

Solar System happenings

Richard J Edgar, Learners lecture for Oct 28, 2020

**Website for course materials:
richardjedgar.github.io**

- Asteroids:
 - Recent sample obtained from Bennu; see also Ryugu
 - 2018 VP1 and potentially hazardous objects
- Potential life in the clouds of Venus??
- Updates on Mars exploration

Touch and Go

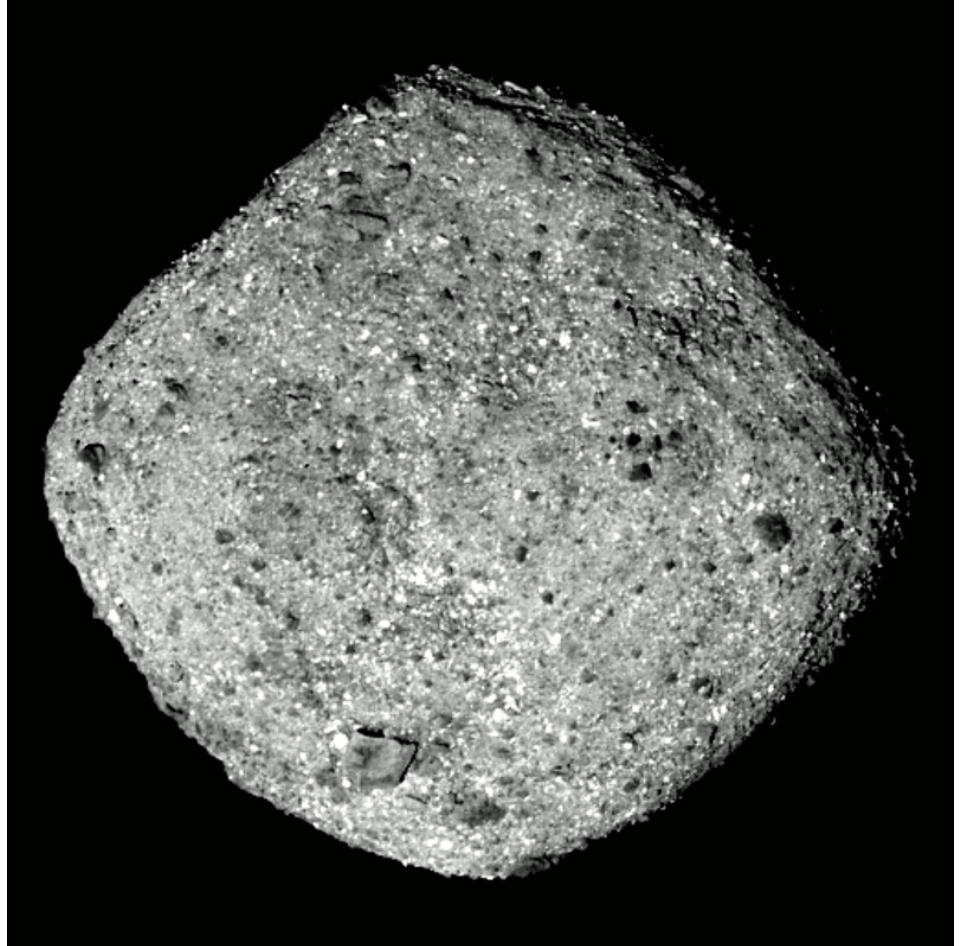
Sampling asteroid 101955

Bennu



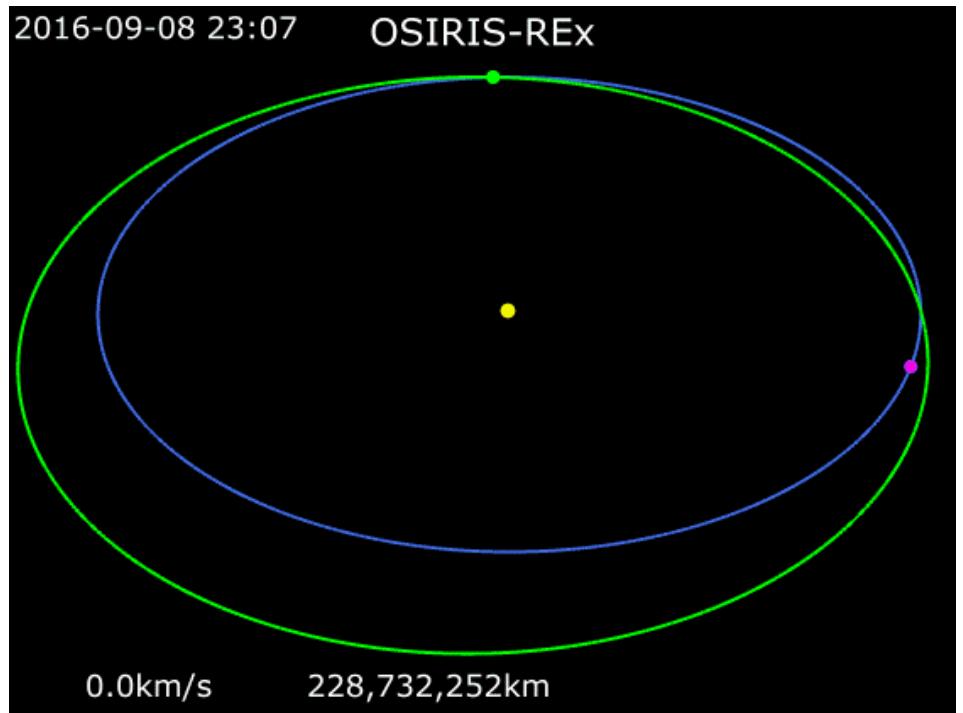
The OSIRIS-Rex Mission

