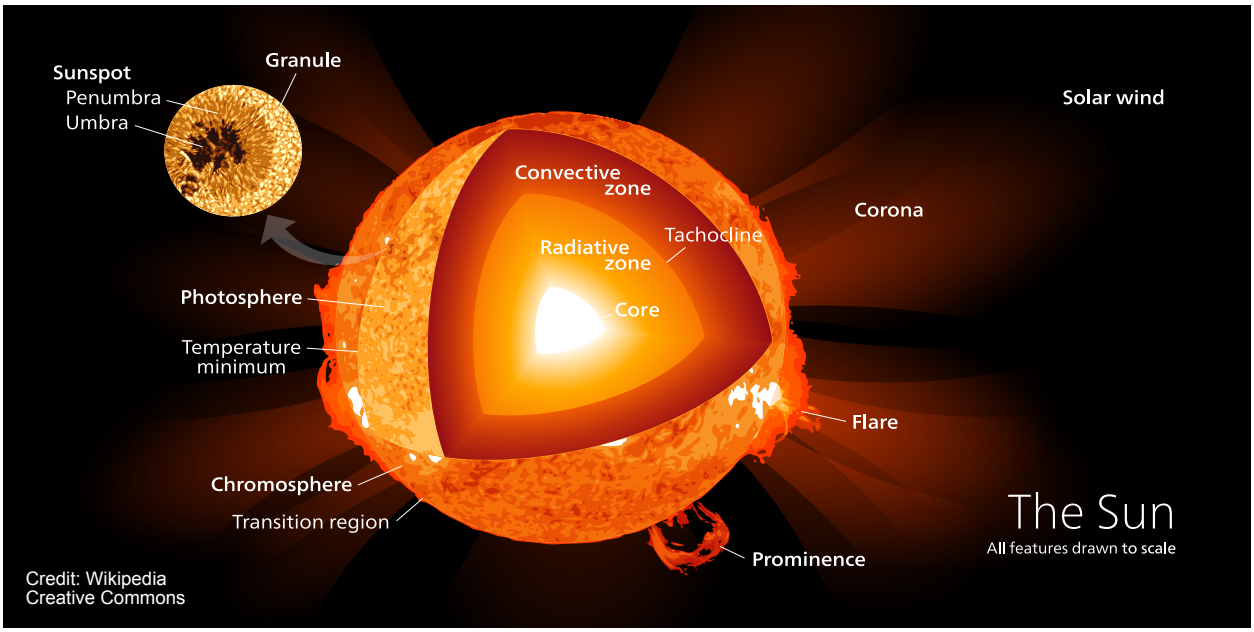
You teach your students the diameters of the planets and wonder when you are done that they do not delight in your company.

Samuel Johnson

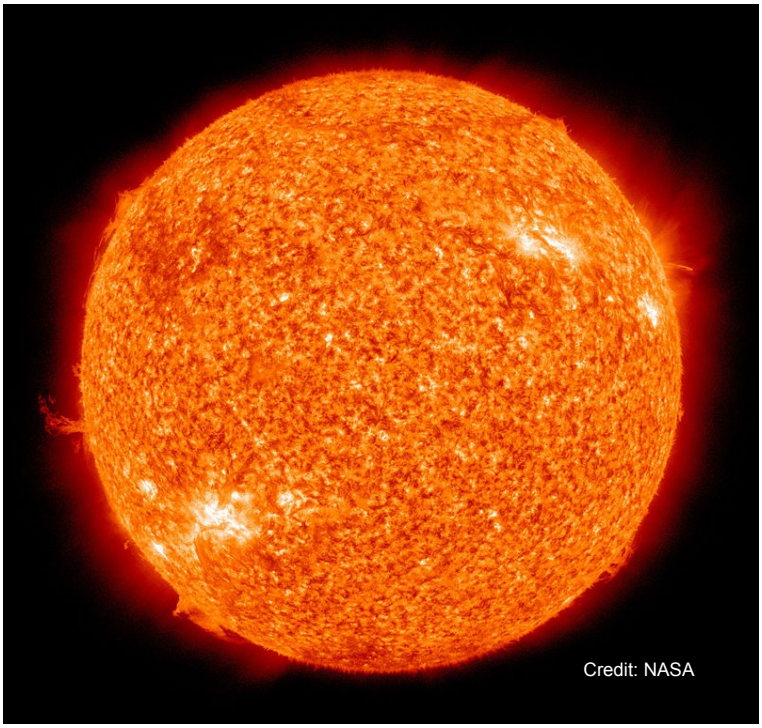
Our Inner Family Portrait

Hi there. In this module we're going to start the journey of the planets themselves. We'll begin with a global overview of the inner planets, the terrestrial planets. A whirlwind greatest hits tour if you like. No diameters here!

