



EXPLORE

Astrobiology and RCNs

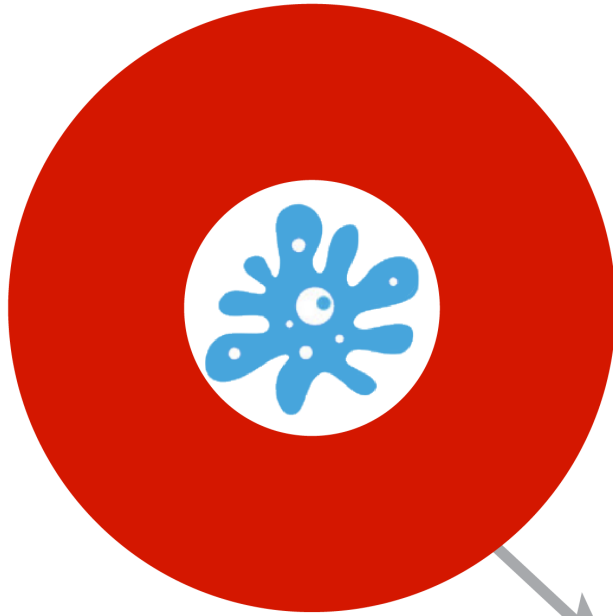
Dr. Mary A. Voytek
Senior Scientist Astrobiology
NASA Headquarters
Dec 5, 2022

What is a Research Coordination Network (RCN)?

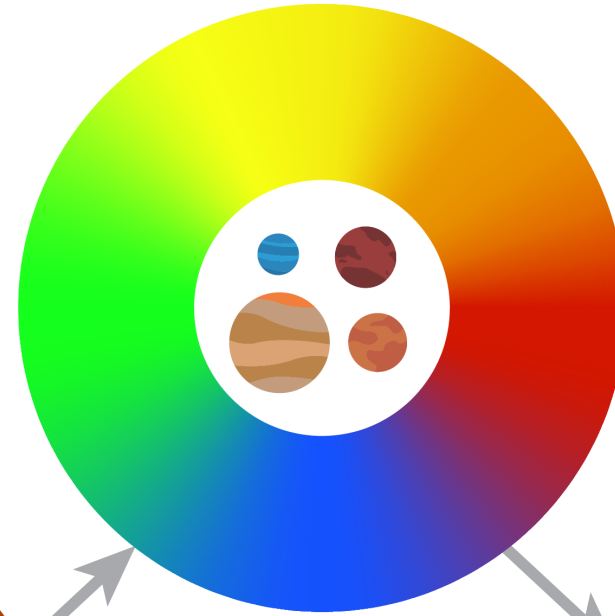
A Research Coordination Network (RCN) is a virtual collaboration structure that helps support groups of investigators to communicate and coordinate their research across disciplinary, organizational, **divisional (intra and inter)**, and geographic boundaries. NASA has modified a mechanism utilized by NSF to achieve the research goals for the Astrobiology Program.

