Summary of the Last Lecture

- Earth: An active world
- Evolution through geological time
- Significant past (4.5 billion years)
- Answers to key unknowns:
  - *What processes?*
  - *Operating time scale?*
  - *Controlling factors?*
  - *Products (outcome)?*
  - *Evolution of life?*
- Geological records ~ Time capsule
- Distant past → Blurry vision
- Looking beyond the Earth for clues
- Predicting the future

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The Face of the Moon (above) tells the story of the Earth's past.

Exploring Clues to the Past

- Geological record is scattered throughout the solar system
- Planetary bodies: products of diverse evolutionary trajectories
- Insight into short-term / long-term changes caused by various physical processes e.g. Global Magnetism
- Planetary bodies as space resource
- Future Habitat*
- Tied to the understanding of processes & products

Exploring Clues to the Past

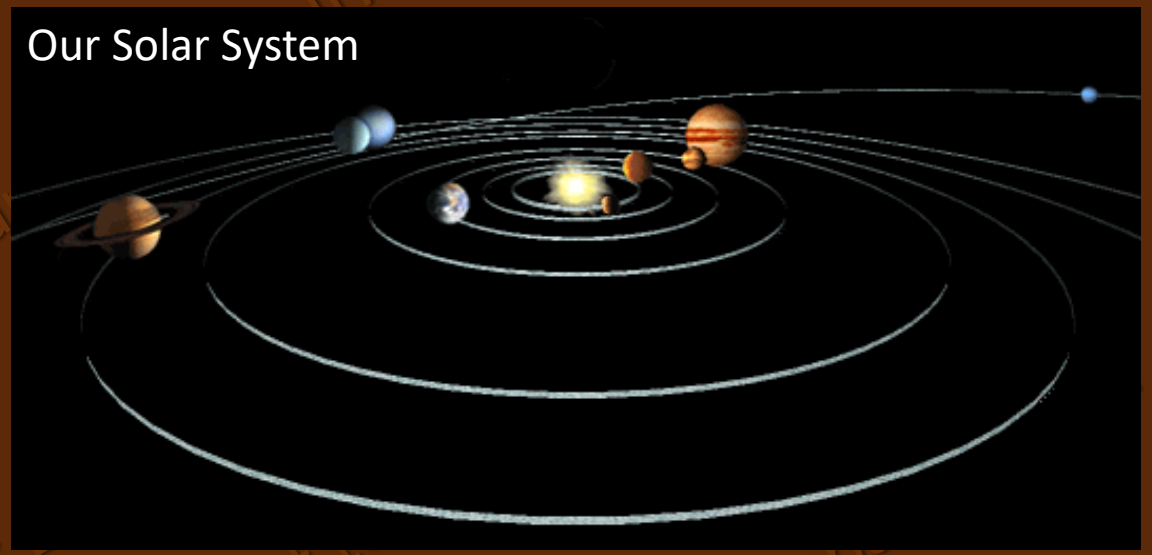
(Source: https://www.universetoday.com/134314/exploring-universe-magnetic-fields/)

- Magnetic field → an umbrella → shield against energetic radiation from the Sun and beyond.
- Absence of a magnetic field → Scorching radiation reaches surface → inhospitable terrain.

- Absence of a magnetic field → Planetary atmosphere gets stripped off.
- Mars had a much thicker atmosphere in the past.
- Loss of Mars' magnetic field → Atmospheric loss followed…

