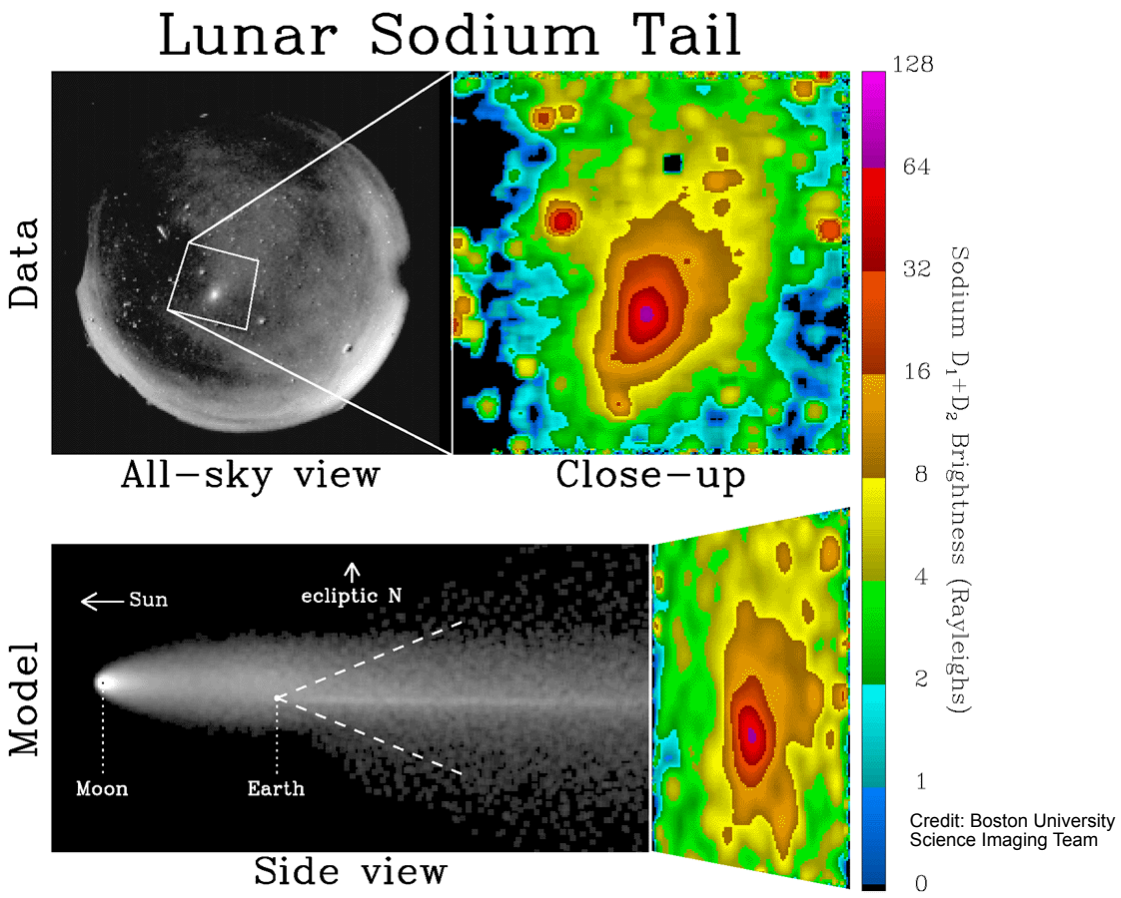
Irrigation of the land with seawater desalinated by fusion power is ancient.
It's called ‘rain'.