- OSIRIS-REx stands for “Origins, Spectral Interpretation, Resource Identification, Security, Regolith Explorer”
- Launched Sep 8, 2016
- Arrived at asteroid Bennu Dec 31 2018
- Sample obtained last week
- Will return the sample on or about Sep 24, 2023



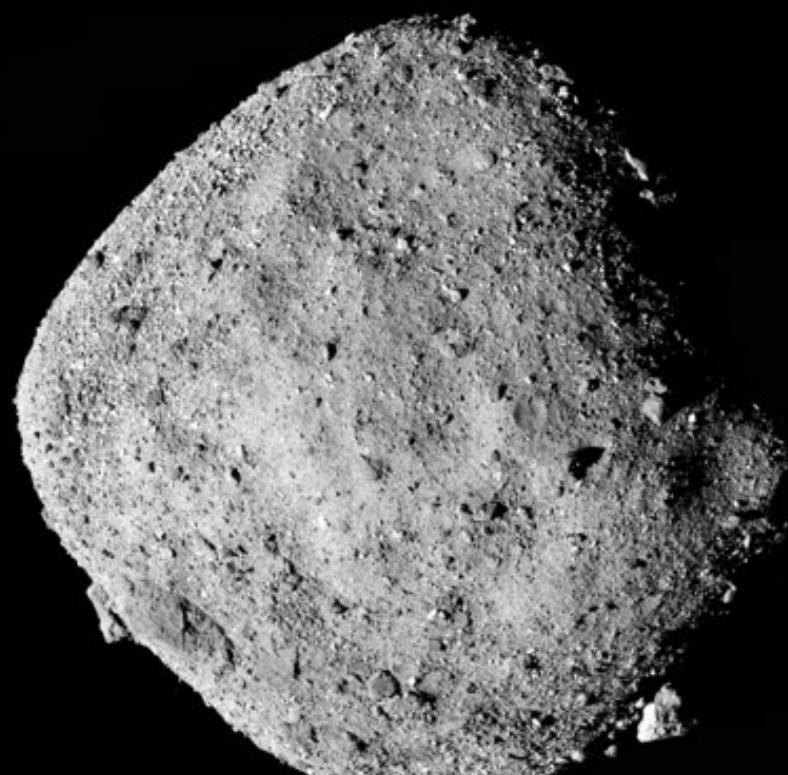
Orbits

- The orbit of Bennu crosses that of the earth. It's unlikely to hit the earth anytime soon. 1 in 1800 chance before 2170.
- Blue=earth, green=Bennu, pink=OSIRIS-REx
- It's worth knowing what such asteroids are like, in case we need to divert one.