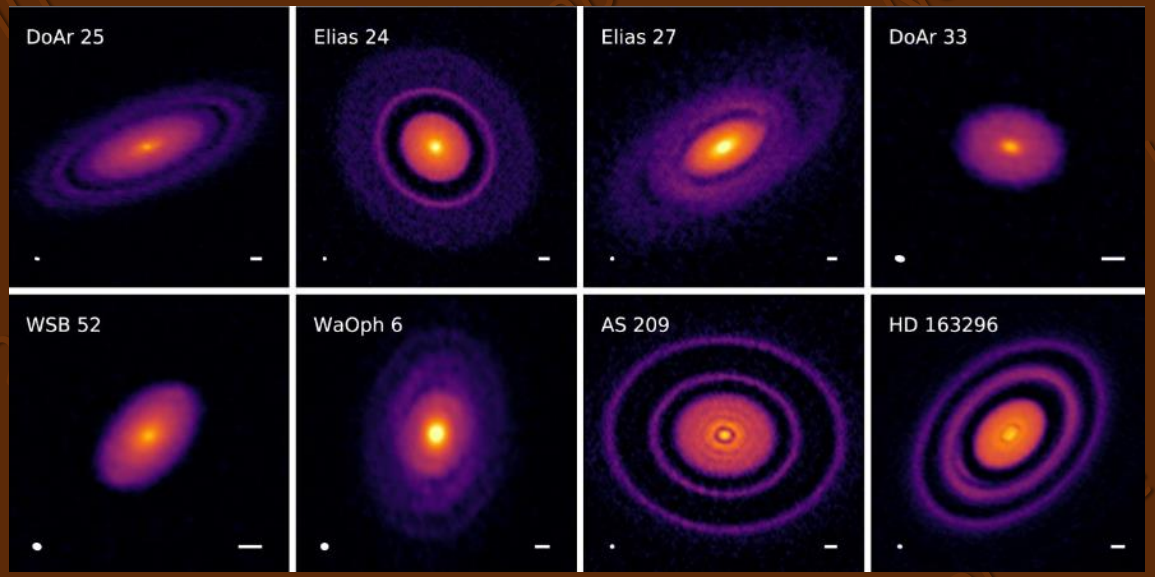
Knowing our Neighbours

- Solar System: A star and all the material that orbits around it, including its planets & their moons
- Are their other solar systems?
- Do they look similar?
- Did they form the same way as ours ?



(Source: https://www.windows2universe.org/images/best_solar.gif)

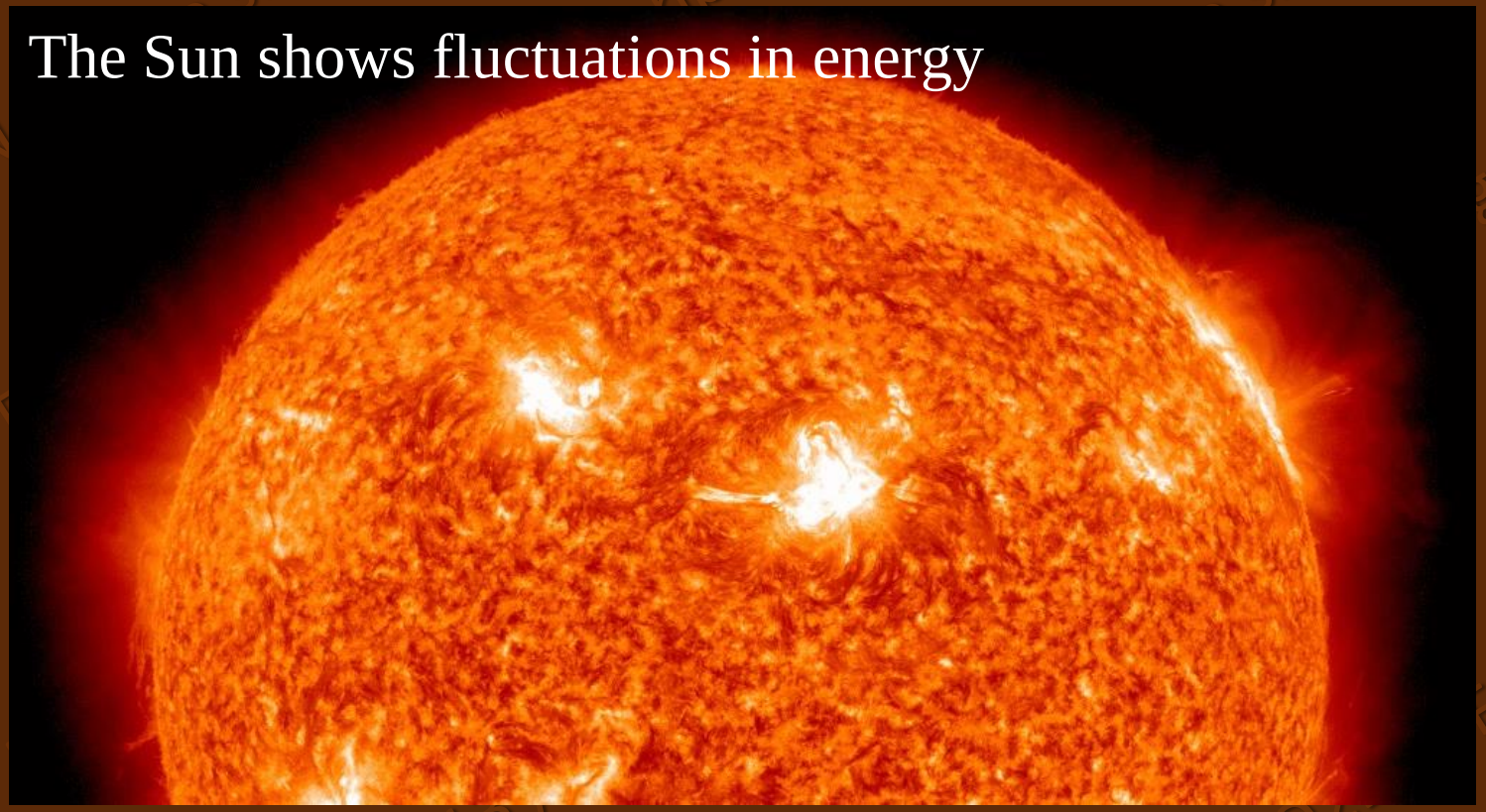
Other Potential Solar Systems being Studied

