



ASTROBIOLOGY SCIENCE STRATEGY AND THE CURRENT STATUS OF EXTRATERRESTRIAL LIFE DETECTION

Background and Description for an NRC Study

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NASA Authorization Act of 2017

The SMD-related portion of this bill includes several additional reporting requirements:

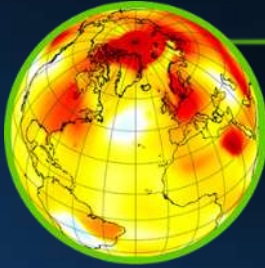
Sec. 508 requires NASA to task **the National Academies to develop a science strategy for the study and exploration of extrasolar planets**; this strategy is due 18 months after enactment (~September 2018).

Sec. 510 requires a report on how NASA **plans to expand public-private partnerships in astrobiology**; this report is due 180 days after enactment (~September 2017)

Sec. 509 requires NASA to task **with the National Academies to develop a science strategy for astrobiology**; this strategy is due 18 months after enactment (~September 2018).



Key NASA/SMD Crosscutting Science Themes



Safeguarding and
Improving Life on Earth



Searching for
Life Elsewhere



Expanding our Knowledge



Astrobiology

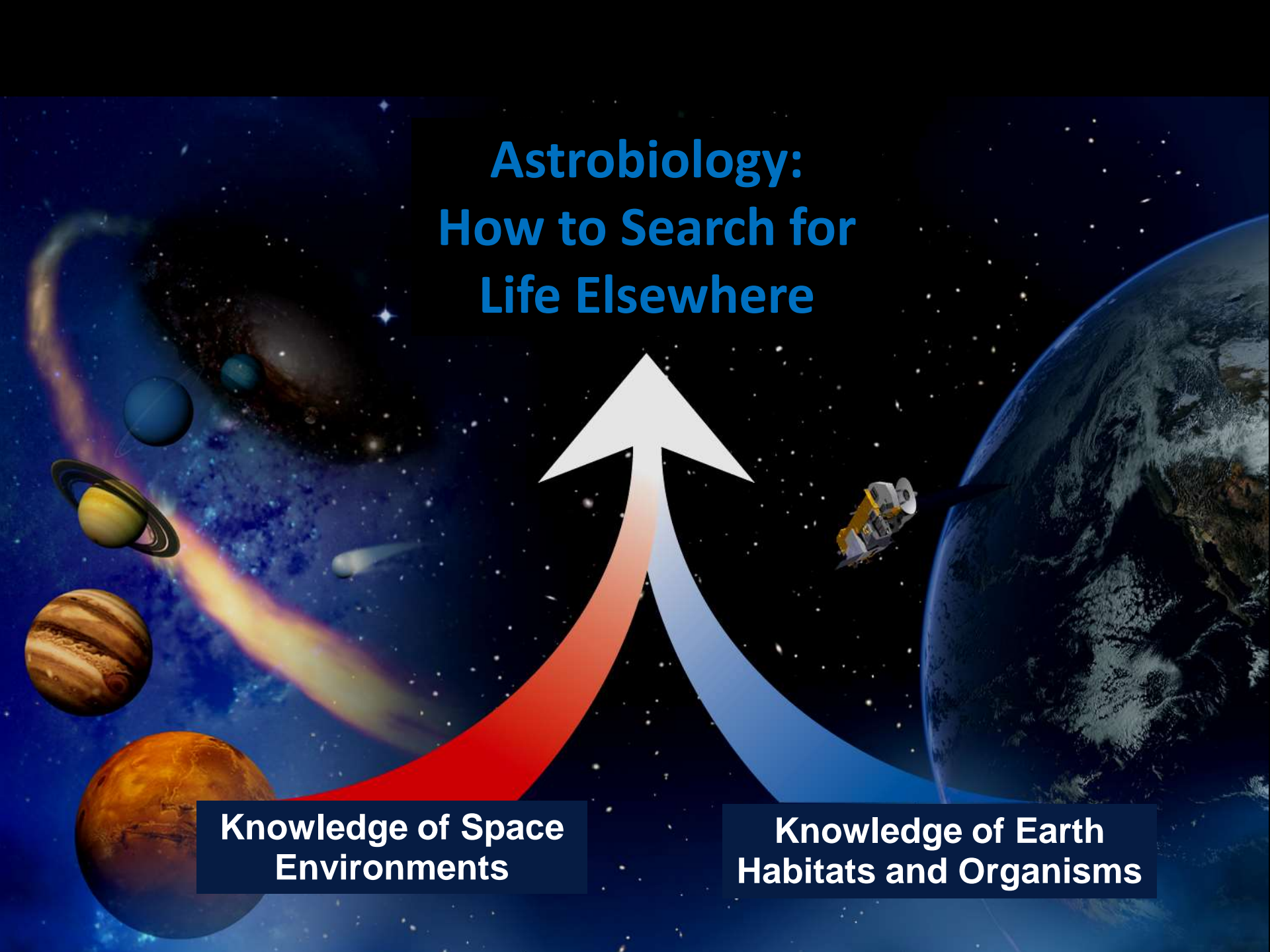
The study of life in the Universe, focusing on three fundamental questions:

- How does life begin and evolve?
- Does life exist elsewhere in the Universe?
- What is the future for life on Earth and beyond?