Astrobiology Across SMD

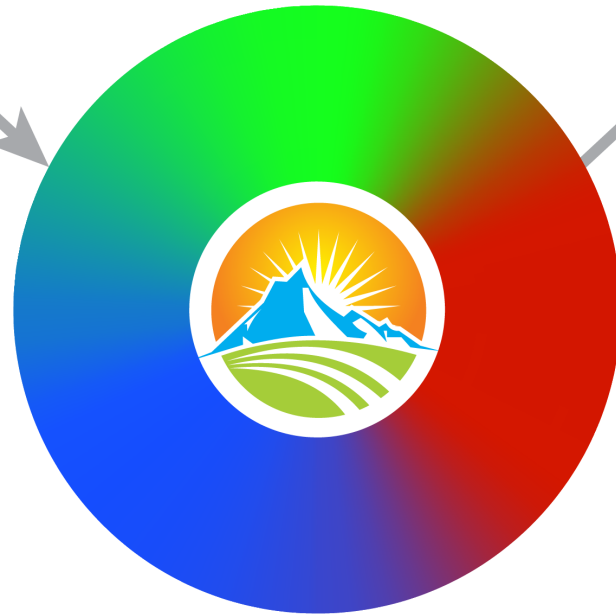
Origins of Life



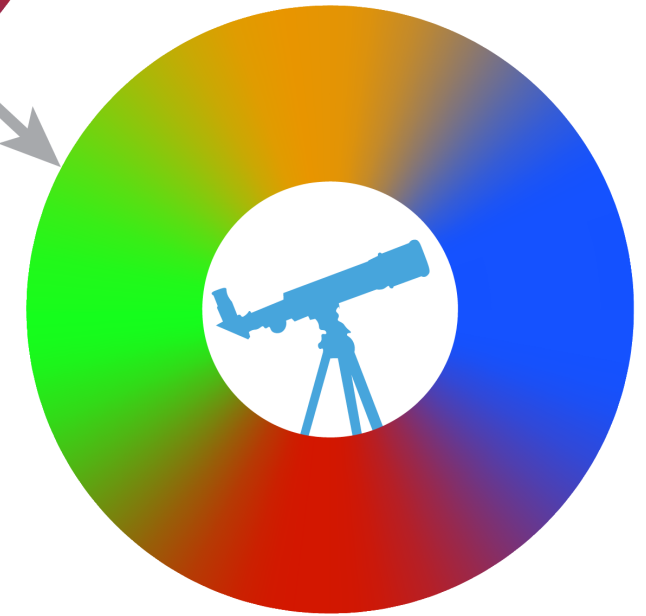
Habitable Worlds



Evolution and Future



Search for Habitable Worlds and Life



- PSD
- ESD
- HPD
- BPSD
- APD

Nuts and Bolts of the Astrobiology Program (PSD) RCNs:

- The NASA Astrobiology RCNs are a mechanism for community collaboration.
- Each RCN will have a steering committee comprised of the PIs of all teams who have elected to join to join, both from large teams selected from the ICAR solicitation as well as smaller teams from relevant ROSES R&A programs.
- The NASA Astrobiology Program, along with representatives of relevant research elements and SMD Divisions, will identify co-leads and potential members of the RCN and provide funding to support the logistical requirements of the RCN.
- The Astrobiology RCNs will be regularly reviewed (~5 years) by a Senior Review-like independent panel of experts to provide input to any decision to continue, modify, or sunset the RCN.
- New RCNs may also be established as the science in astrobiology evolves, new missions come on line, or the priorities of NASA shift.

Expected outcomes for the Astrobiology Program RCNs:

- Investigators carry out and propose interdisciplinary research that addresses new topics through new collaborations.
- Produces a plan for utilization of current mission data (if applicable).
- Spawns ideas for new and exciting missions, and encourages participation in and contributions to missions from planning through operations (if applicable).
- Identifies new targeted technologies or instrumentation needed, but not yet reported elsewhere.
- Influences Decadal Surveys for all NASA Science Mission Directorate (SMD) Divisions
- Enhances international engagement.
- Supports continued development of the astrobiology community.



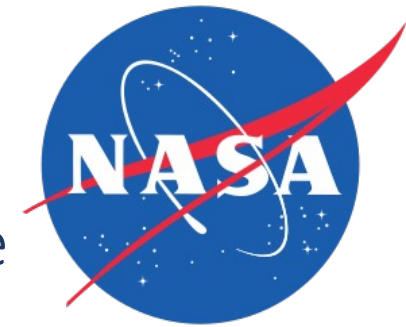
Areas of Research:

- Biosignatures and Life Detection (RCN-NfoLD)
- Habitability and Detection of Life on Ocean Worlds (RCN-NOW)
- Habitability and Detection of Life on Exoplanets (RCN-NExSS)
- Prebiotic Chemistry in Early Earth Environments (RCN-PCE3)
- Primitive Cells to Multicellularity (RCN-LIFE)