Objectives

- Sample of pristine, ancient solar system material for analysis on earth.
- What are near-earth asteroids like? Solid hunk of rock, or pile of rubble?
 - The answer to this question drives strategies for diverting an asteroid if that becomes necessary.
- Measure non-gravitational forces on the asteroid (Yarkovsky effect) to make orbit prediction more precise.
- An article on the sample collection: <https://spaceflightnow.com/2020/10/23/osiris-rex-overflowing-with-asteroid-samples-after-bagging-a-bounty-from-bennu/>



Japanese Hyabusa2 Mission

- Very similar idea, destination 162173 Ryugu
- 2014 Dec 3: Launch
- 2018 Jun 27: Arrived at Ryugu
- 2019 Nov: departed for home
- 2020 Dec 6: Arrival at earth.
- Ryugu may be another piece of the same rock that spawned Bennu



Oh great, Neil...

- Be careful what you read (including the fine print)
- Wait a day or two for somebody else to react
- Don't panic
- Think about the source (publication and the person quoted)



NEIL DEGRASSE TYSON COVID, Trump, Economy, Racism, Add This To 2020 **ASTEROID COULD HIT U.S. DAY BEFORE ELECTION!!!**

10/18/2020 7:18 AM PT



Will an astroid hit the earth?

- It happened 65 million years ago, wiping out the dinosaurs.
- A small one burned in the atmosphere over Chelyabinsk, Russia Feb 15, 2013
- There's a new one, 2018 VP1 buzzing the earth on Nov 2, 2020.
- Yes, that's the day before the election.
- You can buy yard signs for your favorite outcome...
- But no, it's not going to hit the earth. Even if it did it would burn up in the atmosphere. It's roughly refrigerator sized.
- More info: <https://www.syfy.com/syfywire/no-an-asteroid-is-not-likely-to-hit-earth-the-day-before-the-election>

**GIANT
METEOR**

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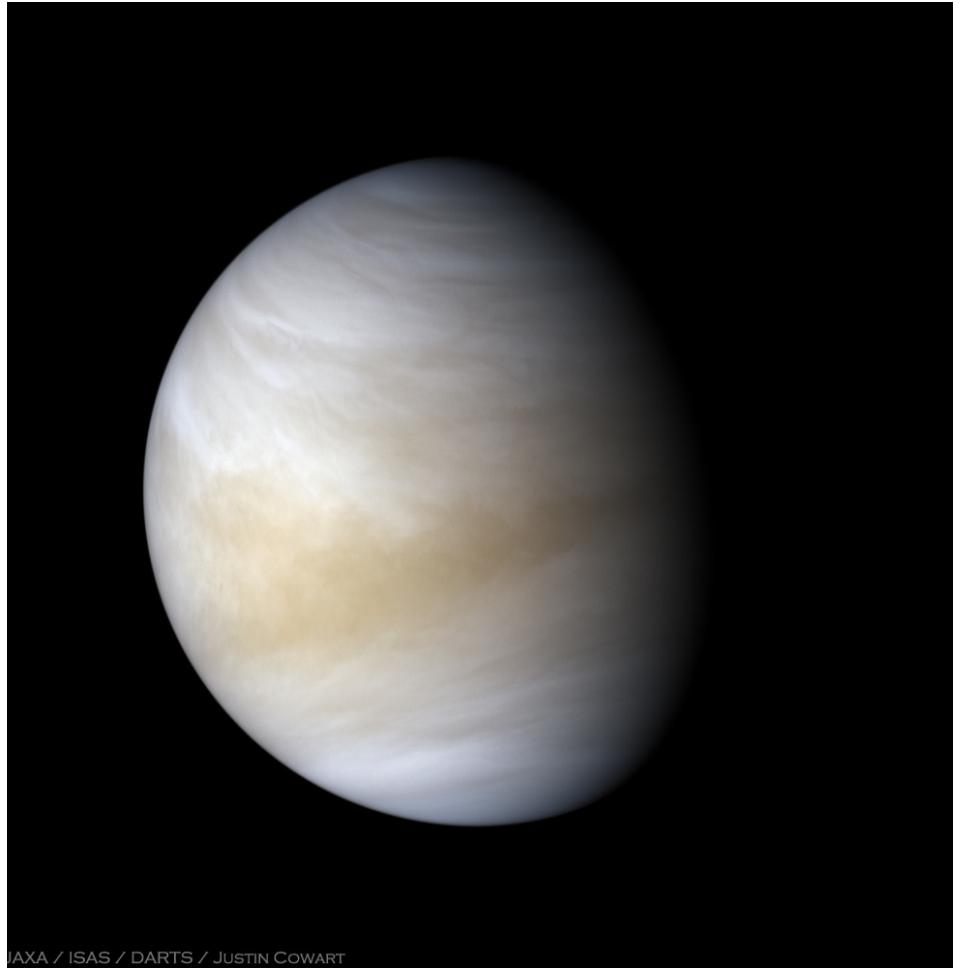
JUST END IT ALREADY