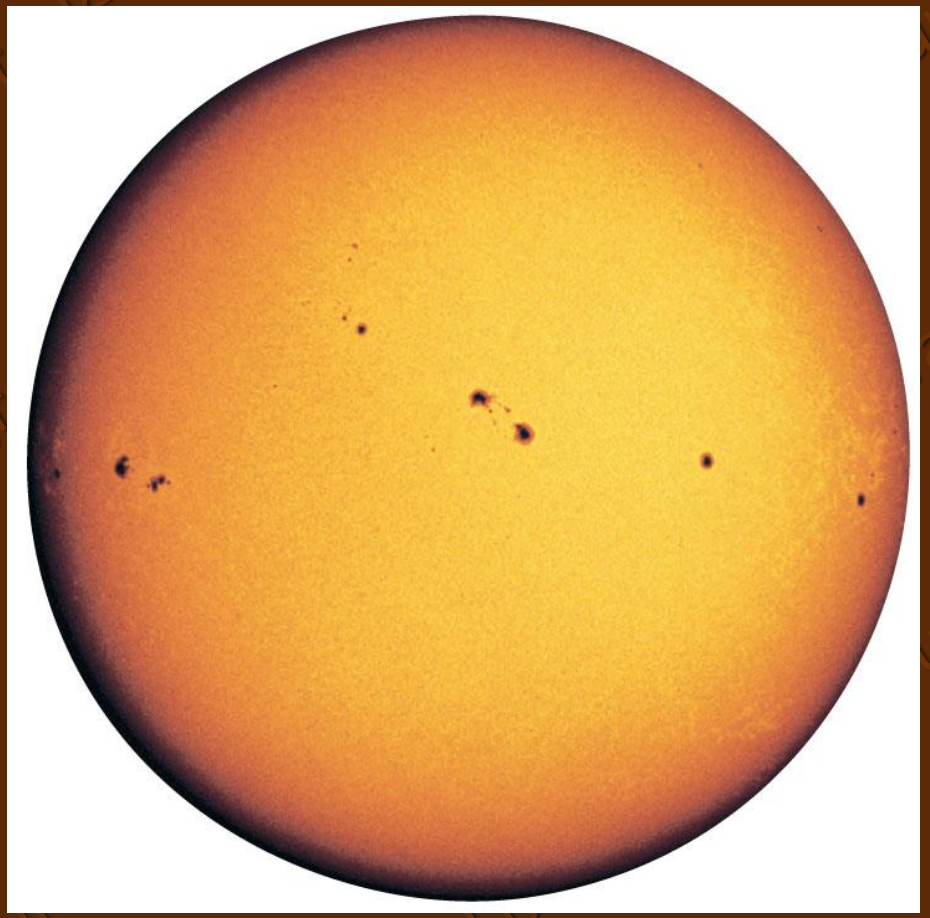


(Source: https://news.ufl.edu/2022/08/new-exoplanet-offers-clues-on-planet-formation/)

