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# NAI Briefing to the PSS

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Senior Scientist for Astrobiology  
PSS Meeting  
Washington, DC 09/04/2014



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# NAI Mission Statement

## Five Elements

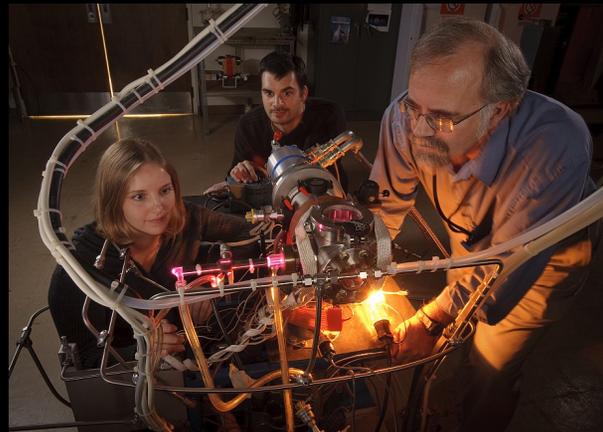


**Train the Next Generation  
of Astrobiologists**



**Education and Outreach**

**Collaborative,  
Interdisciplinary  
Research**



**Provide Leadership for  
NASA Space Missions**



**Information Technology  
for Research**



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# NAI: A 'Virtual' Institute

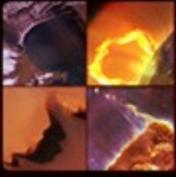
- Competitively-selected science teams, each a consortium (currently 15 teams)
- ~770 members at ~130 participating institutions
  - ~420 “senior” scientists
  - ~350 postdocs and students
  - 18 members of the US National Academy of Sciences
- Managed/integrated by a central office at NASA Ames Research Center

## CAN 5 Teams

Arizona State University  
Carnegie Institution of Washington  
Georgia Institute of Technology  
NASA Ames Research Center  
NASA Goddard Space Flight Center  
NASA Jet Propulsion Laboratory (Icy Worlds)  
NASA Jet Propulsion Laboratory (Titan)  
Pennsylvania State University  
Rensselaer Polytechnic Institute  
University of Hawaii, Manoa

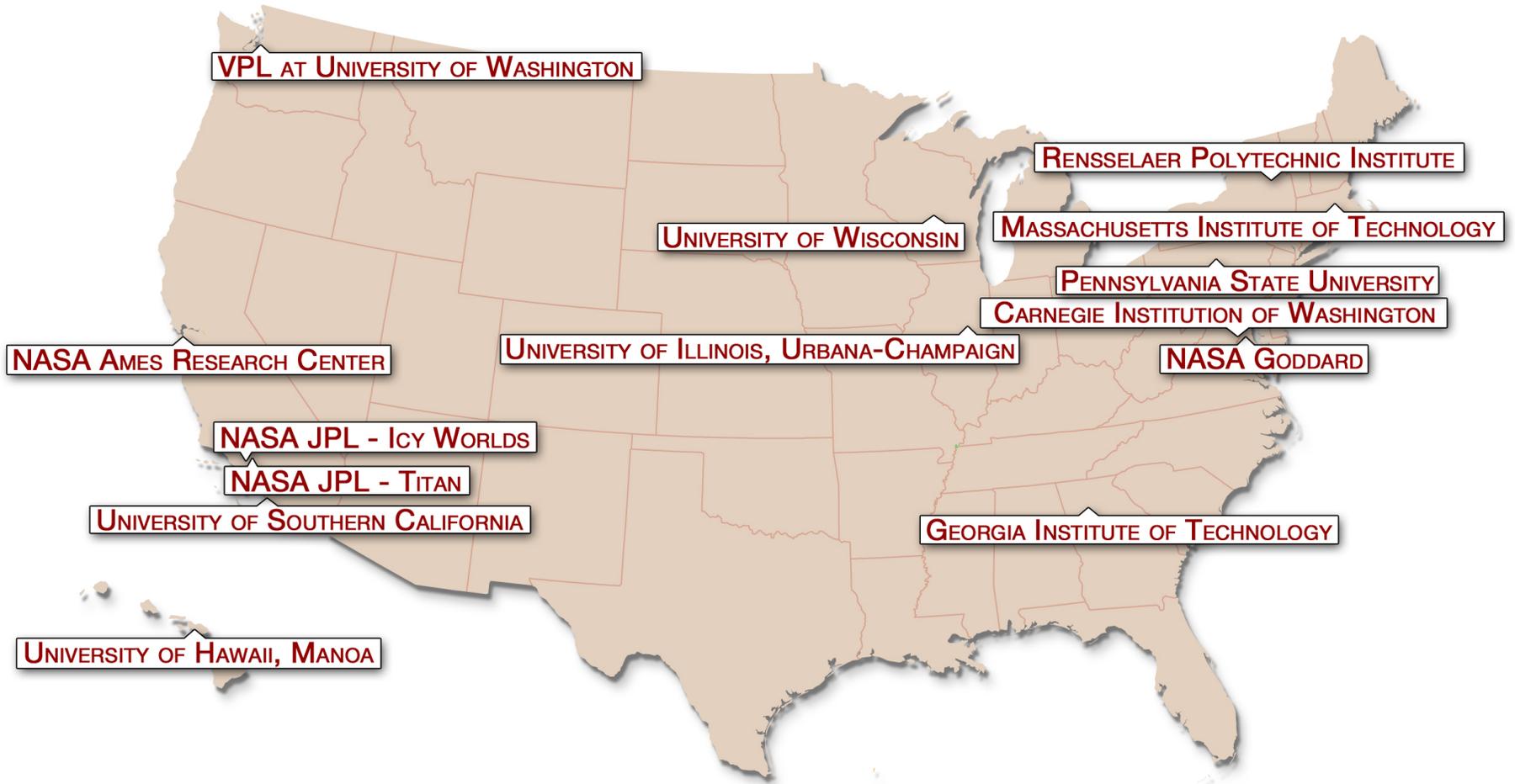
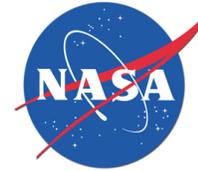
## CAN 6 Teams