**WATCH
FOR
FALLING
ROCKS**

**And now for something
completely different...**

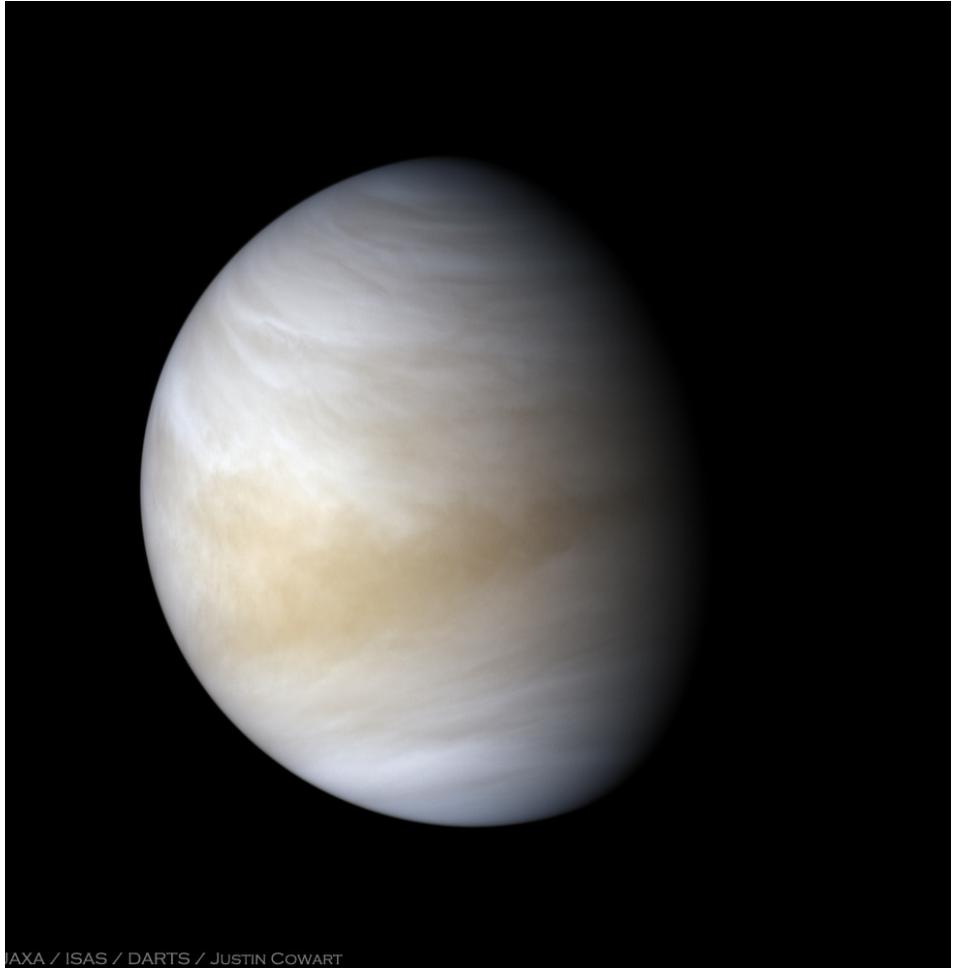
**Life on Venus?
probably not...**



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Venus facts & figures

- Venus is our “sister” planet
- Mass very similar to earth
- Atmosphere is 90 times more than earth, mostly CO₂ with sulfuric acid clouds
- Surface temp 900°F
- Like earth if you boiled the oceans.
- Top of cloud deck has earth-like conditions



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- Astrochemistry models chemical reaction networks that might happen elsewhere in the universe.
- There's an ongoing theoretical search for "biomarkers"... chemical signatures of life in the atmosphere of the planet it lives on.
- One promising candidate is Phosphine, PH₃. On earth it's made either industrially or by anaerobic bacteria (that live where there's no oxygen). Tiny amounts come from volcanoes.
