1 Lecture 11

1.1 Mars

- It would take a long time to get there because it is 1.5 AU away from the Sun (it would take a few years)
- You have little to no protection from radiation (little atmosphere)

1.1.1 Mars vs The Earth

- It has half Earth's radius and a tenth Earth's mass
- It gets 44% less heat/light
- The axis tilt is about the same as the Earth's—has seasons but the tilt is more variable
- Similar rotation period
- Orbit is more elliptical than the Earth's
- Very thin CO_2 atmosphere: little greenhouse effect
- Cold deser; red look due to soil color from oxidation
- The main difference is that *Mars is smaller*

> **Note.** Because Mars is so small, it is not geologically active (because it is not hot enough).

1.1.2 Martian Seasons

- Martian axial tilt is 25 degrees compared to Earth's 23.5
- Mars' orbit is significantly more elliptical, which leads to more variable seasons
- Martian winters are cold enough to freeze a portion of the atmosphere
- Winds associated with cycling of carbon dioxide gas lead to large, sometimes global wind storms

1.1.3 Mars Today

- It has atmospheric CO_2 just like Venus, but 10000 times thinner
- Low atomspheric pressure causes water to sublimate

> **Note.** Liquid water cannot exist on Mars.

1.1.4 Features of Mars

- It seems to be split into Northern lowlands and Southern highlands
- The southern hemisphere seems more cratered (there is evidence of erosion in some craters)
- There are three regions of varying age on Mars

1.1.5 Martian Volcanism and Tectonics

- Evidence for Martian volcanism includes four massive volcanoes of the Tharsis Bulge
- Sedimentary walls are similar to the Grand canyon

1.1.6 Evidence for Ancient Water

- Orbital evidence—missions yield evidence of riverbeds
- Rover evidence—both orbiters and rovers have found hydrated minerals
- Phoenix lander found water ice on Mars

1.1.7 Evidence for Recent Water

- Dark streaks on crater walls seem to grow in the summer months
- All evidence points to a planet that was once much wetter and perhaps still contains water ice or subsurface liquid water

1.1.8 The Climate History of Mars

- Early Mars might have had a hot convecting core that would've protected it from the solar wind (too small to have a convection core)
- Mars' axial tilt could vary from 0 to as much as 60 degrees

1.1.9 The Viking Experiments

- Carbon assimilation experiment—mixed martian soil with CO_2 and CO to look for metabolic results (no indication of life)
- Gas exchange experiment—mixed martian soil with a nutrient "broth" (no indication of life)
- Labeled release experiment—mixed martian soil with a radioactive nutrient "broth" (expected signs of life)
- Gas chromatograph experiment—no organic material in martian soil

The results of these tests are inconclusive—more testing is needed.

> **Note.** We need to make sure that we don't contaminate Mars with Earth life.

There are four lines of evidence for life from ALH84001:

1. Layered carbonate grains similar to biological activity on EArth
2. Polycyclic aromatic hydrocarbonds produced by both living and non-living processes (high relative amounts)
3. Crystals match similar crystals on Earth produced by bacteria
4. Images of rod-shaped structures resemble fossilized bacteria

However, this is equally refuted by:

1. Non-biological mechanisms also produce these carbonates
2. PAHs are produced by both living and nonliving reactions
3. Similarities between crystals may be coincidence
4. These structures have also been seen on other meteorites and seem too small for RNA/DNA

1.1.10 Terraforming Mars

- In the future, it might be possible to make Mars habitable
- However, this is currently impractical, because the scale is too massive