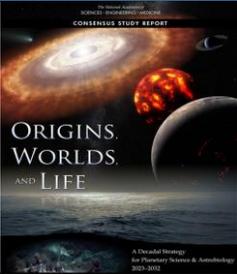


ASTR 4800 - Space Science: Practice & Policy
 Today: **The Planetary Sciences & Astrobiology Decadal Survey**

- **Next Class:** NASA's Commercial Space Economy.
- Reading: NASA website linked on class webpage for Nov. 2.
- Heads up - Exam #2 on Nov. 16.



Astronomy 4800 - Space Science: Practice & Policy

1

Origins, Worlds, and Life: A Decadal Strategy for Planetary Science and Astrobiology 2023-2032

By Meggan Amos and Evan Walsh

2

What is Planetary Science and Astrobiology

- Astrobiology - An interdisciplinary field studying life in the universe from its origins to evolution.
- Planetary Science - the study of planetary systems and the evolution.



"The Decadal committee evaluated potential activities by their capacity to address the priority science questions identified by the committee, cost and technical readiness as assessed through independent evaluation, programmatic balance, and other factors."

State of the Profession:

- Scientists being added to the field is slow
- Looking forward to adding diversity especially people of color

3

Comparison to Astrophysical Decadal Survey

- One example of how the astrophysical and planetary decadal surveys differ are on the subject of exoplanets.
- Both the planetary and astrophysical decadal surveys focus on exoplanets, but approach them in different ways.
- The decadal astrophysical survey focus on telescopic and spectroscopic observations of the planets themselves.
- The planetary decadal survey focuses on properties of exoplanets with planets and materials within our own solar system as analogs.



https://www.nasa.gov/press/202208/nasa-kepler-mission-discovers-8-giggle-older-planet-to-earth

4

How was the decadal received?

- Head of NASA's Planetary Science Division approved of most of the survey, though many think amount of money it would take is out of scope.
- Many were particularly excited about possible missions to Uranus



https://www.nasa.gov/press/202208/nasa-kepler-mission-discovers-8-giggle-older-planet-to-earth

5

Priority Science Questions: Origins

- Evolution of the protoplanetary disk.
 - Initial conditions of the solar system
 - Processes that produced planetary building blocks
 - Evolution of materials
- Origin of inner and outer solar system
 - When and how did the planets and satellite systems originate
 - Migration of planets
 - When did dwarf planets form and how did the evolution of the solar system affect them



Photo credit: NASA/JPL

6

Priority Science Questions: Worlds and Processes

- **What are the giant planets made of?**
 - Jupiter and Saturn are primarily composed of hydrogen and helium, but the exact abundances as well as those of each and whether they are consistent with models of the solar nebula are still uncertain. The composition of ice giants like Uranus and Neptune is even more uncertain.
- **How have the interiors of solid bodies evolved?**
 - Mass and energy transport in the interiors of solid Solar System bodies such as the inner planets or dwarf planets has led to changing temperatures and even composition. How does planetary size, composition, and recycling of the crust affect planetary evolution?

7

Priority Science Question: Life and Habitability



Oumuamua: first detected interstellar object

- **Dynamic Habitability**
 - Where in the solar system do potentially habitable environments exist
 - What process led to the formation of habitable environments
 - How do planetary environments and habitable conditions co-evolve over time
- **Search for life elsewhere**
 - Evidence of past or present life in our solar system
 - How do we detect it

Question: We search for intelligent life/technosignatures with radio telescopes. Is this the best or only way we should search?



Book written by Carl Sagan

8

Class Exercise

Of the priority science questions discussed which would be your top priority?

- **Origins**
 - Evolution of protoplanetary disks
 - Origin of the inner and outer solar system
- **Worlds and Processes**
 - Composition of the gas planets
 - Evolution of solid body interiors (ie. planets, moons, asteroids)
- **Life and Habitability**
 - Dynamic Habitability
 - Search for life in the social system

9

Mission proposals: Mars Sample Return

- The Mars Sample Return Mission will use robotic systems on an unmanned spacecraft to return samples of Martian material to Earth.
- The exact launch date for the mission has yet to be determined, although NASA intends 2027 for an orbiter and 2028 for a lander. The mission still in the concept phase.
- The lander will land in Jezero Crater. The Perseverance Rover as well as a pair of small helicopters would be the primary means of sample collection. The samples would then be transferred to a container aboard a rocket which would launch from the surface and rendezvous with an orbiter that would return them to Earth some time around 2033.

10

Mission Proposals: Mars Exploration Program

- Mariner 3-9
- Viking 1&2
- Mars Observer
- Mars Pathfinder
- Mars Global Surveyor
- Mars Climate Orbiter
- Mars Polar Lander/Deep Space 2
- 2001 Mars Odyssey
- Spirit
- Opportunity
- Mars Phoenix
- Curiosity
- Mars Reconnaissance Orbiter

- Supports the search for life science question
- Supports the origins and evolution science questions
- Captures public enthusiasm

Recommendations:

- Maintain the MEP managed by the Planetary Science Division
- Next medium-class mission: Mars Life Explorer (\$1.1 billion, 2033)

Question: If the United States wasn't going to Mars where would you recommend we go and why?

11

Lunar Discovery and Exploration Program

- The Lunar Discovery and Exploration program is intended to establish commercial and international partnerships for lunar landings and the development of lunar science instruments, and the continued use of the Lunar Reconnaissance Orbiter.
- One of the proposed missions is the Endurance-A rover, which travel about 1000 kilometers across the moon's surface to collect approximately 100 kilograms of lunar samples. The rover will deliver samples to astronauts for return to Earth.

12

