

# DAY ONE PROJECT

## Advancing Astrobiology: The Search for Signs of Life Elsewhere in the Universe

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*The Day One Project offers a platform for ideas that represent a broad range of perspectives across S&T disciplines. This memo was drafted by contributors from the Day One Project and leaders in the Space Policy Community. The views and opinions expressed in this proposal do not reflect the views and opinions of the Day One Project S&T Leadership Council.*

## Summary

NASA should invest in a comprehensive program to answer one of humanity's biggest questions: "Are we alone?"

The United States has the scientific and technological prowess to find possible evidence of past or present life in our solar system. Over the last decade, the space science community has discovered Earth-like planets around other stars. The United States has launched Mars 2020—its first astrobiology mission to Mars. The Perseverance Rover will seek signs of ancient life and is part of the initial Mars Sample Return campaign. And, in the coming decade, we are poised for exponential growth in the technology, planetary science, and astrophysics components of the search for life.

Establishing a formal Astrobiology Program Office at NASA would better elevate, coordinate, and guide what could be the agency's most important mission. Notably, there are currently no NASA programs on astrobiology that integrate across the Astrophysics and Planetary Science divisions in NASA's Science Mission Directorate along with the technology investments of NASA's Space Technology Mission Directorate. NASA has no astrobiology czar.

Astrobiology is a relatively modern scientific field of study that has been enabled by a suite of robotic space missions and next-generation telescopes. We now have the potential to reveal new insights into the fundamental nature of life across the universe and our own planet.

## Challenge and Opportunity

From the disputed evidence of life on Mars in the 1970s found during the Viking lander missions, to a Martian meteor that was found in Antarctica in 1996 (leading to a presidential statement), one primary challenge in the search for life is the debate on what exactly is found and what it means for our understanding of what qualifies as a lifeform.

An Astrobiology Program at NASA would create a clearinghouse for all federally-funded research related to the search for life. It could (a) consolidate ongoing activities within the Agency and (b) provide an avenue and funding source for new activities. Serving the public interest, it could also accelerate our progress in this scientific quest.

### **Inner Solar System Planets Like Mars and Venus**

Perseverance, the latest Mars rover, launched to the red planet on July 30, 2020, will land in the early days of the Biden-Harris administration on Feb 18, 2021. Perseverance will collect scientifically-selected samples for return to Earth from Mars.

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When returned to Earth in the coming decade, these samples could provide evidence of past life on Mars. This first-ever roundtrip Mars mission requires the launch of other components in future years, which will enable Martian samples to be returned to Earth in 2031. Mars Sample Return is the most important planetary science undertaking of our generation.

Recently, Earth-based telescopic investigations have raised the possibility of detection of chemical elements associated with life in the upper atmosphere of Venus. Multiple spacecraft, including missions proposed through NASA's Discovery program, the European Space Agency, and even a privately-funded venture, are under consideration for travel to Venus. Astrobiology science objectives span the inner planets.

## Ocean Worlds

One of the biggest opportunities to look for signs of life in our own Solar System are on worlds with oceans as large as those on Earth. Missions are already in development, including an orbiter that will go to Europa, a moon of Jupiter, to help frame this search. NASA's current mission to Europa, slated to launch in 2024, has significant astrobiology objectives.

Ocean World in-situ technology investments made over multiple years have prepped the community for further exploration. Additional Ocean World missions could be launched in the coming years to destinations like Enceladus, Titan, Ceres, and Trident. An early example is the DragonFly mission to Titan scheduled for launch in 2027. Flotillas of deep space SmallSats deployed throughout the solar system could further aid in this quest.

Ocean World exploration has suffered from a disjointed approach across the Agency. A NASA Astrobiology Program could provide focus, strategy, and integration for an interconnected set of missions to our solar system's ocean worlds (as NASA's Mars Exploration Program has done for decades).

## Exoplanets

Through the Astrophysics Division of NASA's Science Directorate, NASA is already searching for planets outside of our solar system that could potentially harbor life.

The first Earth-like planet outside of our solar system was found in 2015, and the astrobiology community has since confirmed detection of approximately 25 more through the Kepler Mission and other astrophysics missions. Our sensing technology is improving rapidly such that oceans and atmospheric properties will soon be observable on some of these worlds.

## Plan of Action

In 2018, NASA took steps to evolve its Astrobiology Program to meet the needs of the future, and the Biden-Harris Administration has an opportunity to build on this. NASA should invest in expanding the agency-wide Astrobiology Program. It should combine the efforts of the present Astrophysics and Planetary Science Divisions in this domain and also integrate the research and technology investments needed to propel the search for life forward. An astrobiology czar would coordinate all extra-terrestrial life-detection at NASA, much like the Mars Czar did in the early 2000's as the Mars Exploration Program was being created.

The Program Director for Astrobiology would report to the Associate Administrator of the Science Mission Directorate. Increasing our investment in astrobiology research, technology, and missions would accelerate the pace of scientific discovery. This is also a ripe area for public-private partnerships with the interest of a broad range of foundations and angel investors. Much like the quadrupling of NASA's Near-Earth Object Program Office budget under the Obama Administration, the search for life aligns NASA's scientific and technological prowess with the interest (and assumption) of the public that we are already doing it.

## Conclusion

Investing in an expanded Astrobiology Program will allow NASA to focus its quest to find signs of life in the universe. It's an opportunity for the United States to assert its global leadership in the growing scientific frontier of astrobiology, and ensure this exciting scientific enterprise has strong, clear support from the space community going forward.

## Frequently Asked Questions

### **1. Is this just creating another bureaucracy within NASA?**

No. This will prioritize a new, specific goal for the agency while consolidating existing activities to build critical mass while acting as a clearinghouse for new approaches.

### **2. What if there is scientific disagreement on life-like findings?**

As Carl Sagan once remarked, “Extraordinary claims require extraordinary evidence.” The scientific process encourages debate and this field would certainly create that. Such debate is likely to only be resolved when multiple lines of independent inquiry point to the same conclusion. Such debate is also likely to inspire young people from all walks of life to pursue educational and career paths aligned with science, technology, engineering and mathematics.

### **3. Isn't there already an Astrobiology Institute at NASA Ames?**

Yes. NASA presently has an Astrobiology Institute and an Astrobiology Program as part of its Planetary Science Division that has advanced the basic state of astrobiology research for more than two decades. These basic research and technology efforts have provided the foundation for what is proposed here and would be a key part of a renaissance in this area. In the manner of the Mars Exploration Program of the early 2000s, this proposal suggests a synergistic and integrated set of research, technology, mission and flight system development activities to dramatically advance our state of knowledge about life in our universe. This proposal also suggests focusing a key science theme at the intersection of the present Planetary Science and Astrophysics divisions of NASA's Science Mission Directorate.

### **4. What other NASA activities could be part of this new Astrobiology Program?**

This program could include the following existing missions: Perseverance, Mars Sample Return, DragonFly, and Europa Clipper, as well as potential new missions under study through the Discovery and New Frontiers programs and significant observatory time from JWST and WFIRST.



### About the Day One Project

The Day One Project is dedicated to democratizing the policymaking process by working with new and expert voices across the science and technology community, helping to develop actionable policies that can improve the lives of all Americans, and readying them for Day One of the next presidential term. For more about the Day One Project, visit [dayoneproject.org](https://dayoneproject.org).