Mike McAlary

Too Small To Hold Its Gas

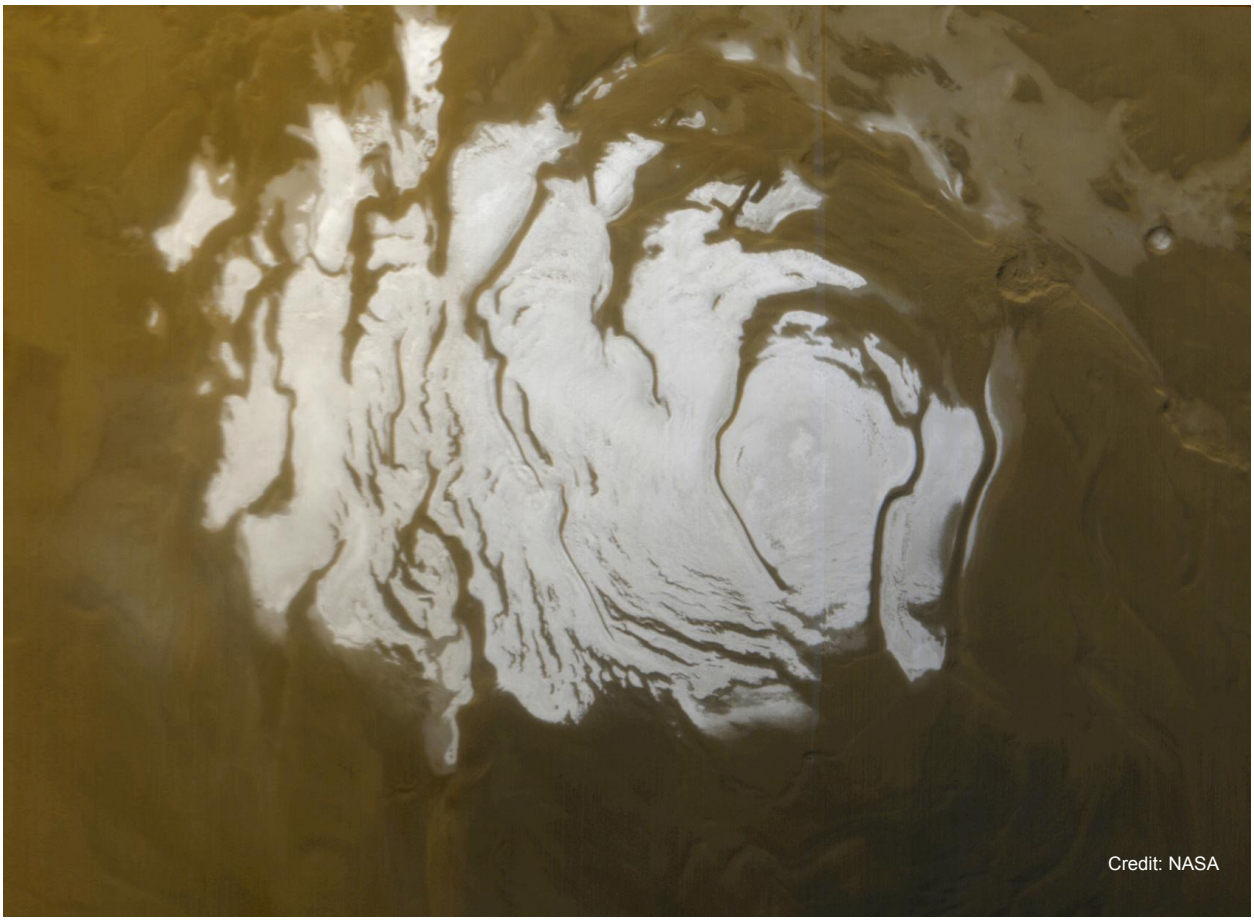
Greetings AST 111. In this module we’ll explore the atmospheres of the Moon, Mercury and Mars.



