

# The SSB and Astrobiology: 1958-2011 and Beyond

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Space Studies Board, National Research Council

Committee on the Origins and Evolution of Life

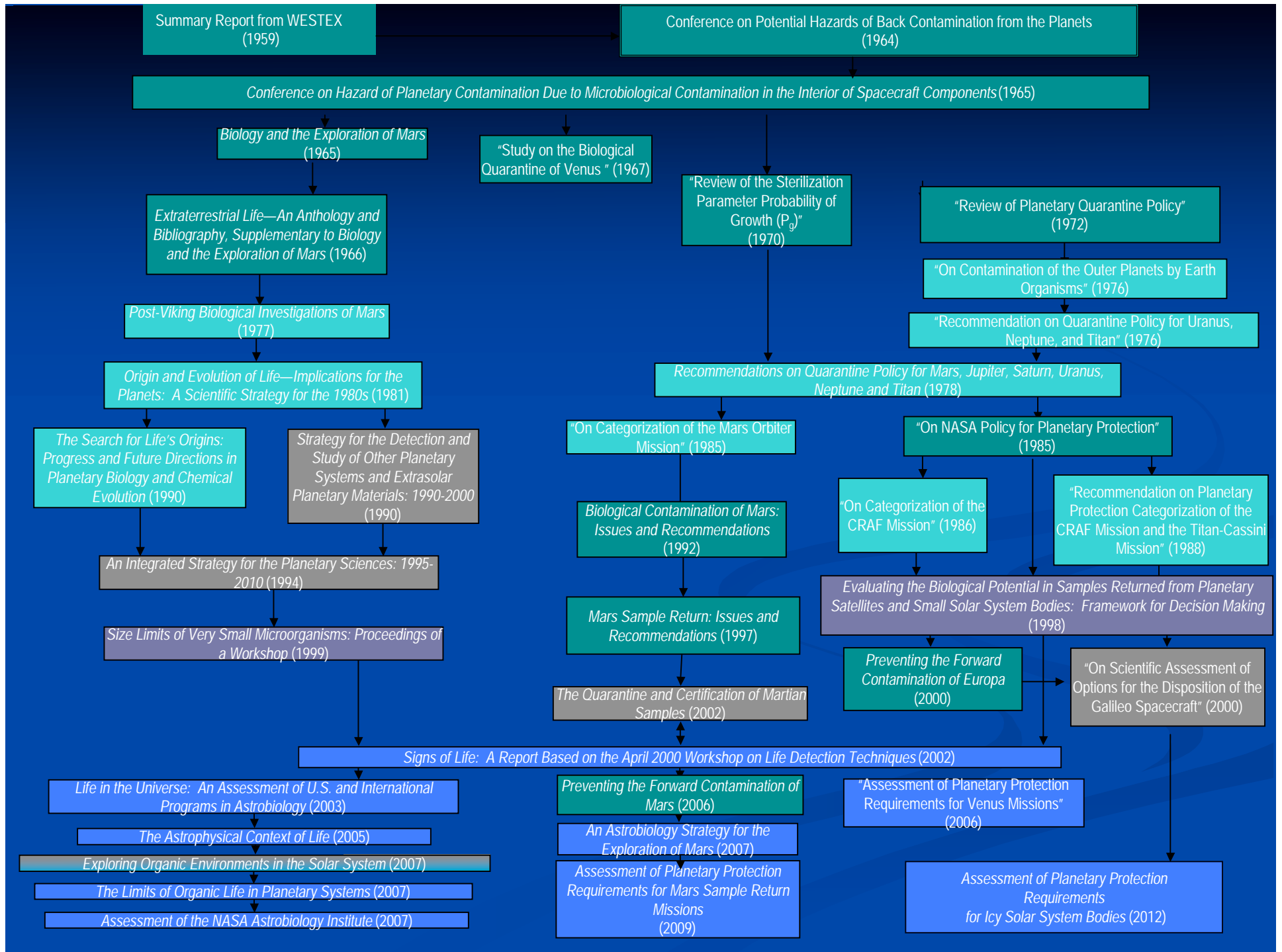
Woods Hole, 7 June 2011

# Summary

1. A summary of how the SSB's approach to exo/astrobiology has varied over the last 50 years
2. An indication of the types of studies the SSB's various exo/astrobiology committees have undertaken
3. A brief outline of the SSB's proposed approach to astrobiology in the next decade.