National Aeronautics and Space Act

20102. Congressional declaration of policy and purpose

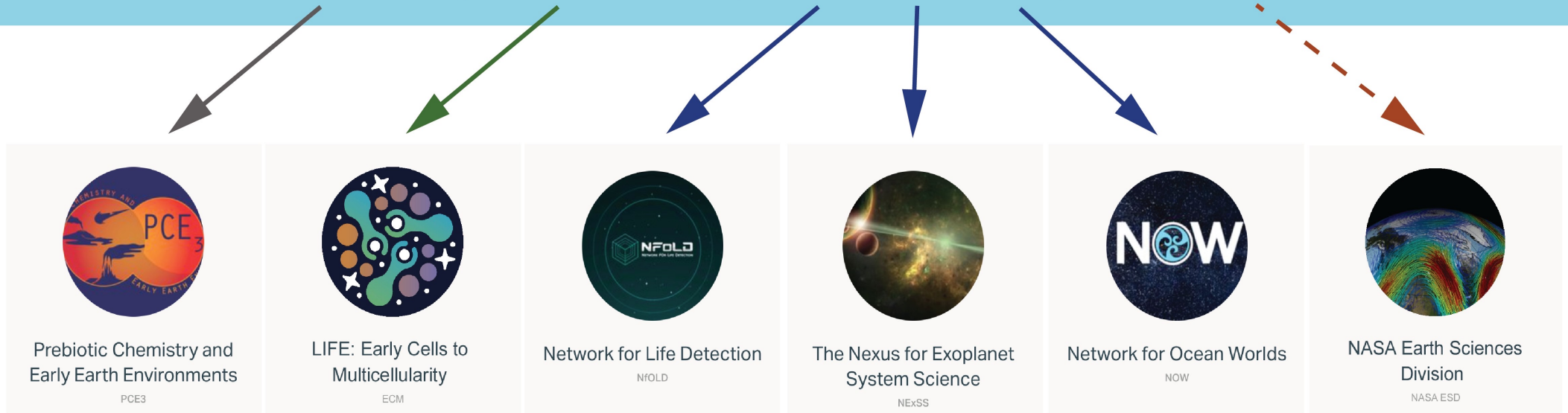


Objectives of Aeronautical and Space Activities.—The aeronautical and space activities of the United States shall be conducted so as to contribute materially to one or more of the following objectives:

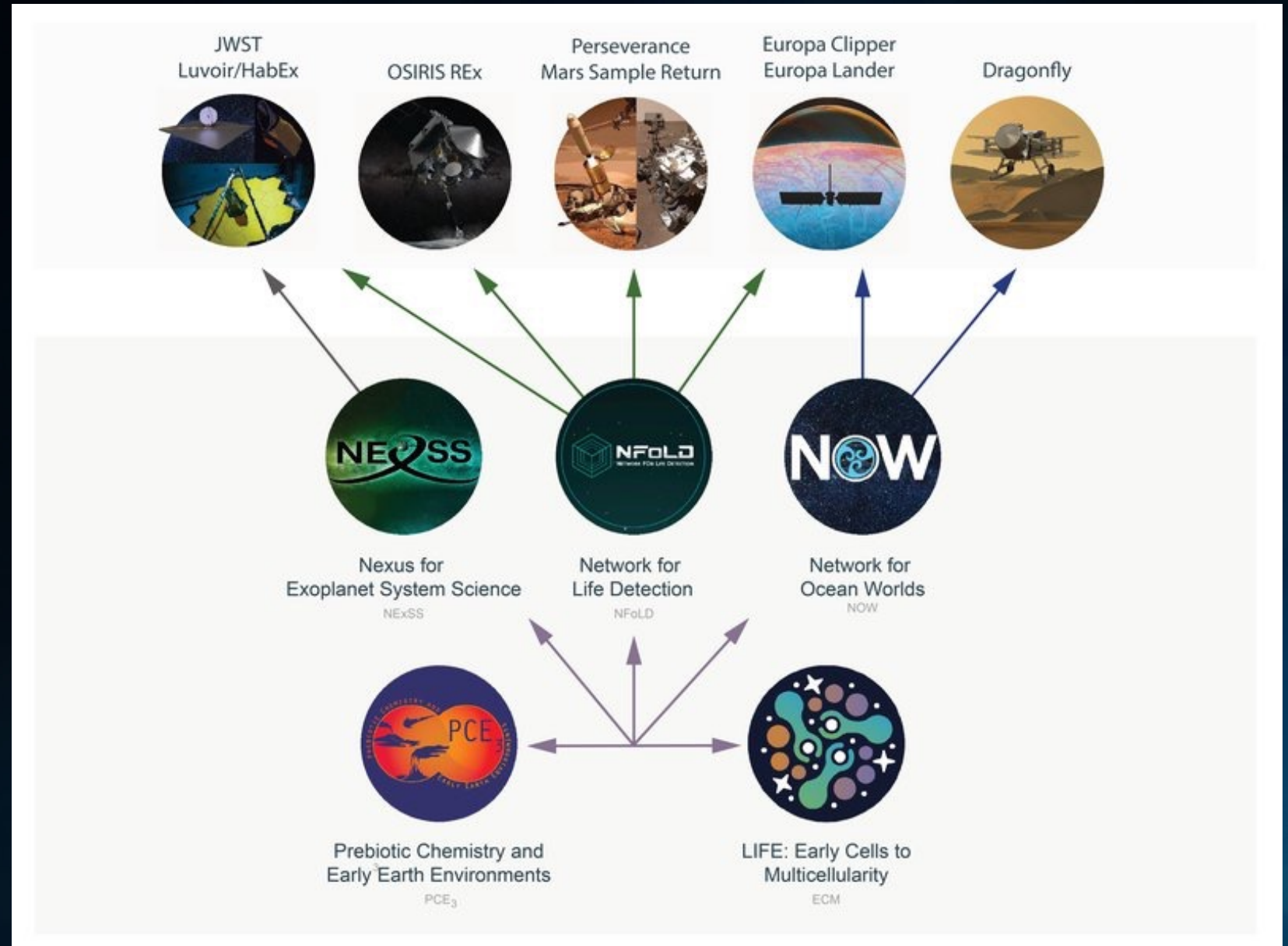
1. The expansion of human knowledge of the Earth and of phenomena in the atmosphere and space.
2. The improvement of the usefulness, performance, speed, safety, and efficiency of aeronautical and space vehicles.
3. The development and operation of vehicles capable of carrying instruments, equipment, supplies, and living organisms through space.
4. The establishment of long-range studies of the potential benefits to be gained from, the opportunities for, and the problems involved in the utilization of aeronautical and space activities for peaceful and scientific purposes.
5. The preservation of the role of the United States as a leader in aeronautical and space science and technology and in the application thereof to the conduct of peaceful activities within and outside the atmosphere.
6. The making available to agencies directly concerned with national defense of discoveries that have military value or significance, and the furnishing by such agencies, to the civilian agency established to direct and control nonmilitary aeronautical and space activities, of information as to discoveries which have value or significance to that agency.
7. Cooperation by the United States with other nations and groups of nations in work done pursuant to this chapter and in the peaceful application of the results thereof.
8. The most effective utilization of the scientific and engineering resources of the United States, with close cooperation among all interested agencies of the United States in order to avoid unnecessary duplication of effort, facilities, and equipment.
9. The preservation of the United States preeminent position in aeronautics and space through research and technology development related to associated manufacturing processes.
10. **The search for life's origin, evolution, distribution, and future in the universe.**

RCNs map to #10 policy and purpose

The search for life's **ORIGIN**, **EVOLUTION**, **DISTRIBUTION**, and **FUTURE** in the Universe.



RCNs map to ongoing and future missions





RCN Presentations: Running Order

1. LIFE
2. NExSS
3. NFOLD
4. NOW
5. PCE3



LIFE

FROM EARLY CELLS TO MULTICELLULARITY

Join us: LifeRCN.org

Earth the only planet known to harbor life.