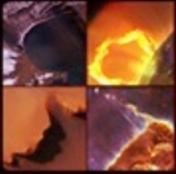
Massachusetts Institute of Technology  
University of Illinois at Urbana-Champaign  
University of Southern California  
University of Wisconsin  
VPL at University of Washington



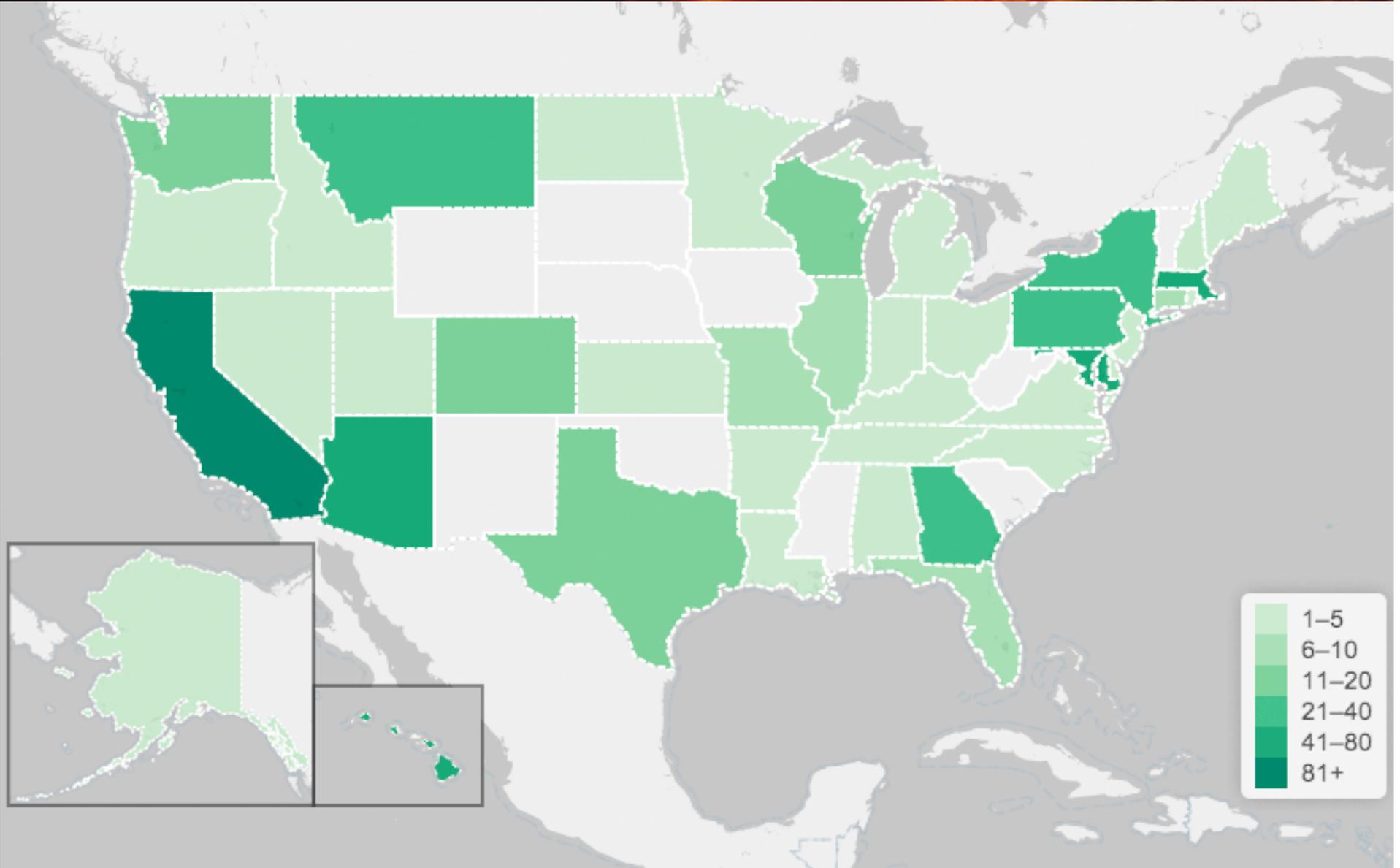
# History of NASA Astrobiology Institute

