

*The National Academies of*  
SCIENCES • ENGINEERING • MEDICINE

DIVISION ON ENGINEERING AND PHYSICAL SCIENCES  
SPACE STUDIES BOARD

**SEARCHING FOR LIFE ACROSS SPACE AND TIME: A WORKSHOP**

Beckman Center of the National Academies, Irvine CA  
December 5-6, 2016

**WORKSHOP AGENDA**

**MONDAY, DECEMBER 5, 2016**

8:30 a.m.	Welcome	Michael Moloney, <i>Director</i> , Space Studies Board
8:35 a.m.	Introduction to the Workshop	Jim Kasting, Workshop Planning Committee Chair
<i>Session 1—Setting the stage</i>		<i>Moderator: Jim Kasting, Penn State University</i>
8:40 a.m.	How likely is it that life exists off the Earth?  <i>20 min + 15 min Q&amp;A</i>	John Baross, University of Washington
9:15 a.m.	Current understanding of the environmental limits of life and life's interactions with its environment  <i>20 min + 15 min Q&amp;A</i>	Tori Hoehler, NASA Ames
9:50 a.m.	Is life a cosmic imperative: How did thermodynamics force life into existence?  <i>20 min + 15 min Q&amp;A</i>	Eric Smith, Santa Fe Institute
10:25 a.m.	<i>BREAK</i>	

<i>Session 2: Habitable environments in the Solar System</i>		<i>Moderators: Bethany Ehlmann, Caltech and Britney Schmidt, Georgia Tech</i>
11:00 a.m.	Habitable environments on present and ancient Mars <i>20 min + 15 min Q&amp;A</i>	John Grotzinger, Caltech
11:35 a.m.	Habitable environments on Ocean Worlds/summary of Ocean Worlds Life Detection Workshop <i>20 min + 15 min Q&amp;A</i>	Kevin Hand—Jet Propulsion Laboratory
12:10 p.m.	Planning for the Exploration of Mars and Ocean Worlds <i>15 min + 5 min Q&amp;A</i>	Ellen Stofan, NASA
12:30 p.m.	<i>LUNCH</i> (available in the Beckman Center refectory) <i>Poster viewing opportunity</i>	
<i>Session 3: Exoplanets</i>		<i>Moderator: David Des Marais, NASA Ames and Dimitar Sasselov</i>
2:00 p.m.	Current state of knowledge of exoplanets and their habitability Summary of Exoplanet Biosignatures Workshop <i>20 min + 15 min Q&amp;A</i>	Vikki Meadows, University of Washington
2:35 p.m.	Extrasolar biosignatures: Thinking out of the box <i>20 min + 15 Q&amp;A</i>	William Bains, Massachusetts Institute of Technology
3:10 p.m.	<i>BREAK</i> <i>Poster viewing opportunity</i>	

3:30 p.m.	The First Spaceborne Direct Imaging Exoplanet Mission: WFIRST Coronagraph — and Starshade? <i>20 min + 15 Q&amp;A</i>	Margaret Turnbull, SETI Institute
4:05 p.m.	Prospects for ground-based characterization of Proxima Centauri b <i>20 min + 15 Q&amp;A</i>	Matteo Brogi, University of Colorado, Boulder
4:40 p.m.	<u>General discussion:</u> Practical biosignatures that can be exploited to search for life in situ in the solar system and from afar on extrasolar worlds	<i>Moderator:</i> <i>Gary Blackwood, Jet Propulsion Laboratory</i>
5:30 p.m.	<i>Session 4: Poster Display and Reception</i>  <i>ADJOURN for refreshments, poster viewing and working buffet dinner in Beckman Center Atrium</i>	Panelists and Audience Members
8:30 p.m.	<i>Adjourn</i>	

**TUESDAY, DECEMBER 6, 2016**

<i>Session 5: Life detection techniques</i>		<i>Moderator: Gary Ruvkun, Harvard Medical School</i>
8:30 a.m.	Life Detection: 40 years after Viking <i>20 min + 15 Q&amp;A</i>	Ben Clark, Space Science Institute
9:05 a.m.	Signatures of life as we know it <i>20 min + 15 Q&amp;A</i>	Ken Nealson, University of Southern California
9:40 a.m.	Signatures of life as we don't know it <i>20 min + 15 Q&amp;A</i>	Steve Benner, the Foundation for Applied Molecular Evolution
10:15 a.m.	<i>BREAK</i> <i>Poster Viewing Opportunity</i>	
<i>Session 6: Instrumentation</i>		<i>Moderator: Phil Neches, Teradata Corporation and Nilton Renno</i>
10:45 a.m.	In-situ life detection in the context of plume fly thru missions <i>15 presentation + 15 Q&amp;A</i>	Morgan Cable, Jet Propulsion Laboratory
11:15 a.m.	Life detection capabilities of LUVOIR and HabEx <i>15 presentation + 15 Q&amp;A</i>	Shawn Domagal-Goldman, NASA Goddard Space Flight Center
11:45 a.m.	In-situ detection of organics on Mars <i>15 presentation + 15 Q&amp;A</i>	Jen Eigenbrode, NASA Goddard Space Flight Center