Star

- A large, glowing ball of gas that generates heat and light through nuclear fusion

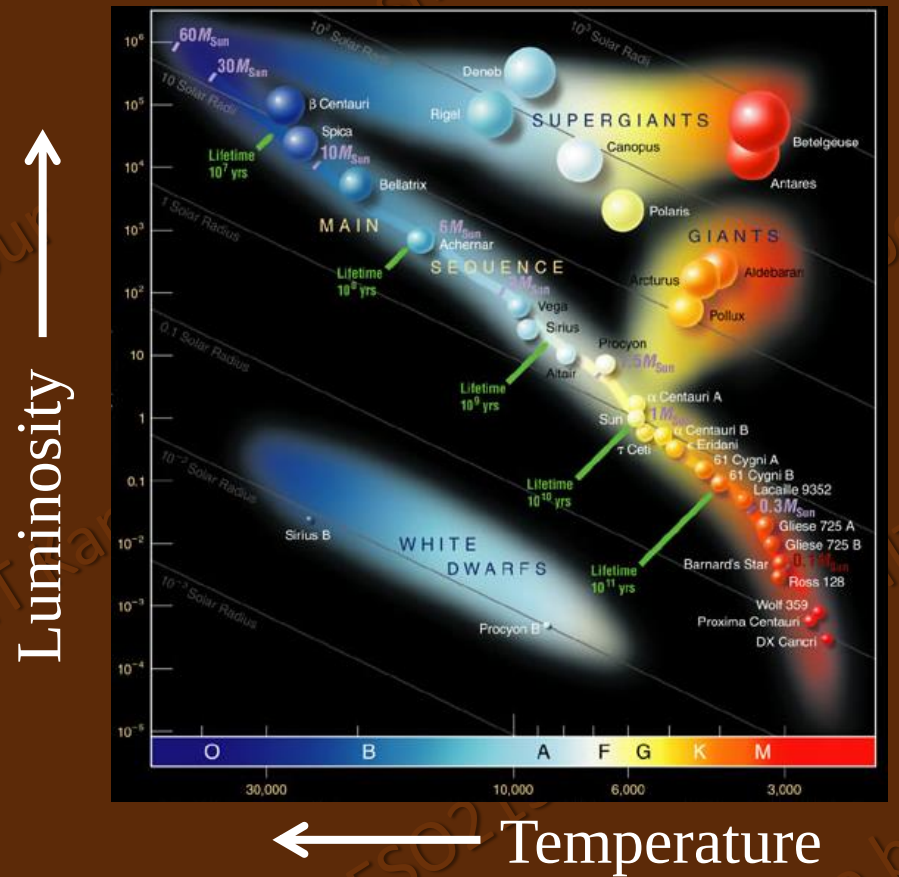




- The Sun is not a stable source of energy

Star

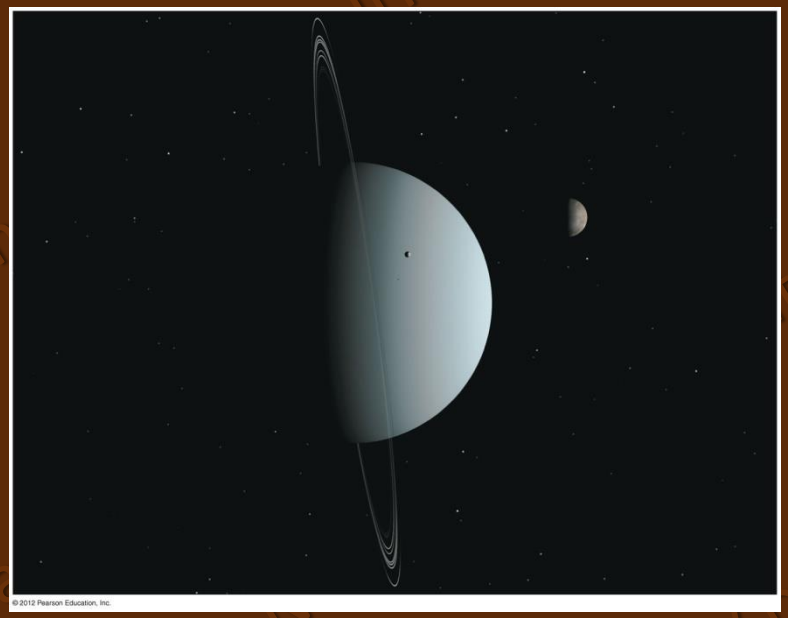
- There are billions of stars in the universe.
- Do all have solar systems?



