- Olympus Mons: extinct volcano: 25 km high, 500 km round
- **Much** larger than Mauna Kea (why?)

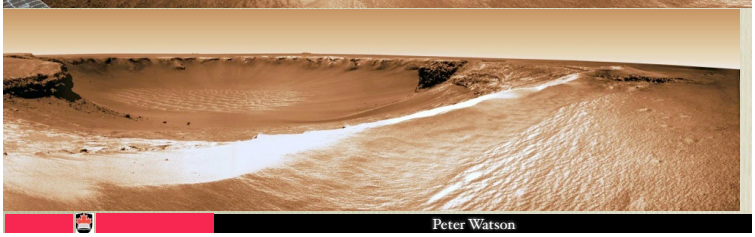
Impact craters

- Lots, at various stages of newness

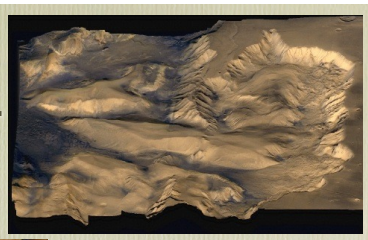


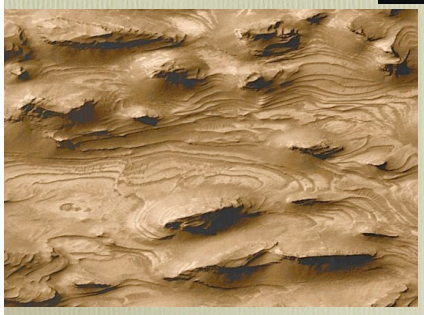
- Note the quality of pictures now: Victoria crater.
- Frost is frozen CO_2





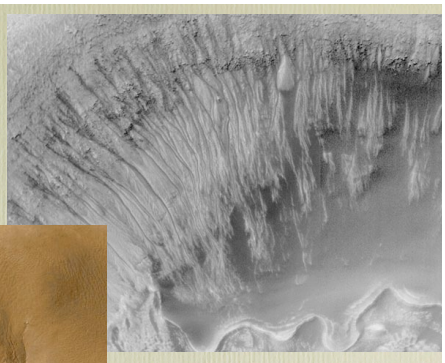
Candor Chasma: Massive rift valley.

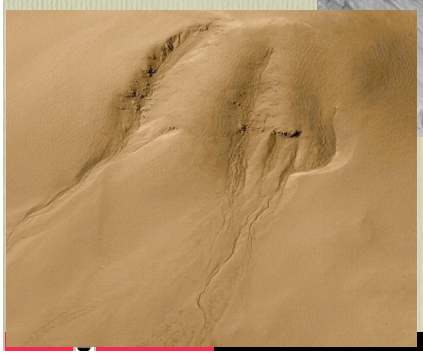




- The interesting problem:
- Does Mars have water?
- Some places looks just as though it once did

This is the Newton crater

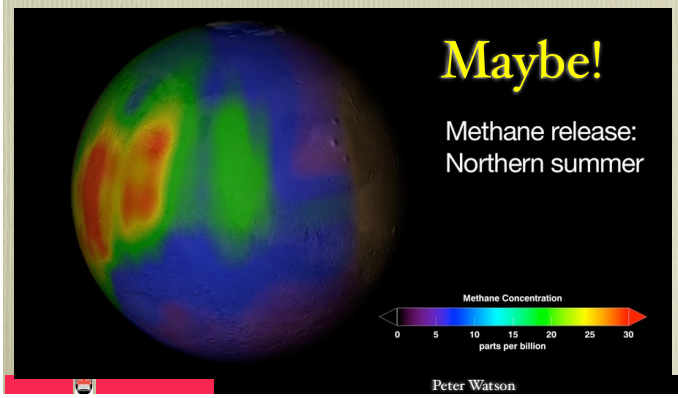




- and what really look like arroyos in New Mexico

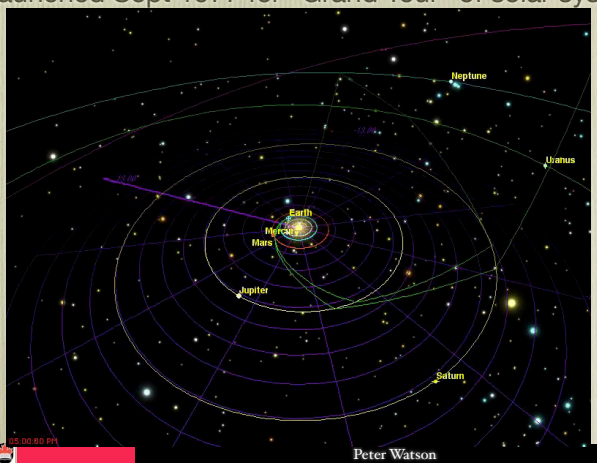
So is there **life** on Mars?