- Jane Greaves (Cambridge UK) and her colleagues observed Venus at wavelengths absorbed by Phosphine and found a signal, confirmed with both JCMT and ALMA (two millimeter-wave radio observatories).
- They calculate volcanoes or sunlight could make 1/10,000 of what they see... what else could it be?

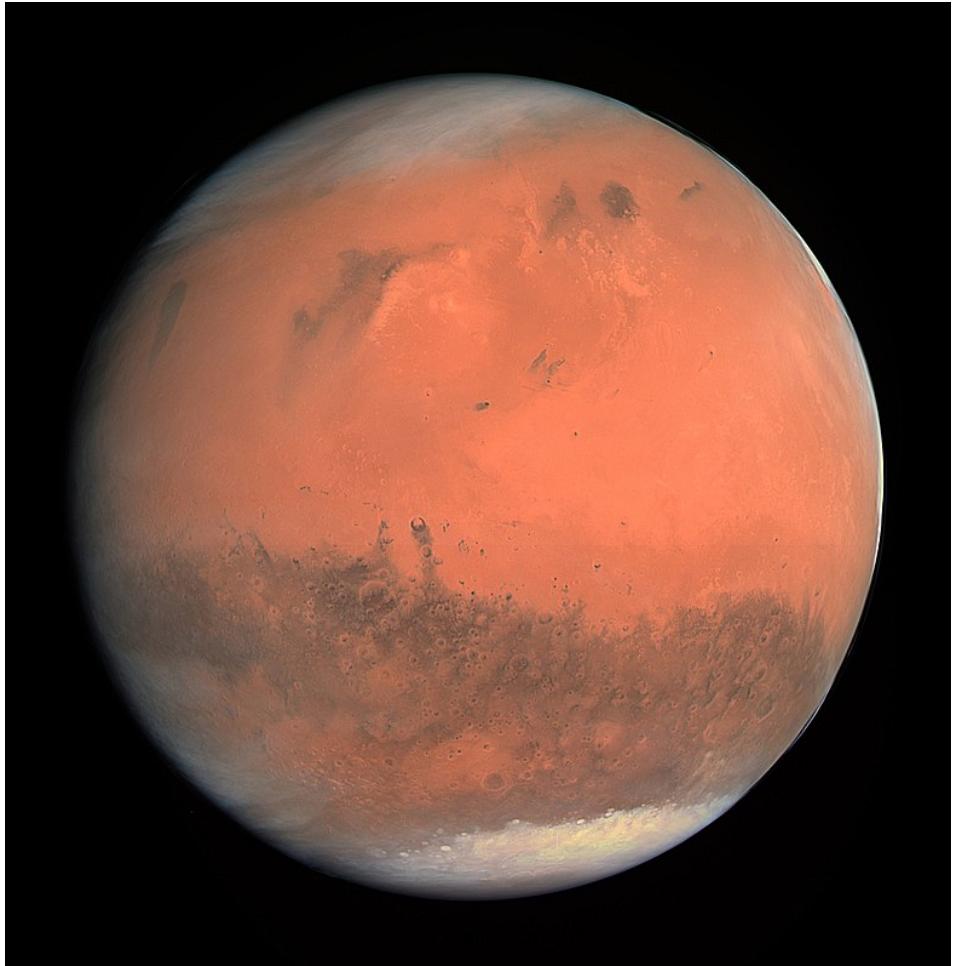
- The idea isn't completely nuts.
- There are bacteria found high in the earth's atmosphere (they often nucleate snowflakes, for example).
- Conditions at the cloud tops on Venus are rather similar to earth (temperature, pressure).
- It's possible Venus had oceans early in its history, which boiled away due to a runaway greenhouse effect (this is Carl Sagan's PhD thesis work).
- If so, and if life started on Venus when it was starting on earth, it's possible microbes found a way to survive in the thickening atmosphere.