	98-99	99-00	00-01	01-02	02-03	03-04	04-05	05-06	06-07	07-08	08-09	09-10	10-11	11-12
		Arizona State University										Arizona State University		
		NASA Ames Research Center					NASA Ames Research Center					NASA Ames Research Center		
		Carnegie Institution of Washington					Carnegie Institution of Washington					Carnegie Institution of Washington		
		Harvard University												
		Jet Propulsion Laboratory										Jet Propulsion Laboratory- Icy Worlds		
		NASA Johnson Space Center										Jet Propulsion Laboratory - Titan		
		Marine Biological Laboratory, Woods Hole					Marine Biological Laboratory, Woods Hole							
		Pennsylvania State University					Pennsylvania State University					Pennsylvania State University		
		Scripps Research Institute, La Jolla												
		University of California, Los Angeles					University of California, Los Angeles							
		University of Colorado, Boulder					University of Colorado, Boulder							
				Michigan State University										
				University of Rhode Island										
				University of Washington										
				Virtual Planetary Laboratory (VPL) JPL/Caltech							VPL @ U Washington			
							University of California, Berkeley							
							NASA Goddard Space Flight Center					NASA Goddard Space Flight Center		
							Indiana-Princeton-Tennessee Astrobiology Institute							
							SETI Institute, Mountain View							
							University of Arizona							
							University of Hawaii, Manoa					University of Hawaii, Manoa		
										Montana State University				
										University of Wisconsin				
										MIT				
												Georgia Institute of Technology		
												Rensselaer Polytechnic Institute		
TOTAL NUMBER OF NAI TEAMS	11	11	11	15	15	16	16	16	12	16	14	14	14	14
NAI DIRECTORS	HUBBARD	BLUMBERG			GRYMES (acting)		RUNNEGAR			PILCHER				





# Astrobiology Projects by State





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# International Astrobiology

- ★ Astrobiology Society of Britain (ASB)
- ★ Canadian Astrobiology Network (CAN)
- ★ Centro de Astrobiología (CAB)
- ★ European Exo/Astrobiology Network Association (EANA)
- ★ Helmholtz Alliance: Planetary Evolution and Life
- ★ Instituto de Astrobiología Colombia (IAC)
- ★ Nordic Network of Astrobiology
- ★ Russian Astrobiology Center (RAC)
- ★ Société Française d'Exobiologie (SFE)
- ★ Sociedad Mexicana de Astrobiología (SOMA)
- ★ UK Centre for Astrobiology (UKCA)
- ★ USP Research Unit in Astrobiology (NAP-Astrobio)
- ★ Australian Centre for Astrobiology (ACA)

# Top 10 international Collaboration based on co-authorship

England	48
France	45
Germany	40
Netherlands	34
Canada	28
Australia	27
Spain	20
Mexico	15
Denmark	13



# **Overview of the findings and recommendations of the 2008 NRC Review of NASA Astrobiology Institute (NAI)**



# Review Questions

- a. Has the NAI developed, as envisioned, as an evolving experiment in cutting-edge, distributed, collaborative science and education in astrobiology?
- b. Does the NAI provide a unique and useful complement to other Astrobiology program support mechanisms (e.g., individual grants to principal investigators), and if improvements need to be made in this area, what are they?
- c. Are the research, training, and public educational activities of the NAI appropriately balanced in terms of investments and outcomes, services to NAI members and external partners, and activities that engage and support the wider astrobiology community and the needs of young professionals?
- d. What other activities or roles not currently undertaken by the NAI might be appropriate in the future?