- Stars are of different kinds
- Star has a lifetime during which it goes through different phases
- Which stars are likely to have solar systems?

Planet

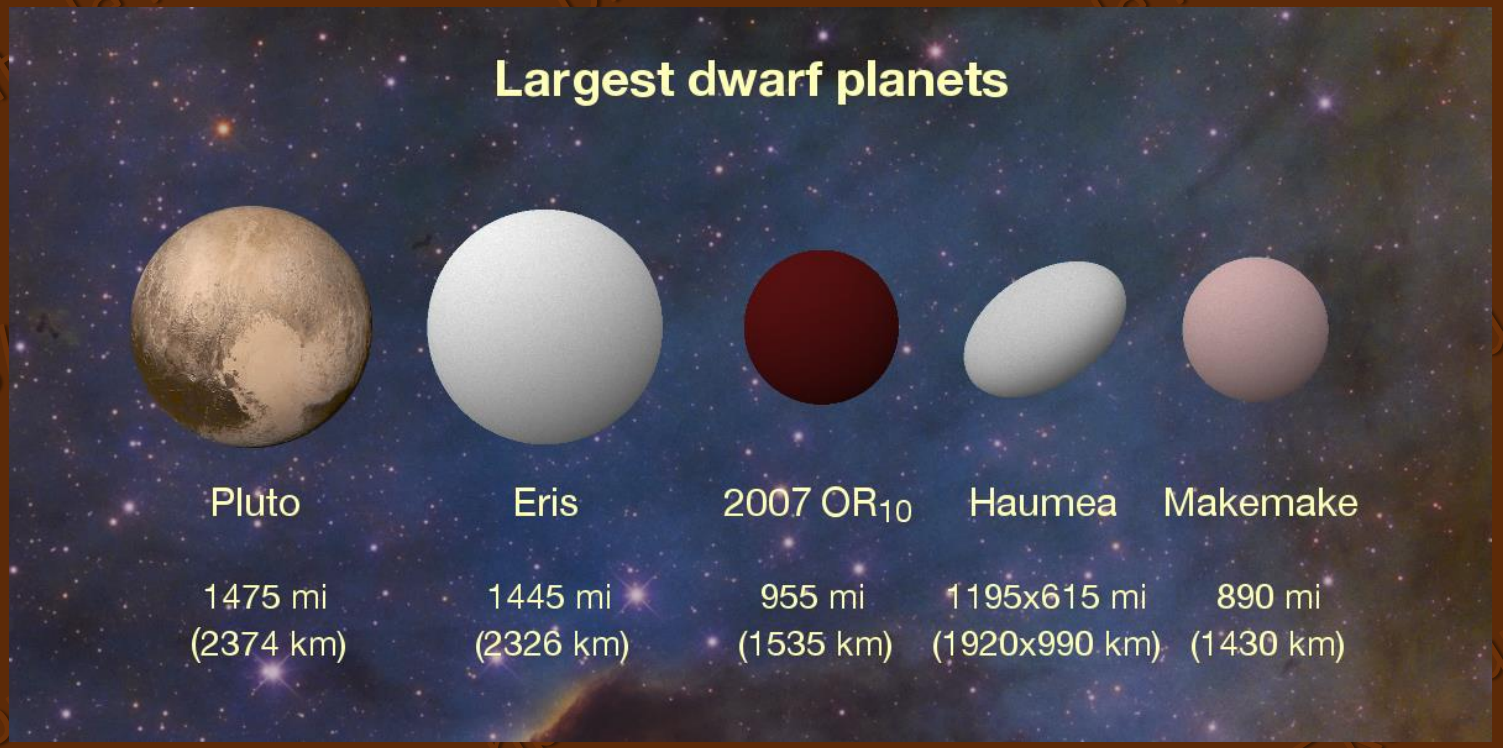
Mars (Diameter ~6800 km)