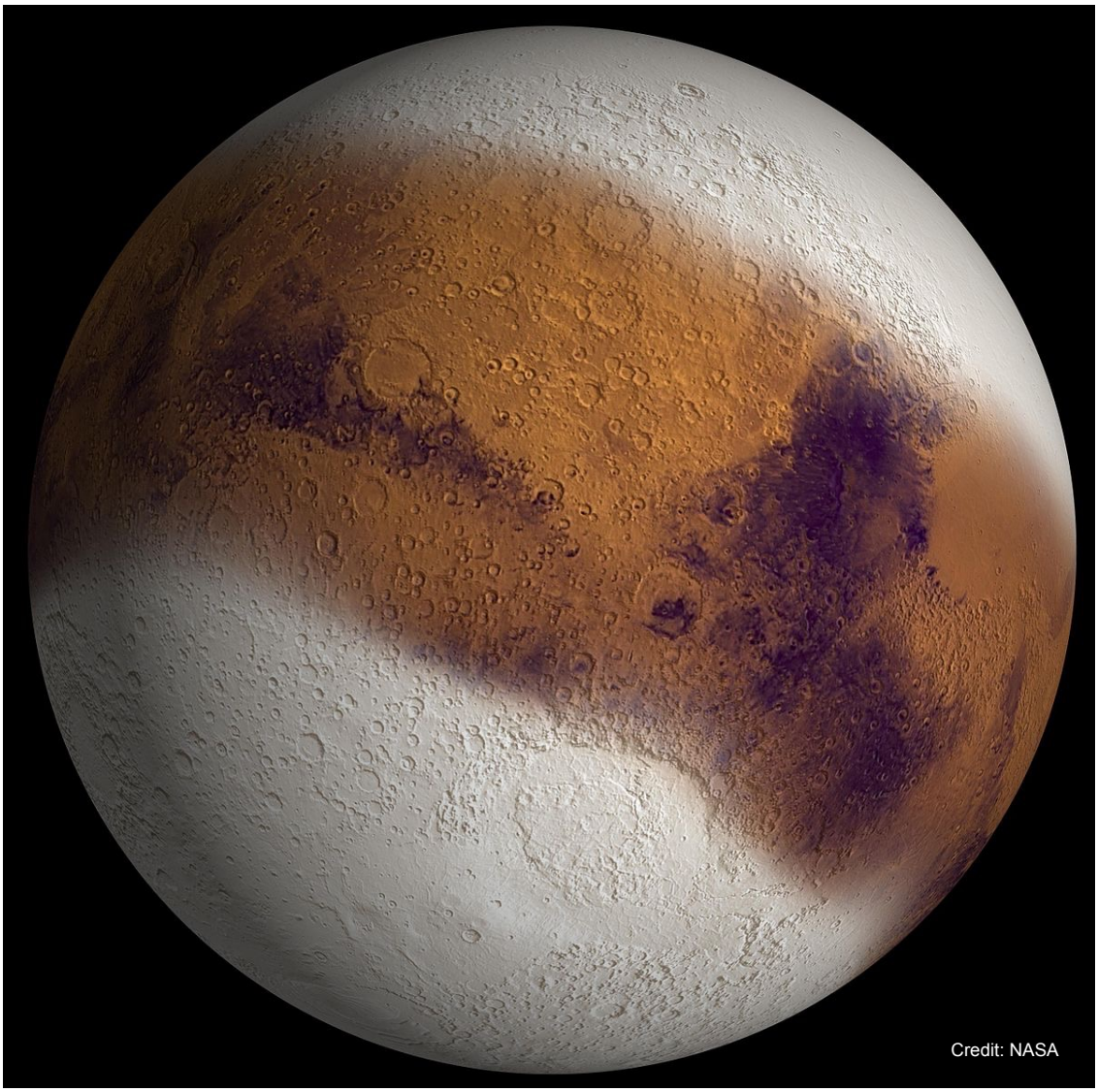
The Moon and Mercury do have atmospheres, but only thin tenuous outer layer exosphere. They don't have a troposphere. They don't have a stratosphere. Their exospheres mainly consists of gas, which is released from the surface by impacts with micrometeorites, solar wind particles, and high energy solar photons. So they hit the surface which releases a tiny bit of gas, which comprises the atmosphere.

You can actually “see” the atmosphere of the Moon, as the image above shows. As the Moon moving around in orbit, it loses some atmosphere, primarily sodium, which gets

blown back by the solar wind. So it kind of looks like a comet tail. It's not very strong, so the image has been highly enhanced. But you can detect the atmosphere of the Moon, and that it's losing that atmosphere as it orbits.