- Methane is a hint

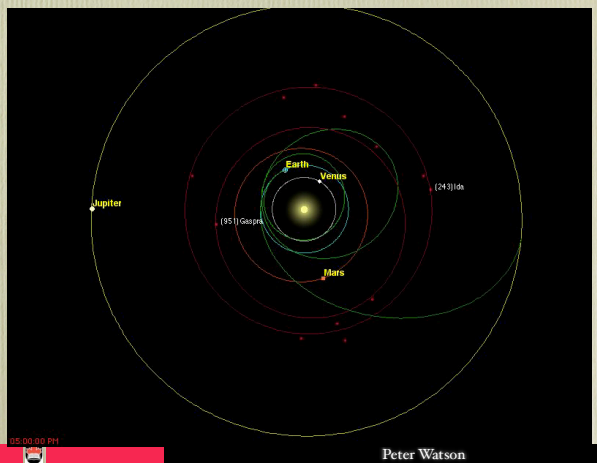


Voyager 1 & 2

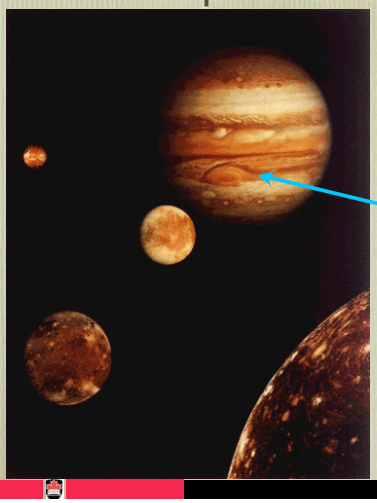
- Launched Sept 1977 for “Grand Tour” of solar system



Galileo, the space probe



Jupiter and Moons

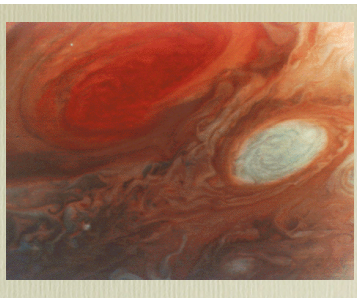


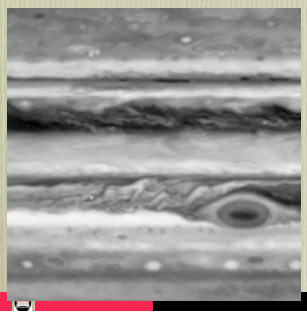
- Largest planet by far.
- Strongly banded appearance

Great Red Spot, seen since 1600's: 20,000 km x 50,000 km.

Top extends well above surrounding clouds.

- Obviously a "hurricane": wind speed ~ 500 km/hr
- Lifetime not too surprising: 1000 x bigger than terrestial hurricanes, so lifetime could well be 1000 x longer!

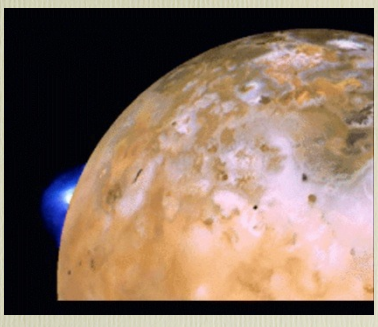




Moons of Jupiter: Io

- Four large moons, easily visible with binoculars
- Can watch Io rotating

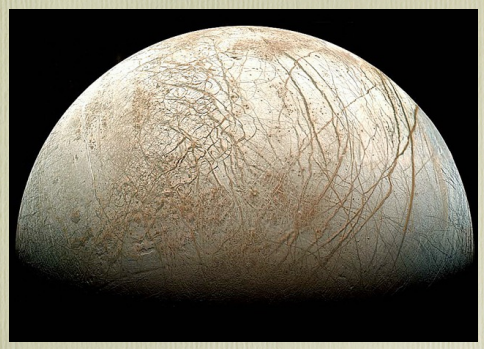
In a state of continuous volcanic eruption: plumes to 250 km, “squeezed”" by other moons.