So the solar system. Unlike what the illustration above suggests (grin), the planets are tiny compared to the distances between them. Our solar system consists of the Sun, the planets and their moons, and vast numbers of comets and asteroids. While each world has its own unique characteristics, there are many clear patterns among the worlds and differences between them. That's what we're going to focus on, comparative planetology as opposed to nitty-gritty study of every planet and moon. That said, it is worthwhile walking through each of the major bodies in the solar system and sort of giving a highlight of each one, the greatest hits of each planet and body as we go through.

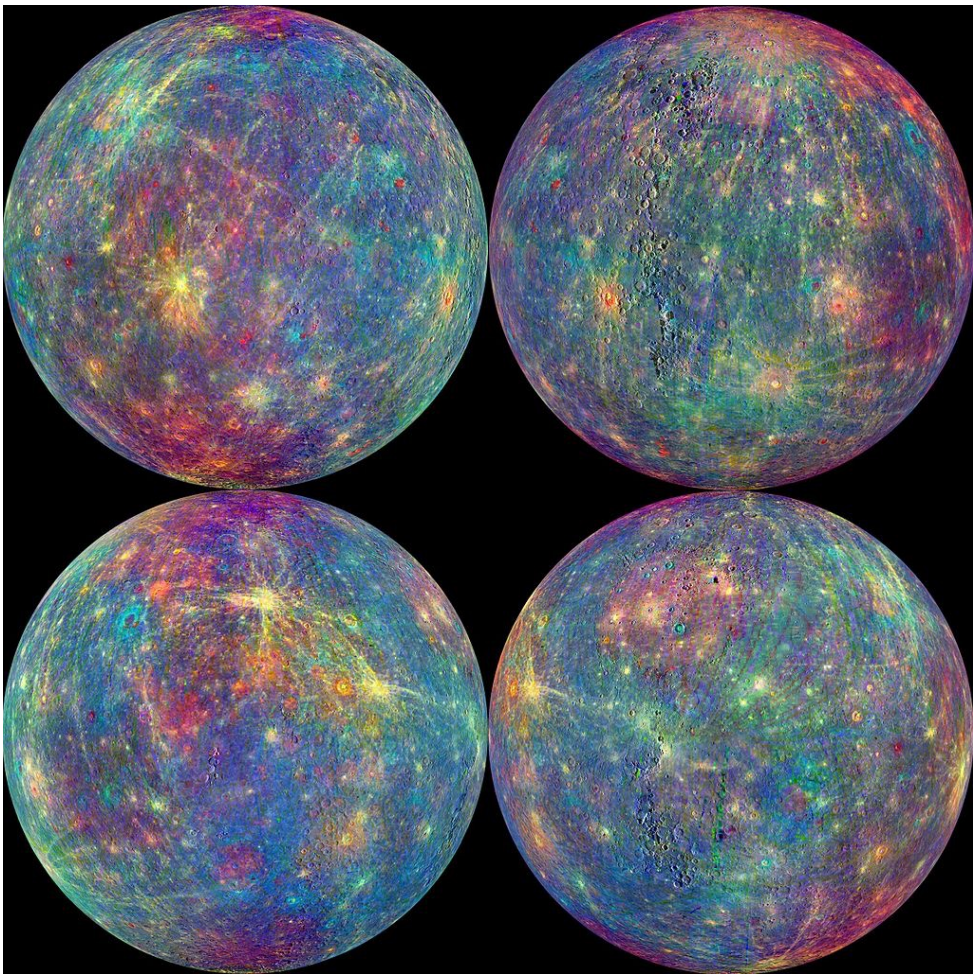


The Sun is a star. RIght up close. It is 4.6 billion years old and the most influential orb in our system. It is gaseous throughout, made of 98% hydrogen and helium and 2% everything else. It's that 2% other stuff -- that carbon, that oxygen, that silicon, that iron -- that makes you and me. The Sun is burning hydrogen into helium in its core. That's what stars do. That's why they continue to shine and how they make new chemical elements.