# NAI Goal 1— Interdisciplinary Research

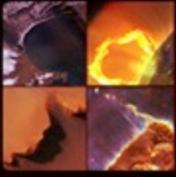
- Successfully promoted interdisciplinary science;
- Stimulated many scientific achievements;
- Successfully integrated life sciences into NASA programs;
- Often effectively leveraged ongoing and new research;
- Contributed to the establishment of new astrobiology programs worldwide; and
- Supported programs that are widely distributed throughout the United States.



# NAI Goal 1 — Interdisciplinary Research

Committee Recommendations:

- The NAI should institute better measures of performance and progress to improve the accountability of its nodes in promoting astrobiology as a field of interdisciplinary and collaborative study;
- The NAI should improve the tracking and critical assessment of its publications; and
- The NAI should encourage and cultivate interactions with non-NAI astrobiology teams and organizations throughout the world.



# Publications Metric

<b>Year</b>	<b>Total Refereed</b>	<b>Science</b>	<b>PNAS<sup>1</sup></b>	<b>Nature</b>
2012	746	19	14	17
2011	768	32	11	20
2010	760	24	4	18
2009	541	21	3	14
<b>2008<sup>2</sup></b>	<b>441</b>	<b>14</b>	<b>1</b>	<b>11</b>
2007	611	22	6	19
2006	712	24	3	10
2005	754	29	5	20

<sup>1</sup> Proceedings of the National Academy of Sciences

<sup>2</sup> 2008 publication drop linked to severe cut in funding in prior years



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# Most common journals published in