If we can't understand life-planet co-evolution here, how can we look for it elsewhere?

LIFE will build a research community dedicated to understanding life-planet co-evolution as recorded in the rock record, in biodiversity, in genome databases, and revealed by *in silico* models and lab proxy studies that look both backward and forward in time.

LIFE will foster a “science of living worlds” that views life- planet co-evolution through a single holistic lens. Our community will address four “Big questions:”

What environmental pressures, biological mechanisms, and evolutionary opportunities:

- 1) *gave rise to cellular life?*
- 2) *caused life to expand to planetary scale?*
- 3) *led to the emergence of eukaryotes?*
- 4) *avored the transition from single cells to multicellularity?*

In parallel, LIFE researchers seek to understand how major biological innovations transitions affected our planet, shaping the evolutionary path of our integrated life-planet system.

LIFE will discern rules of co-evolution that will enable us to predict how life could evolve on worlds other than our own, and inform how we might search for it.

Launched
AbSciCon22

Steering committee assembled
Summer 22

Charter finalized
Fall 22

Upcoming workshops:
“Evolution of the Nitrogen Cycle”
Spring 2023

Upcoming seminar series:
Winter 2023

Life RCN co-Leads



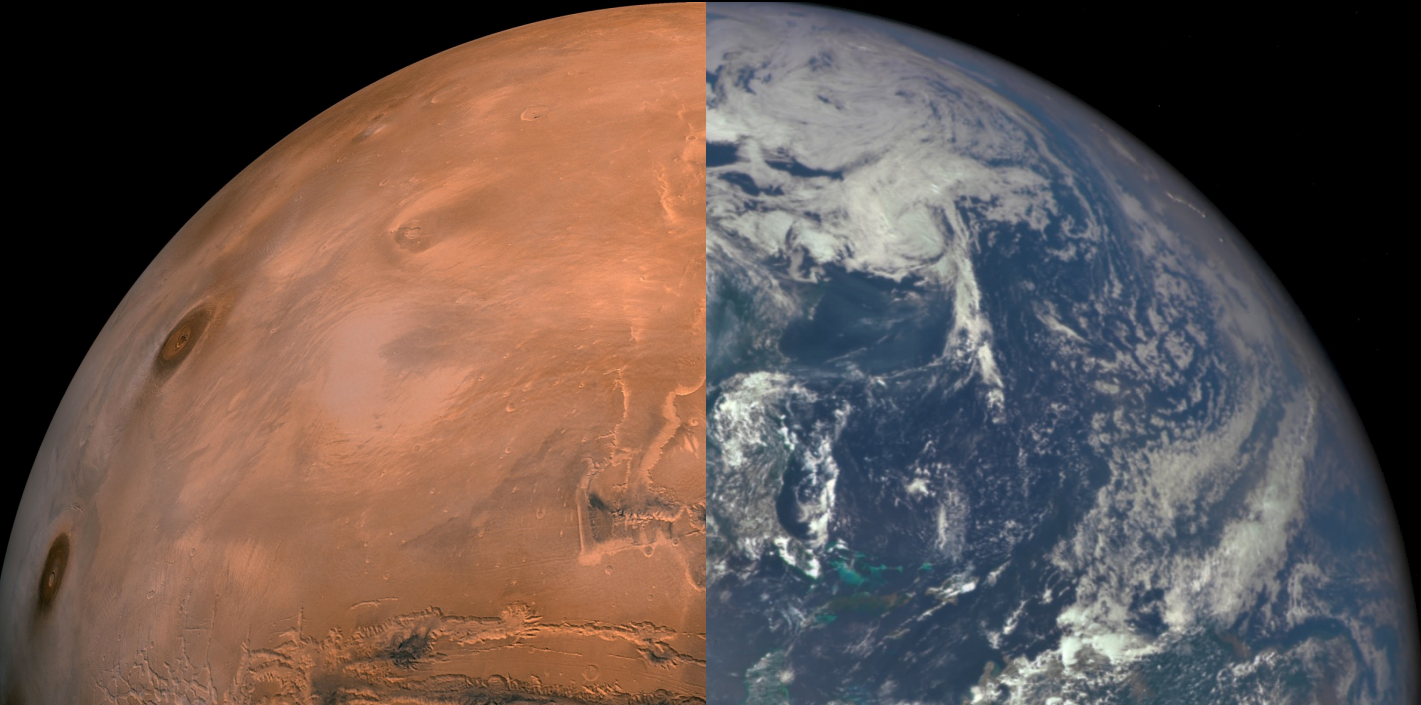
Ariel Anbar
Geochemistry

Betül Kaçar
Biochemistry

F Rosenzweig
Evolutionary genetics

Mary Droser
Paleontology

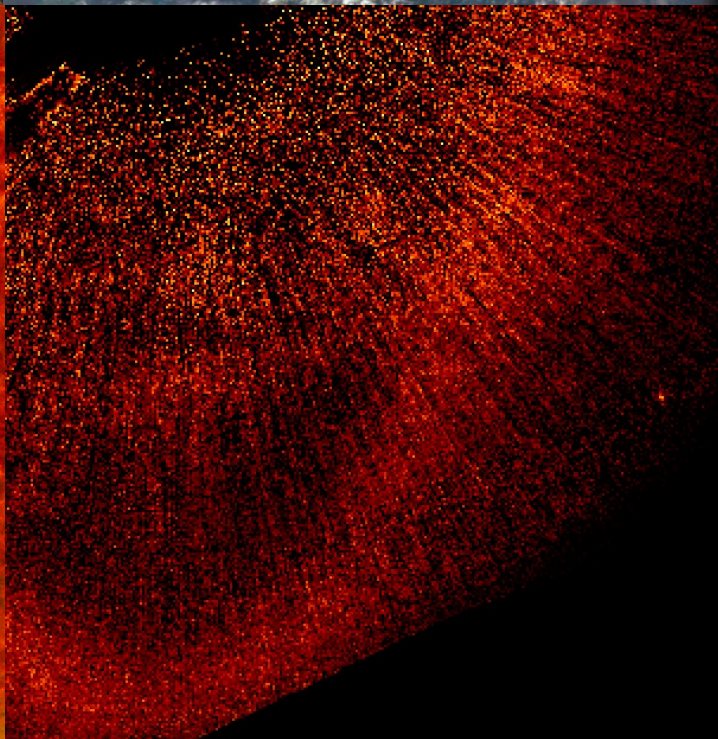
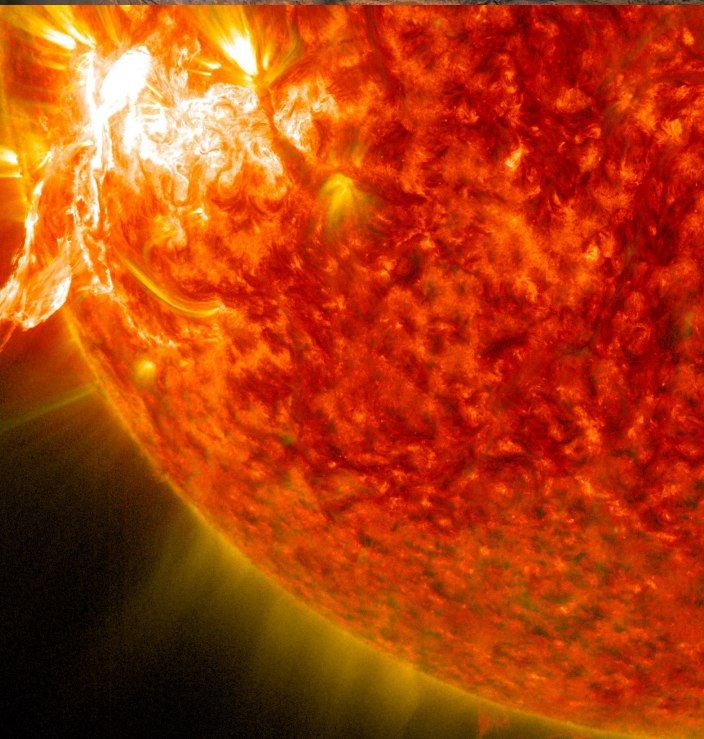
Becky McCauley Rensch
NASA Program Scientist