However, comma...

- Venus does have volcanoes; we don't know how many.
- Those "What else could it be?" arguments depend on knowing all the possibilities (I've gotten burned personally by this).
- The paper was a call for ideas and further research more than it was a claim to have found life.
- I'd call it interesting, intriguing, but not definitive.
- Again, the Bad Astronomy blog has more info: <https://www.syfy.com/syfywire/so-astronomers-may-have-found-evidence-of-life-on-venus>
- And from NatGeo: <https://www.nationalgeographic.com/science/2020/09/possible-sign-of-life-found-on-venus-phosphine-gas/>

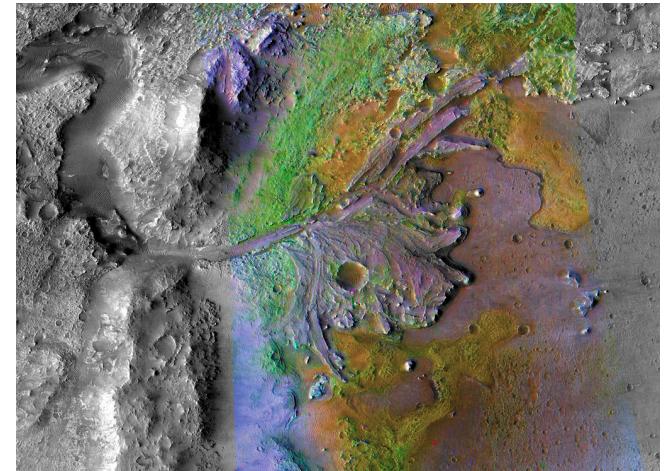
Mars

An update on the Mars exploration program



- There's a planet in our solar system inhabited entirely by robots... Mars.
- It's more earth-like in many ways than other planets: rocky; 10% of earth mass; 0.4 earth gravity; 0.1% of earth atmospheric pressure, mostly CO₂; cold (-226 to +95 F with an average of a balmy -82 F)
- It's likely that in its first billion years there was much more atmosphere, liquid water on the surface, at a time when life was getting started on earth.
- Again, if life started there, microbes might have found a way to survive in the soil or under the polar caps (liquid water has been detected under the south polar cap).

- Every two years or so there's an opportunity to send spacecraft to Mars
- Three missions are bound for Mars now; launched this Aug for arrival in Feb 2021.
- US: Mars 2020, aka Perseverance, a rover with a little helicopter scout. Will collect samples for another mission to return to earth.
- China: Tianwen-1: Lander & rover. Much like their moon rovers.
- UAE: Hope orbiter (Al Amal). Built in the UAE with help from CU, Berkeley, Arizona.
- And of course the rover Curiosity continues its mission, as do half a dozen orbiting craft (US, ESA, Russia), and the Insight lander.



Ice on the moon?

A late-breaking story

- I'm going to wing this one orally, while waving my hands.