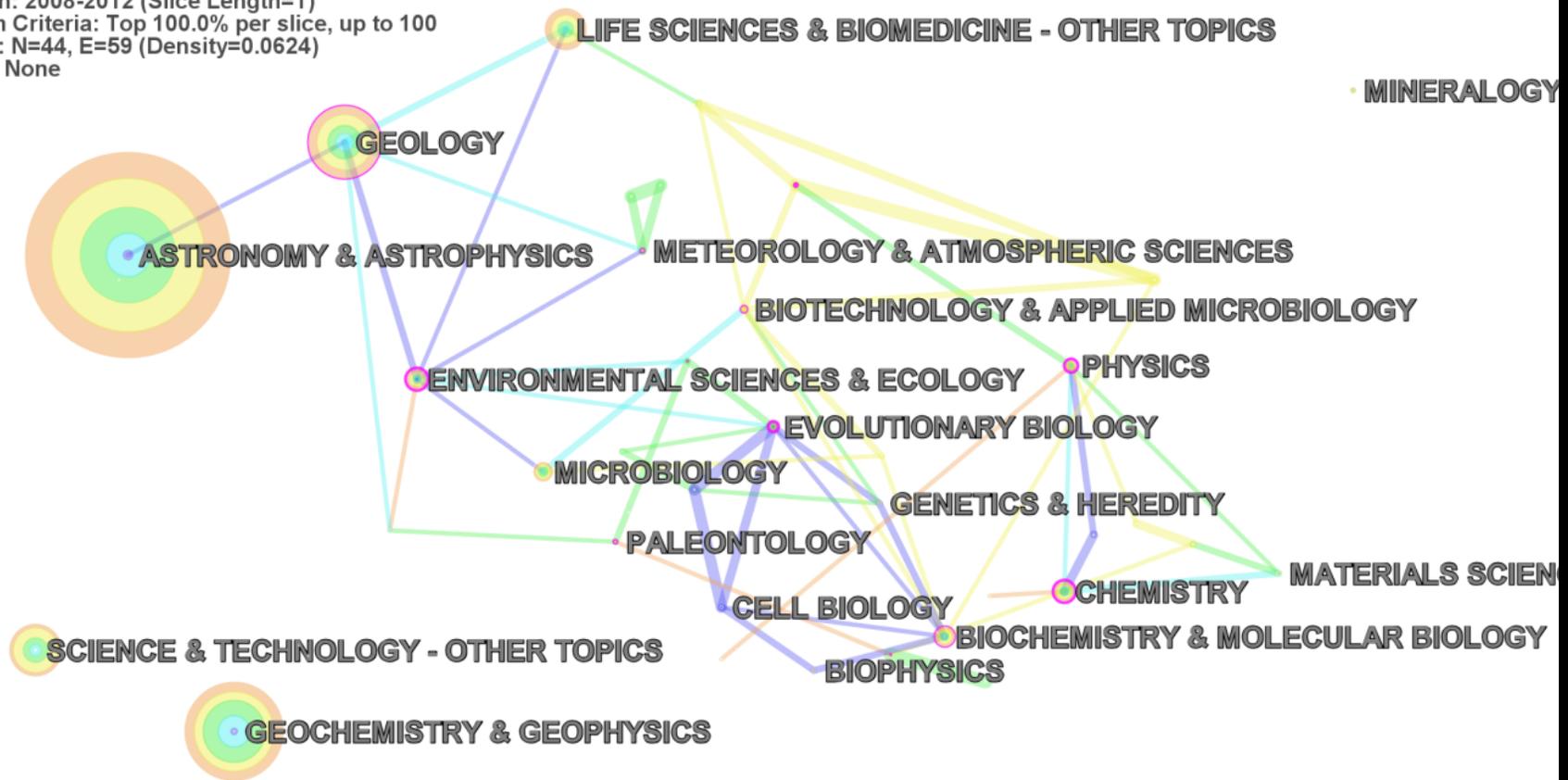
Journal Name	N	%	IF	JR
Astrophysical Journal	161	13.3	6.733	6 of 56*
Geochimica Et Cosmochimica Acta	87	7.2	8.884	6 of 76**
Icarus	68	5.6	3.161	18 of 56*
Science	55	4.5	31.027	2 of 56***
Astrobiology	48	4.0	2.803	21 of 56* 17 of 83**** 35 of 170*****
Earth and Planetary Science Letters	47	3.9	4.349	4 of 76**
Meteoritics & Planetary Science	43	3.5	2.800	19 of 76**
Astrophysical Journal Letters	39	3.2	6.341	7 of 56*
PNAS	36	3.0	9.737	4 of 56***
Astronomical Journal	26	2.1	4.965	12 of 56*
Nature	25	2.0	38.597	1 of 56***
* Category, Astronomy & Astrophysics ** Category, Geochemistry & Geophysics *** Category, Multidisciplinary **** Category, Biology ***** Category, Geosciences, Multidisciplinary (Data Source: Journal Citation Reports 2012 Edition)				



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# Network topology of journal categories

Space, v. 3.7.R5 (64-bit)  
September 22, 2013 6:07:18 PM EEST  
C:\Users\zehra\Desktop\NASA\DATA  
Span: 2008-2012 (Slice Length=1)  
Selection Criteria: Top 100.0% per slice, up to 100  
Network: N=44, E=59 (Density=0.0624)  
Layout: None





## **NAI Goal 2—Training the Next Generation of Astrobiologists**

- Trained graduates who are now employed in academic and other positions;
- Promoted the establishment of new programs and faculty positions in astrobiology at several universities; and
- Not been sufficiently proactive in countering the negative effects on training and education programs caused by recent cuts to NASA's Astrobiology budget.



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# Other NAI Programs

- Education and Public Outreach
- Focus Groups
- Postdoctoral Fellowship Program (*for graduate students & postdocs*)
- Director's Discretionary Fund (DDF)
- The Lewis and Clark Fund for Exploration and Field Research in Astrobiology (*for students*)
- Early Career Collaboration Award (*for students*)
- Minority Institution Research Support Program
- Meeting and Workshop Support



# NAI Goal 2—Training the Next Generation of Astrobiologists

The committee recommended that:

- the NAI should work toward developing more consistent educational and training opportunities.
- the NAI should ensure more stable support of graduate students and postdoctoral researchers in astrobiology.



## **NAI Goal 3—Leadership for Current and Future Space Missions**

- Encouraged astrobiologists to provide needed recommendations and expertise to NASA for mission planning;
- Promoted the participation of astrobiologists in the science teams for current and future missions;
- Organized activities, such as focus groups, that have strongly influenced NASA missions; and
- Identified astrobiology questions that underpin most of NASA's current flight programs.