Uranus (Diameter ~51,000 km)

- A moderately large object that orbits a star. It shines by reflected light.
- Planets may be rocky, icy, or gaseous in composition.
- A planet has cleared any cosmic debris around its neighborhood along its orbit except few orbiting objects, its moons.
- The moons are in systematic (stable) orbits around the planet.

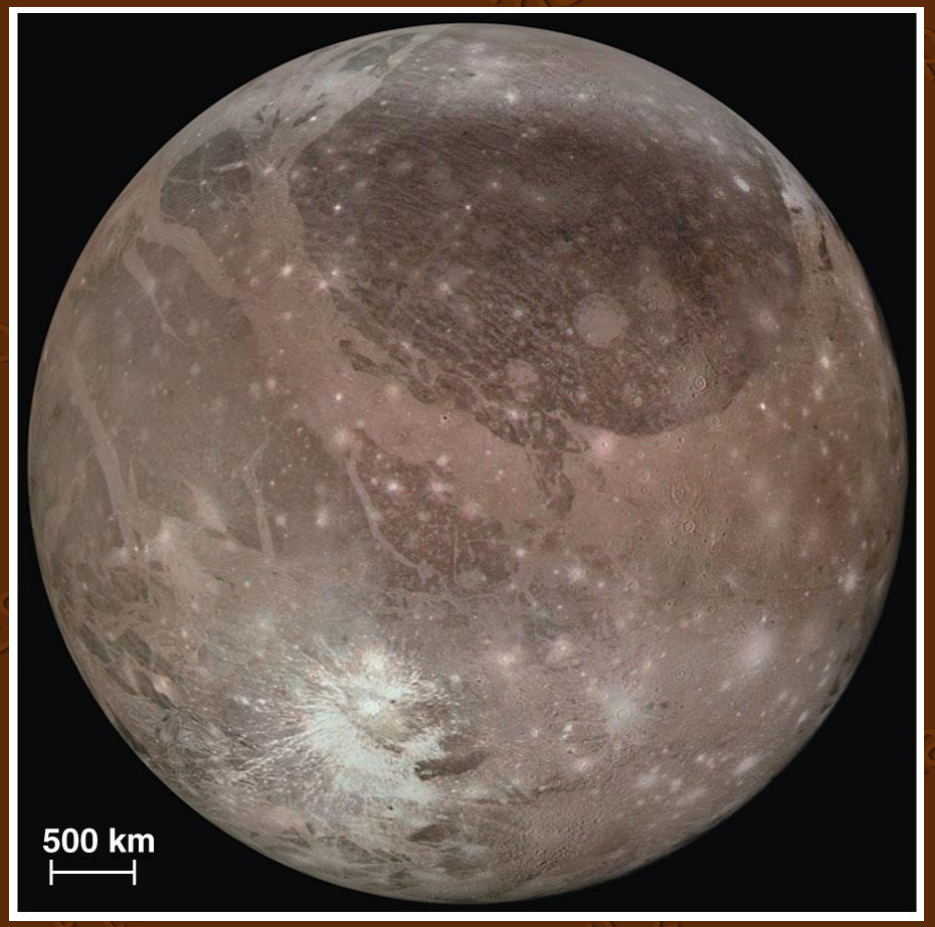
Dwarf Planet



(Credit: Konkoly Observatory/András Pál, Hungarian Astronomical Association/Iván Éder, NASA/JHUAPL/SwRI)

- Largely fit the definition of a planet except…
- Dwarf planets have not cleared the neighborhood around their orbits

Moon



Ganymede (Diameter ~ 5200 km)

- An object that orbits a planet.
- Moon can be icy and/or rocky.
- Moons are typically much smaller than their parent satellite.
- The Moon: The name of Earth's Moon
- Moon: *Term refers to the stable orbiting companion(s) of a planet.*