Nexus for Exoplanet Systems Science (NExSS)

Goals:




- Understand planets in context throughout their formation and coevolution with their parent star and planetary system
- Investigate the diversity of exoplanet characteristics and learn how their properties and evolution can create the conditions for life.
- Understand how to identify the best exoplanet targets for life searches
- Learn how to recognize, and search for, signs of habitability and life on exoplanets.





NFOLD
NETWORK FOR LIFE DETECTION

NEW GOALS

-  *New leads!* Brook Nunn, UW; Alfonso Davila, ARC; Heather Graham GSFC
-  40 SC members funded on life detection R&A and techdev projects
-  76 Early Career Council members engaged in life detection research

- Promote discourse relevant to life detection
- Act as a **THINK-TANK** for life detection science and technology
- Forum-style talks on SC research/tecdev to discuss new life detection science and technology and build cross-discipline collaborations
- Provide life-detection feedback to Analysis Groups (MEPAG, OPAG)
- ECC journal clubs, career development activities, communication and research nuggets



Network for Ocean Worlds: Building Connections Among Ocean, Cryosphere & Planetary Scientists

NOW Co-Leads

Chris German (Geoscience: Seafloor Fluid Flow)
Alison Murray (Polar & Marine Microbiology)
Alyssa Rhoden (Planetary Geophysics)
Kevin Arrigo (Polar Ocean Biogeochemistry)
Kathryn Pietro (Project Coordination)

Network Structure

- 100 Funded Teams from 10+ NASA Programs (10-20 each from CDAP, SSW, ExoBio, PSTAR, HabWorlds, Tech)
- **Inclusivity through NOW Affiliates (650+): On-ramps!**

Future Leaders for Ocean Worlds

- for ECRs, by ECRs, w/StComm Representation
- **Solicited Mentoring where FLOW identifies need**
(Proposal Writing Workshop; Career Trajectory Coffee Hours)

NASA Missions

- **Europa Clipper – Adding Value via PSIE call**
Dragonfly • UOP • Enceladus Orbi-Lander

Research Priorities

- Physics & Chemistry of Ocean Worlds
- Biogeochemistry & Life on Ocean Worlds
- Analog Studies to inform Space Missions
- Technological Needs for future Missions

Capacity Building

- Decadal Survey (**NOW White Paper**; 120+ OW Papers)
- **Ocean Worlds Strategy (NOW+OPAG+SBAG => OWWG)**
- Special Sessions at AGU Oc.Sci. & NASA+NSF OCB mtgs.
- Oceanography: **Oceans Across the Solar System** issue
- **Dedicated OW call in recent ROSES A.28 (ESD-IRES)**

Future Priorities

- Train **Next Gen Planetary Ocean Scientists** (Short Course)
- Continue OW Discussion Meetings (Gordon Conference)
- **National Capabilities for OW Mission Development**
(Lab. testing in vacuum to $\leq 100K$ / Accessible Analog Sites)

Website: OceanWorlds.Space

25 speakers
23,000 YouTube views

PCE₃ Community Workshops
"Building a New Foundation" 2021
"Nano-to-Cosmic Studies of Complex Systems" 2022

PCE₃ will provide the intellectual environment and community network to solve... begins on

PCE₃ Influence
Decadal white papers
OLEB Workshop report
EOS Perspectives

Sustained 100+ audience for ~2 years

PCE₃ Seminar Series

- Community integration & Cross-disciplinary collaboration
- Informal priority to be
- Focus on Early Career Scientists
- Expanding cross-cutting research

***** Coming Soon *****
TIPCEEE – Topics in PCE₃

Early career proposal incubator workshop






Back Up



NFOLD
NETWORK FOR LIFE DETECTION

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NFOLD
NETWORK FOR LIFE DETECTION

WORKSHOPS

 Future of the Search for Life workshop explored connections between life detection science and technology.