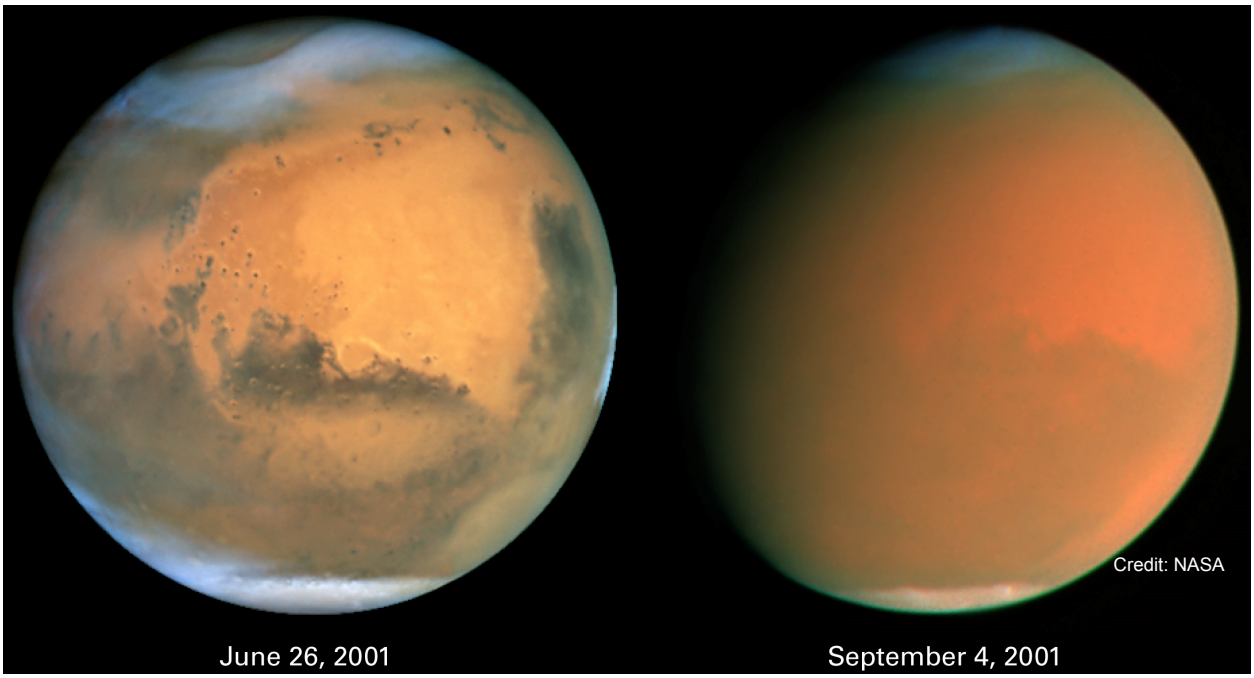
Onwards to Mars. These days Mars is cold and dry with an atmospheric pressure low enough - James Bond 007 bar - that liquid water is unstable. However, there is lots of water frozen in the polar caps, particularly in the Southern Hemisphere, just because the polar cap is much larger. The image above shows the Martian Southern polar cap during the summer, when its depleted. Its a later frozen carbon dioxide and water. It's about eight meters thick. In the Southern Hemisphere winter, that whole area beomes a lot more covered in ice and frost. This cycle of sublimation and condensation drives the Martian atmosphere we see today.