## **NAI Goal 3—Leadership for Current and Future Space Missions**

Because its most critical function is to ensure that its research activities clearly contribute to NASA's current and future spaceflight activities:

- the NAI should be more proactive in identifying future astrobiology missions.
- the NAI should actively encourage a partnership between astrobiologists and their engineering counterparts to help define future NASA missions.
- in selecting new nodes, the NAI should give more weight to the potential contribution of the proposed research to future NASA missions.



## NAI Goal 4—Use of Information Technology

- The substantial efforts by NAI Central to improve communications among NAI members have achieved some significant successes; and
  - The NAI has been less successful in promoting the use of collaborative work tools by the researchers affiliated with its participating teams.
- The committee recommends that the NAI should vigorously pursue new approaches using modern information technologies to increase the effectiveness of the NAI nodes. In particular, additional efforts by NAI Central are needed to ensure that new communications tools are used to enhance the effectiveness of interdisciplinary and collaborative research and training.



## NAI Goal 5—Education and Outreach

- Successfully promoted astrobiology as a field with broad-based public appeal;
- Developed effective programs for outreach to the general public; and
- Enabled minority educational activities.

The committee makes the following recommendations:

- The NAI should be more strategic in exploiting synergies among nodes in K-12 education, [minority education](#), and teacher training; and
- The NAI should address the specific requirements for teaching astrobiology at the undergraduate level.



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# Minority Institution Research Support Program (MIRS)

## 2013 MIRS Fellows

- **Dr. Alan Anderson**, Bowie State University  
*“A Search for the Ancestors of RNA”*  
Host – Ramanarayanan Krishnamurthy, Scripps Research Institute
  - **Dr. Tiffany Oliver**, Spelman College  
*“The Peptidyl Transferase Center (PTC)”*  
Host – George Fox, University of Houston
  - **Dr. Joseph Onyilagha**, University of Arkansas, Pine Bluff  
*“Investigation into the Origin of the Genetic Code”*  
Host – Stephen Freeland, University of Maryland Baltimore County
  - **Dr. Anne Osano**, Bowie State University  
*“Salt Deliquescence Drives Photosynthesis in the Hyperarid Atacama Desert”*  
Host – Alfonso Davila SETI Institute
  - **Dr. Pablo Suárez Joya**, Delaware State University  
*“Adaptive Mesh Refinement Techniques for Simulating Multifluid Magnetohydrodynamic”*
- Sabbatical opportunities for MI faculty with Astrobiology researchers
  - 24 fellows supported since 2003
  - > 40 research publications





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# Astrobiology Education



Dr. Ariel Anbar, a biogeochemist and PI of the Arizona State University's NAI Team, has been selected as a Howard Hughes Medical Institute (HHMI) Professor.

Only 55 scientists have been appointed HHMI professors since the inception of the HHMI Professor program in 2002

These professors are accomplished research scientists who are working to change undergraduate science education in the United States.

The appointment includes a five-year \$1 million grant to support Anbar's research and educational activities.



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# Astrobiology Education & Public Outreach

## Astrobiology Resources

### **Life in the Extremes Trading Cards**

Set of 9, from Acidophiles to Xerophiles!

### **Astrobiology Graphic Novels**

<http://bit.ly/iRjutA>

Issue #1: History of Astrobiology

Issue #2: History of Mars Exploration

Issue #3: The Inner Solar System

*More issues planned!*

### **Finding Life Beyond Earth**

<http://bit.ly/Jk2ZhV>

Developed by NOVA, these video clips and teacher guides link to the recent TV program of the same name.

### **Origins of Life**

A new film from Montana State profiling origin of life scientists and their research...coming soon on DVD

### **Astrobiology Math**

<http://bit.ly/Jbwcu6>

A booklet with math problems on Astrobiology topics from What is Life to Exoplanets and their Properties



## Student Programs

### **Exxon Mobil Bernard Harris Summer Science Camp**

For middle school students

Hosted at RPI

### **Lassen Astrobiology Internship Program**

Held every summer since 2009 at Lassen Volcanic National Park

### **HI STAR**

Hawai'i Student Teacher Astronomy Research Program

### **Life on the Edge**

One week summer camp

Hosted at GaTech

## For Teachers

### **AbSciCon Teacher Workshop**

Train the trainers model for teachers

Hosted at AbSciCon 2012 in Atlanta

### **Astrobiology Teachers Academy**

Summer training and year-long engagement

Hosted at RPI



# Q&A