El Sol contains about 99.9% of the total mass in the solar system. It just utterly dominates the gravity of the planetary orbits. It's light is the primary influence on the temperature of planetary surfaces and atmospheres. Also, EL Sol emits all kinds of charged particles flowing outward. There's a wind of particles coming from the Sun. This wind is what causes space weather. It's

what causes the Aurora Borealis, the northern lights, and other has effects. If a planet has a magnetic field, then it can act like a protective little cocoon from the solar wind. Our magnetic field protects us from those dangerous, deadly, particles that come booming out of the Sun's outer layers.



Credit: NASA

Mercury is the innermost and smallest of the eight planets. It is mostly a iron & rocky geologically dead (no volcanos or quakes) world with a lot of craters on it. Mercury has no significant atmosphere either.

Solar tides — we learned about tides — force Mercury to rotate three times for every two orbits, which gives Mercury days that last about 3 Earth months each. As a result, plus its closeness to the Sun, daytime reaches about 425 °C, nearly as hot as burning coal. Because there's no atmosphere, once that Sun goes down at night, just like the desert here Phoenix, it gets really cold at night. The temperature plummets to -150 degree °C, colder than Antarctica.
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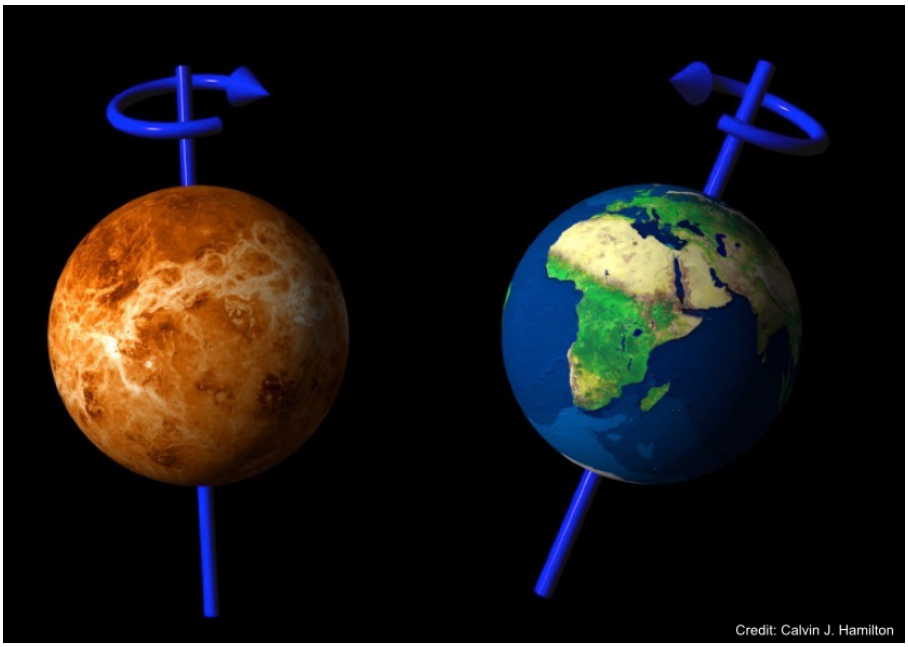
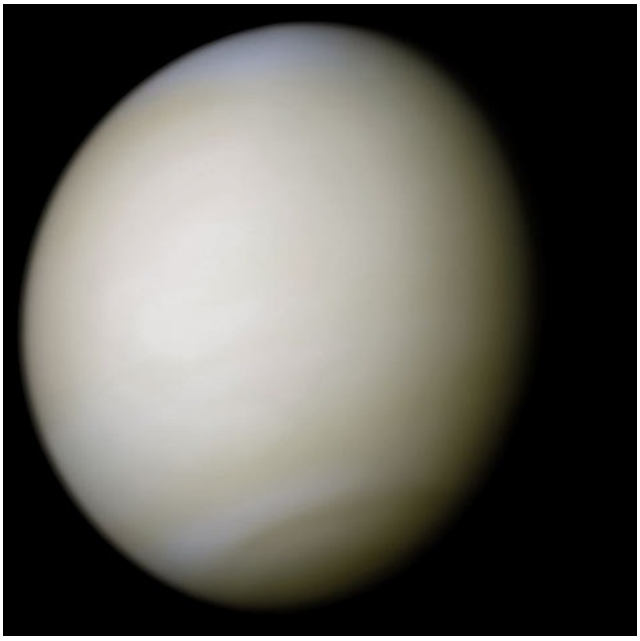
The image above shows faces of Mercury, colored by their spectral properties, obtained from the NASA Messenger mission - the first time in history a mission orbited Mercury. In regions of

permanent shadows, like in impact craters near the north pole, ice water has been discovered. Ice water on Mercury!