Travel Tip

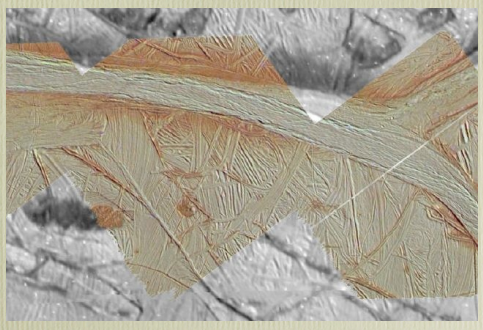
- Beware of Ionians offering time-shares
- The ground won't be there next year

Moons of Jupiter: Europa



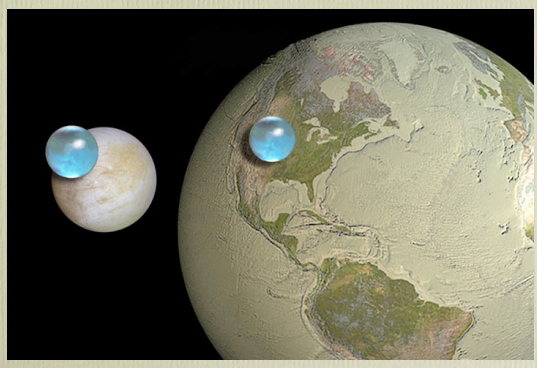
- Rock covered with ice, probably slushy since no impact craters.

- Close-ups show odd crustal structures, almost like pack-ice



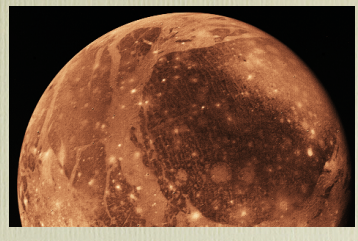
Now thought to have a huge ocean below the ice

- More water than the earth!



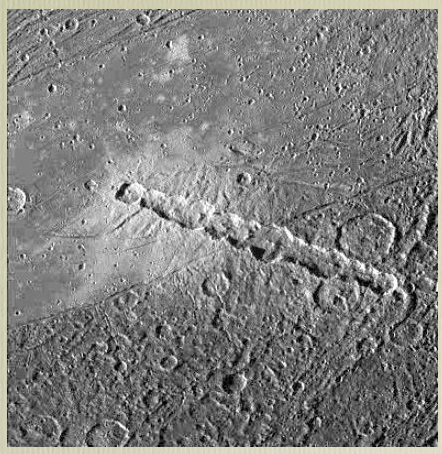
Moons of Jupiter: Ganymede

- Largest moon in the solar system
- Ice on rock.



- Many craters,
- Huge transverse faults

- Chain of craters:
- maybe made by a comet hitting



Saturn

- Atmosphere similar to Jupiter, but less heating (internal & sun) so weather better!

Rings made of small ice pellets and dust (moonlets): very thin (< 2 km) held in place by "shepherd" moons

Cassini fly-through of Saturn:
still pictures assembled by Stephen vanVuuren

A Storm on Saturn

- Started 2010, circled planet
- Orange clouds are deep
- Rings are edge on

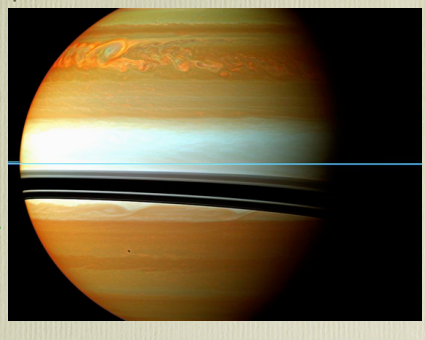


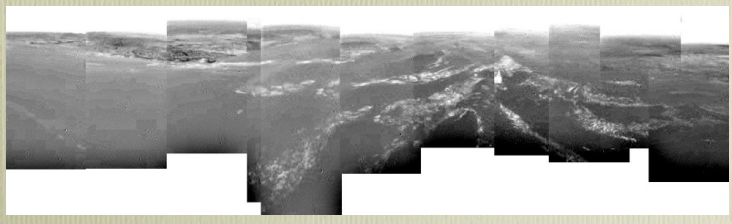
Image Credit: Cassini Imaging Team, SSI, JPL, ESA, NASA

Titan

Larger than our moon, yellow atmosphere so surface invisible

Touchdown of probe: 14 January 2005,

The white streaks are 'fog' of methane or ethane vapour. Wind speed at 6-7 m/s.