12:15 p.m.	<i>Instructions for afternoon breakout groups</i>	Jim Kasting, Workshop Planning Committee Chair
12:25 p.m.	<i>LUNCH</i> (available in the Beckman Center refectory)  <i>Poster viewing opportunity</i>	
<i>Session 7: Future Directions</i>		
2:00 p.m.	<b><u>Breakout Groups</u></b>  Focus question: How could targeted research over the next 5-10 years help advance the state of the art for life detection, including instrumentation and precursor research.  <u>Discussion Topics:</u>  1. In situ detection of life as we know it 2. In situ detection of life as we don't know it 3. Remote detection of life as we know it 4. Remote detection of life as we don't know it	<i>Moderators:</i>  <i>1. Nita Sahai/ Tanja Bosak</i> <i>2. Mark Thiemens/ Steve Benner</i> <i>3. Vikki Meadows/ Sushil Atreya</i> <i>4. William Bains/ John Baross</i>
3:15 p.m.	<i>BREAK</i>  <i>Poster viewing opportunity</i>  <i>Session moderators to collect thoughts in preparation for report back to the group</i>	
4:00 p.m.	<i>Report back from breakout group (10 min each, 40 min total)</i>  General Discussion (50 min)	<i>Moderator: John Grunsfeld, NASA (retired)</i>
<i>Session 8: Conclusions</i>		
5:30 p.m.	<i>Summary of key points raised during the workshop and concluding Remarks</i>	Jim Kasting, Workshop Planning Committee Chair
6:00 p.m.	<i>ADJOURN</i>	

## GENERAL NOTES

**Beckman Center:** Is located on the campus of the University of California, Irvine, and is approximately 3 miles from Orange County/John Wayne Airport. See the following website for more information, including directions: <http://www.thebeckmancenter.org/>

**Parking:** There is plenty of free parking at the Beckman Center.

**Wi-Fi Connection:** To connect to the Wi-Fi chose “Visitor Network” then open up a browser and click “Accept terms and conditions”. You will then be connected to the internet.

## NOTES FOR PRESENTERS

If your presentation contains unpublished data, ITAR controlled and/or other sensitive information, please be aware that the open sessions at the meeting may be recorded and/or webcast. Presentation materials given to the committee may be posted on a publicly accessible website. Please edit your presentations accordingly. Presentations will be displayed via one of the onsite PCs. Speakers will not be permitted to use their own laptops. You should also bring a pdf version of your presentation with you. At some point a staff member will be asking you to sign a consent form allowing us to use your presentation, specifically to post it on our website.

### **The following information is provided for any members of the general public who may be in attendance:**

This meeting is being held to gather information to help the committee conduct its study. This committee will examine the information and material obtained during this, and other public meetings, in an effort to inform its work. Although opinions may be stated and lively discussion may ensue, no conclusions are being drawn at this time and no recommendations will be made. In fact, the committee will deliberate thoroughly before writing its draft report. Moreover, once the draft report is written, it must go through a rigorous review by experts who are anonymous to the committee, and the committee then must respond to this review with appropriate revisions that adequately satisfy the Academy’s Report Review committee and the chair of the NRC before it is considered an NRC report. Therefore, observers who draw conclusions about the committee’s work based on today’s discussions will be doing so prematurely.

Furthermore, individual committee members often engage in discussion and questioning for the specific purpose of probing an issue and sharpening an argument. The comments of any given committee member may not necessarily reflect the position he or she may actually hold on the subject under discussion, to say nothing of that person’s future position as it may evolve in the course of the project. Any inferences about an individual’s position regarding findings or recommendations in the final report are therefore also premature.

## RECORDING OF THE MEETING

The meeting on December 5-6 will be webcast live and recorded by the National Academies of Sciences, Engineering, and Medicine. Please be aware that by attending the meeting, you consent to being webcast live and recorded.