Venus is nearly identical in size to Earth but rotates very slowly so that its days and nights are very long, and rotates in the opposite direction of Earth so the Sun rises in the west and sets in the east.

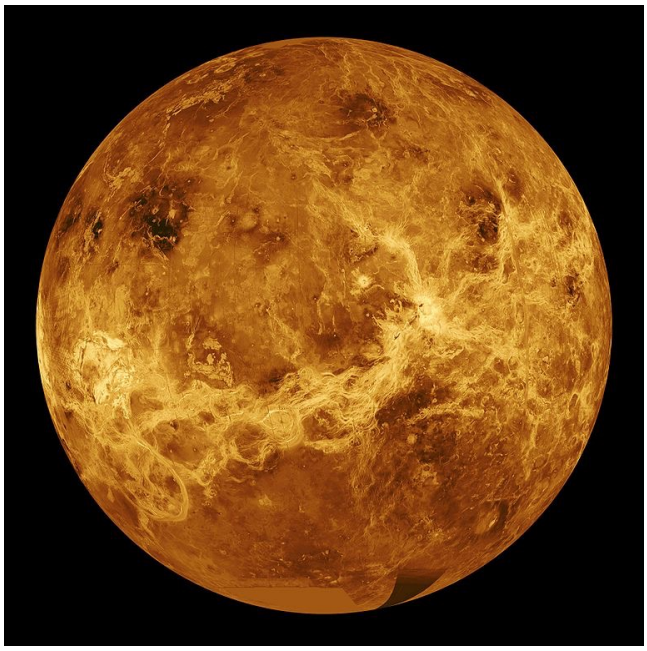


Credit: NASA

Contrast the no atmosphere of Mercury with the extremely heavy atmosphere of Venus. It is completely covered in dense clouds due to the greenhouse effect. In effect if Venus had oceans

like Earth’s early in its history, all those oceans have evaporated. The oceans have become the clouds. As a result of the very thick cloud cover and slow rotation, the surface is an incredible 470°C. Heat is so effectively trapped that night offers no relief from these searing temperatures. It’s still 470 °C at night! The pressure on Venus is equivalent to being about 1/2 a mile beneath the ocean on Earth.

Those clouds have a lot of sulfuric acid. That’s what gives Venus it's yellowish color. So it rains sulfuric acid, but its so hot at the surface that those raindrops never hit the surface.



Credit: NASA

The image above shows the surface of Venus obtained from cloud penetrating radar onboard orbiter missions. We see evidence of recent volcanic flows and not many impact craters. We also have landed on Venus. The probes didn't last very long, just minutes before they were just utterly crushed by the pressure and melted by the temperatures.