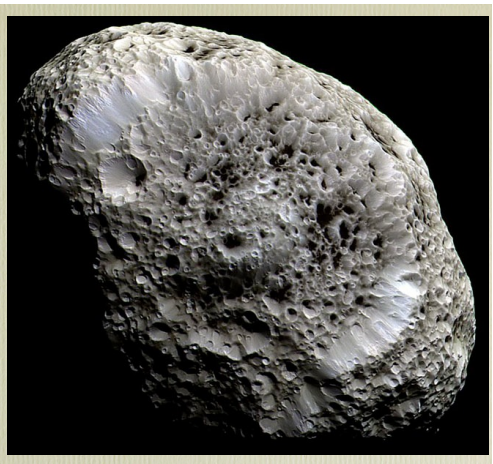


- Touch down at 4.5 m/s
- probe penetrated 15 cm.
- Surface consistency of wet sand or clay.

Hyperion

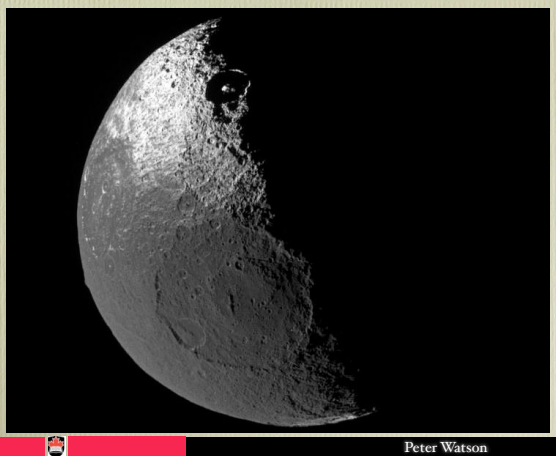
Density about 1/2 water (!)

suggests spongy texture!



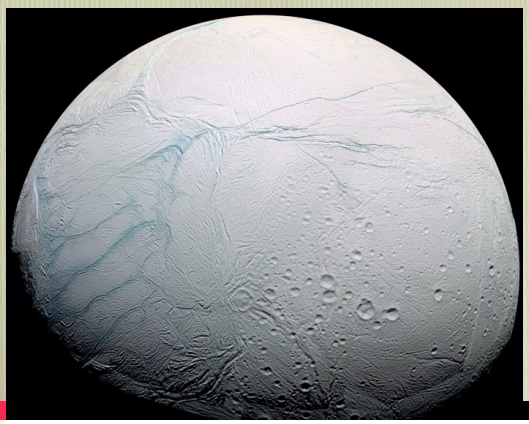
Iapetus

Half of moon is covered in material as black as coal!

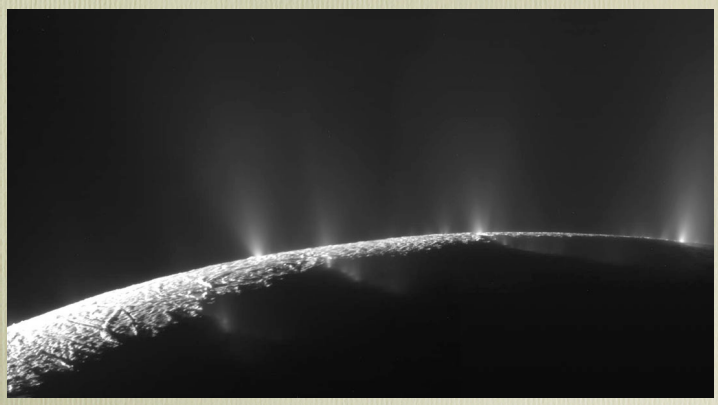


Enceladus

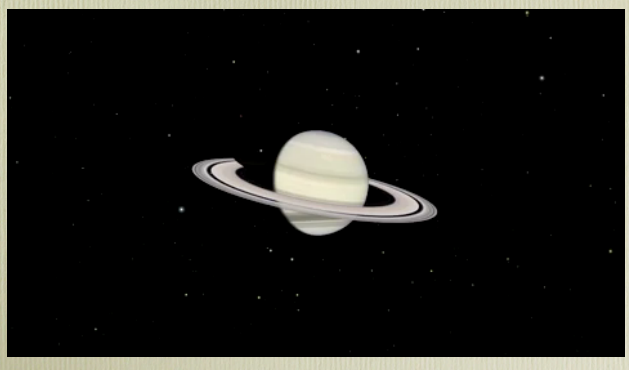
Giant stripey snowball?



- With ice volcanoes!