# Astrobiology's Four Eras

- Exo/astrobiology has been a topic of interest to the SSB since the Board's founding in 1958. The organizational arrangements for astrobiology have however varied over time in a manner that mirrors discipline's waxing and waning fortunes
- Prior to 1976—the run up to the Viking missions— astrobiological advice provided via ad hoc groups and later via the Panel on Exobiology within the Committee on Space Biology and Medicine
- Between 1976 and 1996—the immediate post-Viking boom and then bust—the Committee on Planetary Biology and Chemical Evolution was established and then disestablished and astrobiology added to the portfolio of the Committee on Planetary and Lunar Exploration
- 1996-2011—the post ALH 84001 boom and growth of astrobiology—the Steering Group on Astrobiology is established and leads to the creation of the Committee on the Origins and Evolution of Life
- 2011 and beyond—Astrobiology a mature discipline?—The Committee on the Origins and Evolution of Life merges with COMPLEX to create the Committee on Astrobiology and Planetary Science



# Committee on Planetary Biology and Chemical Evolution

- Organized in the mid-1970s as a successor to the Panel on Exobiology, established in 1973
- CPBCE's primary concern was "the attempts to understand the origin, evolution and distribution of life in the universe. Central to these interests is the general theme of interactions between an evolving biota and the evolving body on which these processes are occurring."
- CPBCE was charged to "...develop a 10-15 research strategy which outlines the scientific goals, objectives and measurement requirements for planetary biology and chemical evolution, including the early history of biogenic elements, the extraterrestrial events which shape evolution, and the search for life outside of the solar system."
- "Advise and provide recommendations...on the science content, planning, and implementation of space missions..."
- "...Provide advice and recommendations concerning the application of planetary protection standards to proposed missions."
- "Coordinate and interact with other groups..."

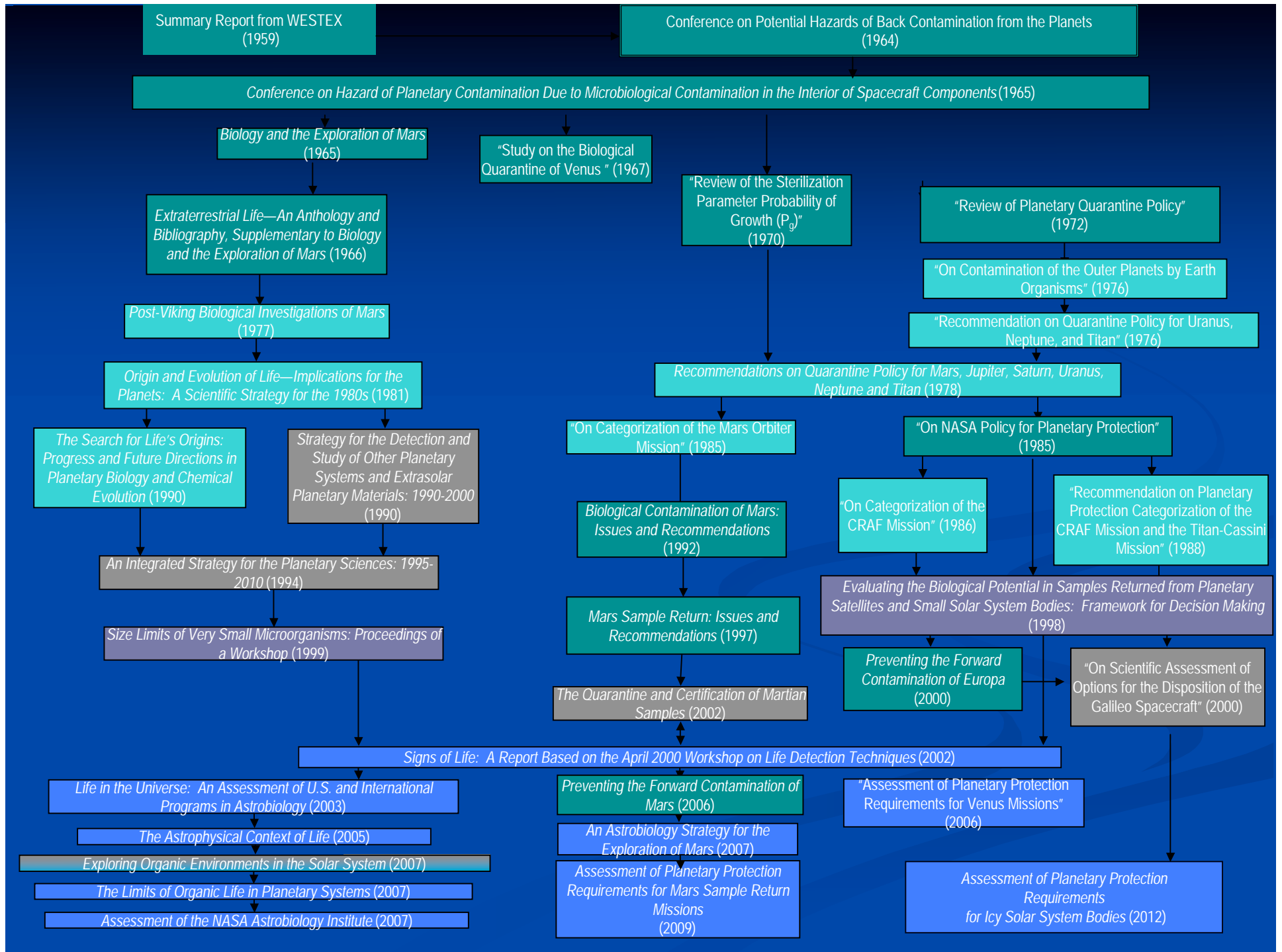
# Chairs of the Committee on Planetary Biology and Chemical Evolution