- 100 participants from 350 applications
- 67% scientists, 33% engineers
- 35% Senior/mid-career, 25% early career, 10% postdoc, 30% grad student
- Workshop report has been submitted to *Astrobiology*

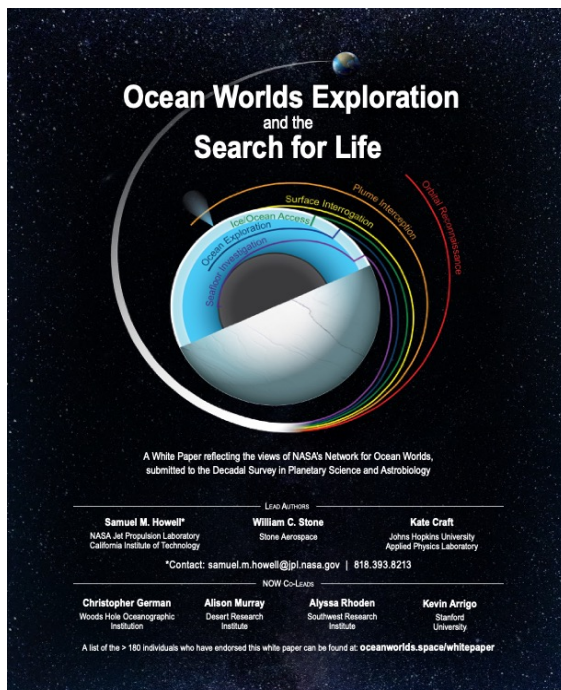
 Ocean Worlds Analog Field Site Assessment workshop with NOW developed a framework to rate the field site suitability based on a science question

- Hybrid format: 54 participants with 10 online
- 60% planetary scientists, 40% earth scientists/oceanographers
- 22% Senior research, 40% mid-career, 38% early career
- Workshop report in progress with SOC and volunteer writing group



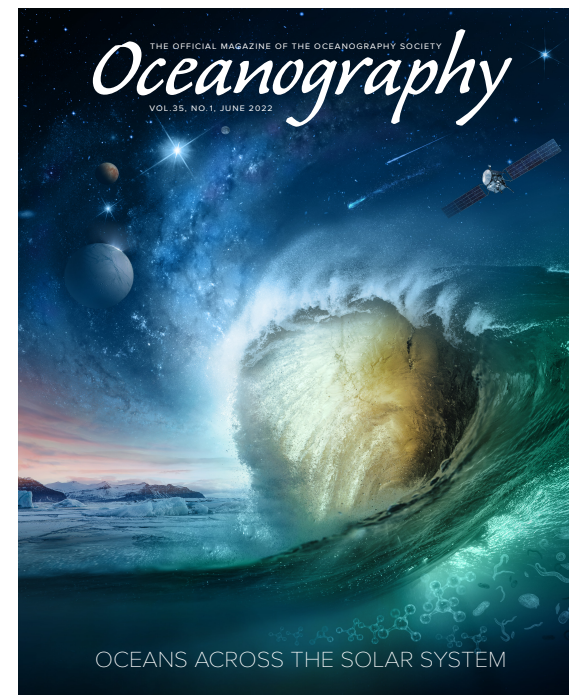
Network for Ocean Worlds: Further Reading (Targeting PSD & ESD communities)

Ocean Worlds: A Strategic Plan (PSADS: Community White Paper)



<https://oceanworlds.space/whitepaper/>

Oceans Across the Solar System (Earth Sciences ↔ Ocean Worlds)



<https://tos.org/oceanography/issue/volume-35-issue-1>

Website: OceanWorlds.Space