Astrobiology: How to Search for Life Elsewhere

**Knowledge of Space
Environments**

**Knowledge of Earth
Habitats and Organisms**





An NRC Study Would Build on The Astrobiology Science Strategy



- ◆ Community based & semi-decadal
- ◆ Broad participation in creation:
 - ✦ 77 Contributors
 - ✦ 744 members of *astrobiologyfuture.org*
 - ✦ 12 reviewers who made invaluable contributions.
- ◆ Goal was to create an “inspirational and aspirational” document.
- ◆ A PDF version is available on the Web. (Limited Printed Copies)
 - ✦ Will be “wiki-fied” to make it a living document.

(Released Fall 2015)



Six Major Research Areas Covered in the Strategy



1. Identifying abiotic sources of organic compounds
2. Synthesis and function of macromolecules in the origin of life
3. Early life and increasing complexity
4. Co-evolution of life and the physical environment
5. Identifying, exploring, and characterizing environments for habitability and biosignatures*
6. Constructing habitable worlds*

* (Overlap APD)



Anatomy of a Science Strategy Chapter



- ◆ Introduction
 - ◆ Why is this topic important?
 - ◆ What does this research entail?
 - ◆ Progress in the last ten years
 - ◆ Areas of research
 - ✦ Key Research Questions for each area
 - ◆ Further Reading
- } Intentionally not prioritized



Additional Foundational Activities and Documents

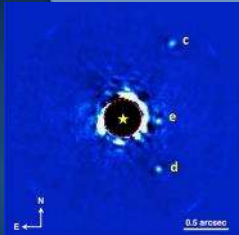
- ◆ Exoplanet Biosignatures Workshop July 2016- Joint NExSS-NAI-ExEP effort
- ◆ Agnostic Biosignatures: Recognizing life as we don't know it. HQ hosted, September 7-9, 2016
- ◆ Biosignatures of Extant Life on Ocean Worlds Workshop. GSFC hosted, September 12-14, 2016
- ◆ Searching for Life Across Space and Time: A Workshop NRC hosted, December 5-6, 2016 Irvine, CA
- ◆ Europa Lander Study 2016 Report
- ◆ Ocean Worlds Exploration Roadmap OPAG coordinated Input for Mid-Term Decadal (Delivery Date 2017)
- ◆ Nexus for Exoplanet System Science (NExSS)



NExSS, NASA's cross-divisional studies of Search for Life Elsewhere

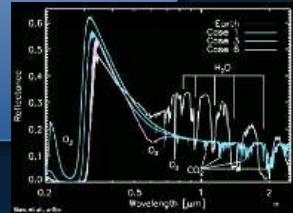
Astrophysics

Exoplanet detection
Star characterization
Mission Data Analysis
Hubble, Kepler,
TESS, JWST,
WFIRST, Etc.



PSD Astrobiology

Comparative planetology
Planetary atmospheres
Exoplanet detection of
Biosignatures
Habitability

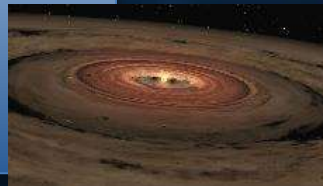


**Earth
Sciences**
How planet
systems works



PSD Exoplanet Research Program (XRP)

Exoplanet characterization
Protoplanetary Disks
Planet formation
Comparative planetology



Heliophysics

Star characterization
Detection of planetary
magnetospheres
Stellar winds





Charge to NRC

In preparation for the upcoming decadal surveys in astronomy and astrophysics and planetary science, the National Academy of Sciences will appoint an ad hoc committee to carry out a study of the state of the science of astrobiology as it relates to the search for life in the solar system and extrasolar planetary systems.



Such a study shall—

- ◆ assess and build on the current Astrobiology Science Strategy 2015;
- ◆ outline key scientific and technology challenges in astrobiology particularly as they pertain to the search for life in the Solar System and **extrasolar planetary systems**;
- ◆ should accommodate the overlap with the Exoplanet Exploration study in the area of assessing habitability and search for signs of life;
- ◆ identify the most promising research goals in the field of life detection in which progress is likely in the next 20 years;
- ◆ consider the role of and how to expand partnerships in furthering the to study life's origin, evolution, distribution, and future in the universe;
- ◆ indicate the extent to which U.S. and international missions and telescopes in operation or in development address the key research goals; and
- ◆ make recommendations on the above as appropriate.



Notional Timeline for Astrobiology Strategy Study

Sec. 509 requires NASA to task with the National Academies to develop a science strategy for astrobiology; this strategy is due 18 months after enactment (~September 2018);

To meet that deadline, NASA envisions the following timeline:

- **April – June 2017** – Engagement with National Academies, negotiation of study terms, establishment of contract (est. 3 mo.).
- **June 2017 – June 2018** – conduct of Astrobiology Strategy Study (est. 12 mo.).
- **June – September 2018** – draft study report, peer review as deemed appropriate, submission of report to NASA.
- **September 2018** – NASA submits report to Congress.