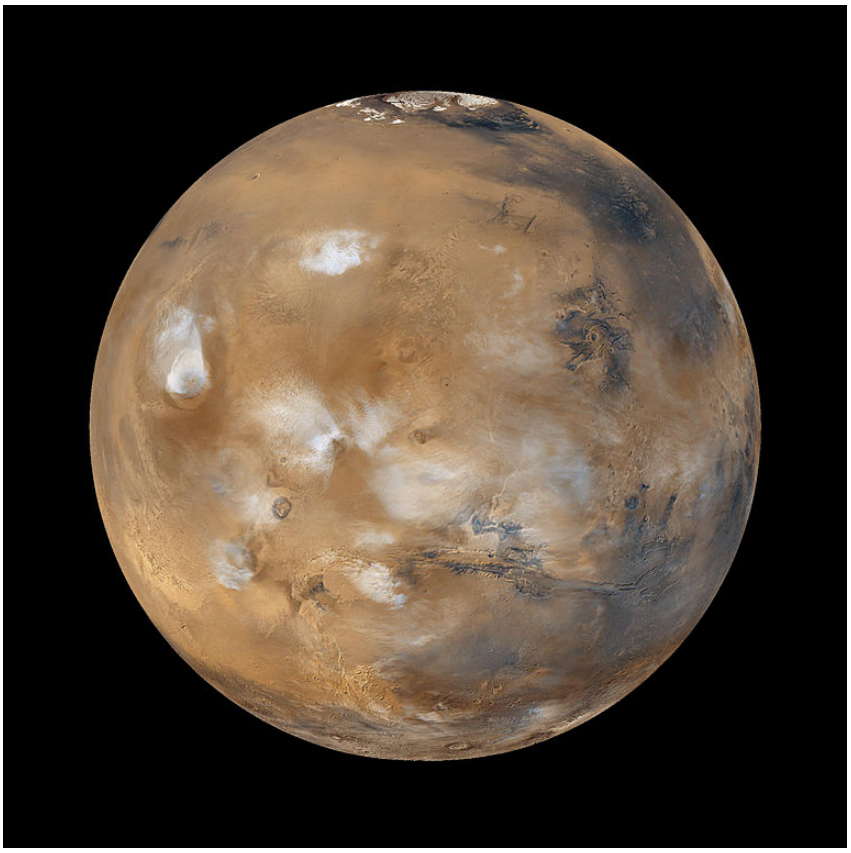
Credit: NASA

And so Earth -- Earth is barely a dot on the scale of the solar system. But it's the only one we know that has life on it. The image above is the famous shot of looking at our blue marble from the Moon, taken from one of the Apollo missions.

It is the only planet that has oxygen for us to breathe, lots of liquid water, an ozone layer that protects us from deadly solar radiation, and a magnetic field cocoon that protects us from the cosmic rays coming from the Sun.

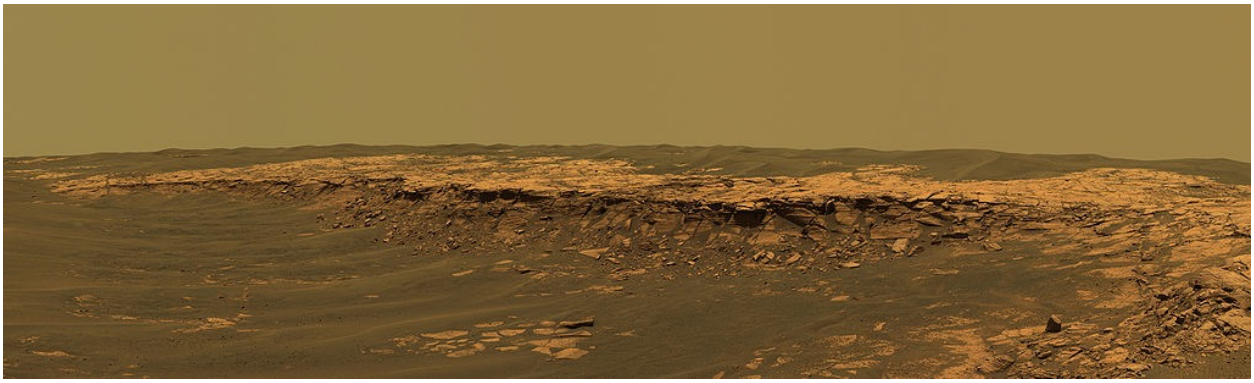
Our atmosphere has just enough carbon dioxide and water vapor to maintain a very reasonable greenhouse effect. If we did not have a greenhouse effect, Earth's oceans would be frozen over. The surface temperature of Earth would be colder than the freezing point of water. Its very valuable. On the other hand, Venus shows its possible to have too much of a good thing.

Earth has a relatively large moon. That's good for us because the Moon helps stabilize our rotation axis from wandering around. There is a solid body of evidence that suggests the Moon was birn from the Earth, The Earth and Moon are mother-daughter.



Credit: NASA

Mars has about half of the size of Earth. So it's a lot less massive. It has ancient volcanoes that dwarf the Mt. Everest on Earth — Olympus Mons — , a ginormous canyon that runs 1/5 of the way around the planet — Valles Marineris that makes the Grand Canyon looks like a minor surface scratch — and ice caps made of carbon dioxide CO_2 and water H_2O. As the image above shows during some months clouds form and occasionally Mars has global dust storms.



Credit: NASA

Mars is frozen today and geologically dying. But the presence of what appears to be dried riverbeds, rock-strewn flood plains and minerals that only form in water all strongly suggest that Mars, at least at some point in its past, was warm and wet. This is what makes Mars is the most studied planet in our solar system besides Earth. The image above is from the Spirit mission. More than a dozen spacecraft have visited Mars and more are planned.

What was that diameter? Thanks! Bye Bye.