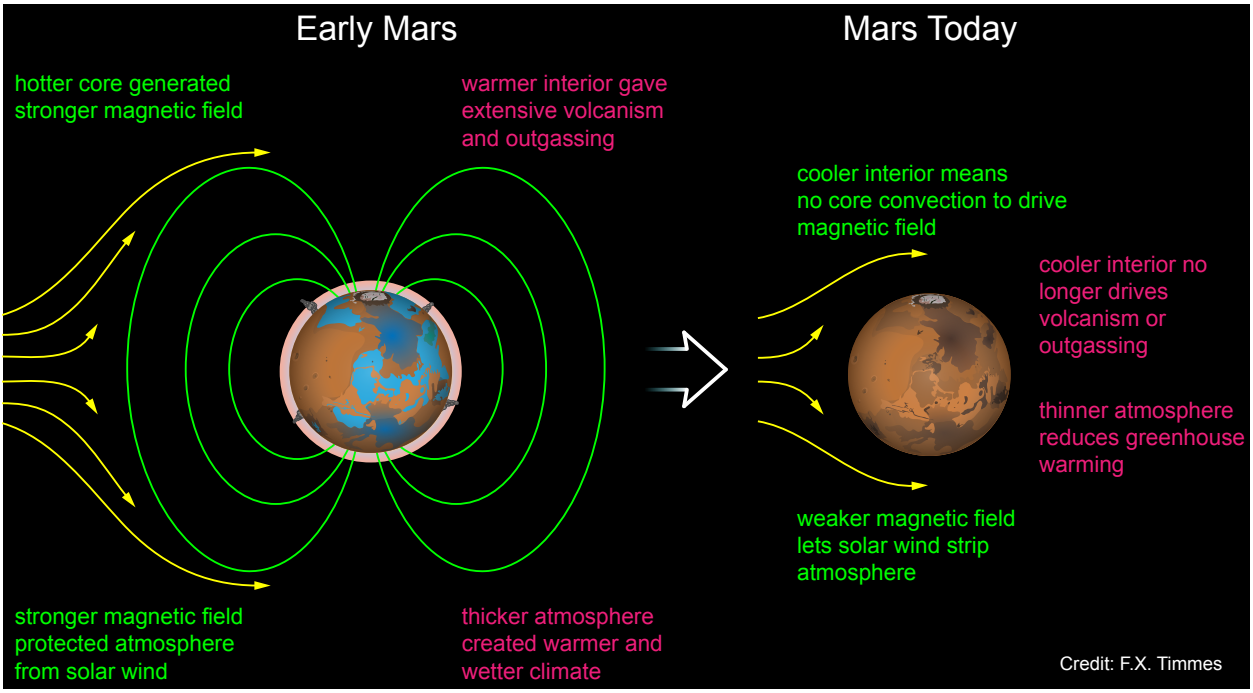
But it wasn't always this way. Mars lacks a big moon like our Moon, which stabilizes our 23.5° axis tilt. Lacking such a stabilizer, Mars' axis tilt wanders about from its current 25° axis tilt. Models suggest Mars' axis was as large as 40° just 400,000 years ago. The illustration above shows what Mars may have looked like then. The polar ice cap regions are much larger. Meaning the martian atmosphere would have been even more depleted than it is today.

Martian weather is driven by seasonal changes that cause carbon dioxide to alternately condense and sublimate at the poles. Mars also doesn't rotate very fast. The combination of big polar changes and slow rotation means Mars has global equator-to-pole prevailing winds. That is, Mar's has just one convection cell, or Hadley cell, per hemisphere because the Coriolis effect is weaker. Sometimes a local dust storm, sort of

like the haboobs we get in Arizona, can get magnified by this these equator-to-pole prevailing winds to create a global dust storm. The image below shows an example. You can hardly see anything because there's so much dust up into the atmosphere driven by the Martian weather. So dust storms -- a prominent weather feature on Mars.



In the distant past, some 3 billion years ago, young Mars probably had a much thicker atmosphere with a much stronger greenhouse effect. Consider the illustration below.



Originally Mars was fairly Earth-like. Hot enough in the core for liquid metal. Hot enough for convection and rotation to generate a magnetic field. A field string enough to set up a cocoon to protect its young atmosphere from the wicked solar wind. But alas, Mars is too small to hold onto its internal heat for very long. As it loses its internal heat, it loses its magnetic field shield. The solar wind can then come on in and strip away the atmosphere.

Things now go from bad to worse. Thermal escape now has an easier route to operate. This is why it probably lost most of its water, because the ultraviolet light comes in, breaking up the water into hydrogen and oxygen. Hydrogen is the lightest of gases and readily escapes into space. Without less of greenhouse effect from having less water vapor, Mars cools down.

Maybe Mars is just in cold storage. A hibernating future Earth-like world. For when our Sun starts to run out of hydrogen fuel in about 5 billion years, it will swell into a swollen configuration. Maybe this will unlock the remaining frozen water on Mars once again.

Thanks! Bye Bye.