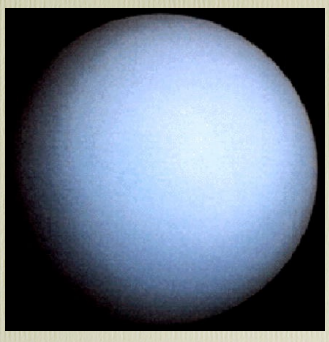


- Spitzer space telescope found a new, very diffuse dark ring round Saturn
- Could be source of the dark face of Iapetus

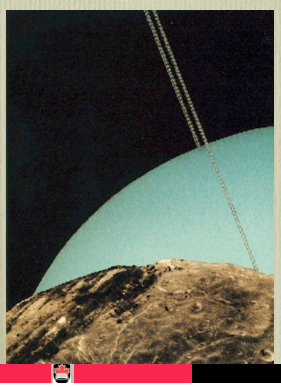


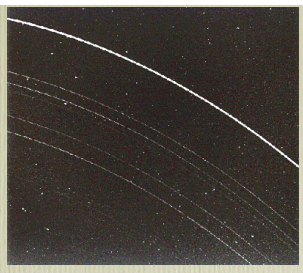
Uranus

- Pale blue in colour, almost featureless



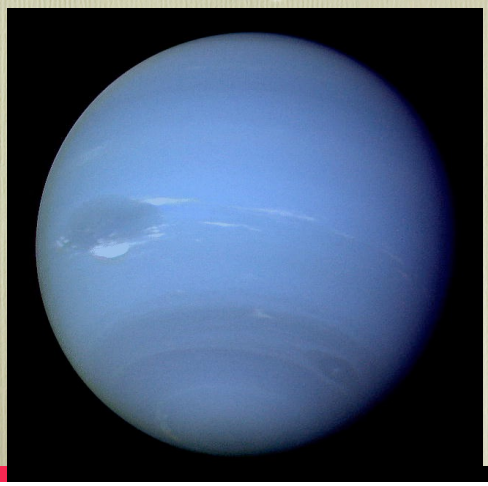
Has rings, but very unlike Saturn





- This is maybe what it would look like from Ariel

Neptune

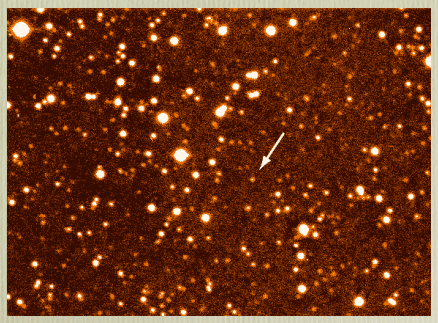


Pluto-Charon

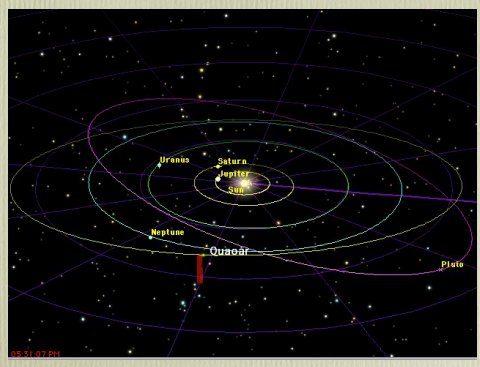
But is it a planet?

How big is the solar system?

- For a long time Pluto set the bounds, but now Quaoar



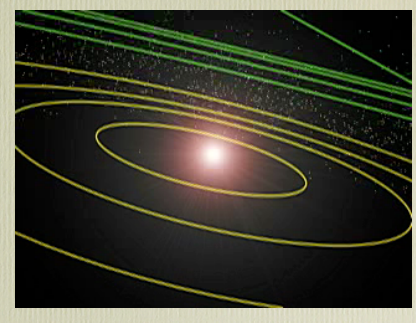
- And it's really far out



And Sedna

- Sedna now at its closest, but 10,000-year orbit takes it into the Oort cloud, the origin of comets.

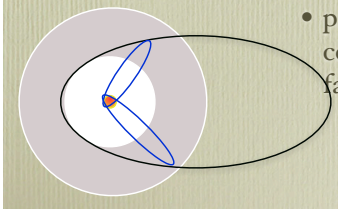
And Eris aka Xena



Can there be anything further out?

- What exactly is a planet?
- No easy answer: conventionally we take original 8 as planets, and say everything else is not (i.e. Pluto isn't).
- Definitely: expect millions (billions?) of small objects
- But large planets very unlikely (we already have limits)

What else? How about Nemesis?



- Mass extinctions on earth seem to follow a 30 million year cycle
- Extinction of dinosaurs about 65 million years ago.
- Maybe Sun has a small companion star in 30 million year elliptical orbit
- passes through Oort cloud of comets, disturbs them enough to fall into inner solar system

- No bright star anywhere close to sun
- IRAS shows no large infra-red object
- Really unlikely!

- So you can relax!

Acknowledgements

- Astronomy Picture of the Day (APOD)
- NASA
- Dick Hallion
- ESA

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