- **Norman H. Horowitz\*** (1973-1974)  
California Institute of  
Technology
- **Peter Mazur** (1974-1977)  
Oak Ridge National Laboratory
- **Lynn Margulis** (1977-1980)  
Boston University
- **Daniel B. Botkin** (1981-1984)  
University of California, Santa  
Barbara
- **Harold P. Klein** (1985-1988)  
SETI Institute

\*

Exobiology Panel





# *Post-Viking Biological Investigations of Mars*

**Origin** Self Initiated

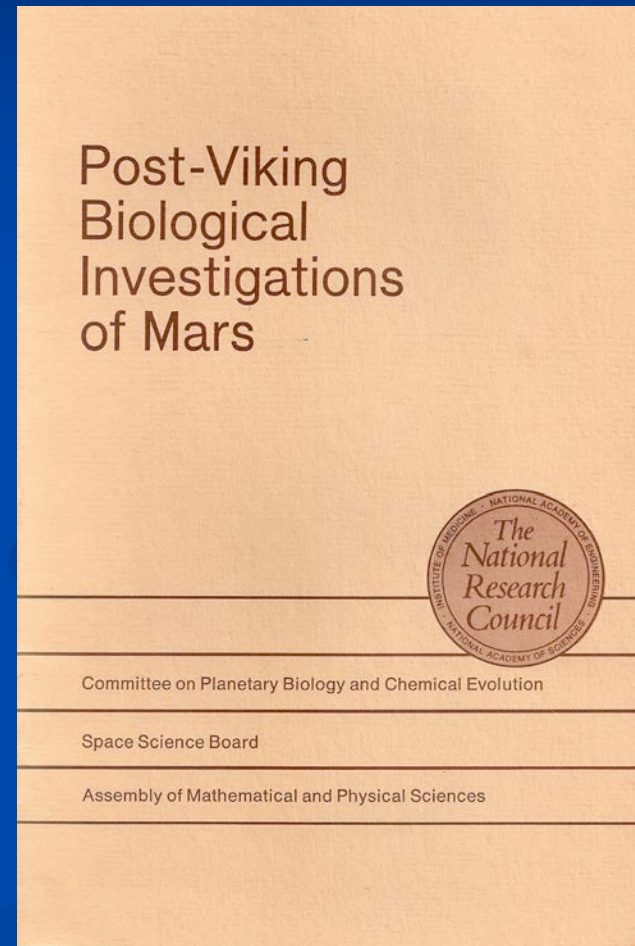
**Purpose** To review the results from Viking life-detection experiments and make recommendations for a post-Viking biology strategy for Mars exploration.

**Study Group** Committee of 7

**Chair** Peter Mazur

**Study Period** 1/75 to 12/76 (?)

**Final Report Issued** 1977



# *Quarantine Policy for Mars, Jupiter, Saturn, Uranus, Neptune and Titan*

**Origin** NASA request

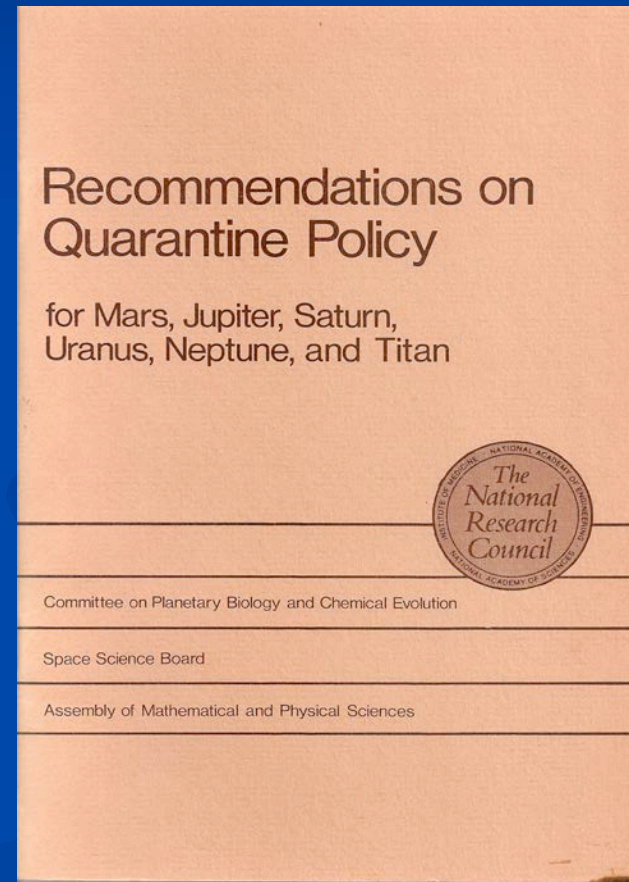
**Purpose** To review and make recommendations relating to planetary protection issues and, in particular, the value of  $P_g$  for diverse solar system bodies.

**Study Group** Committee of 6

**Chair** Peter Mazur

**Study Period** 3/75 to 11/77 (?)

**Final Report Issued** 1978



# *Origin and Evolution of Life Implications for the Planets*

**Origin** Self Initiated

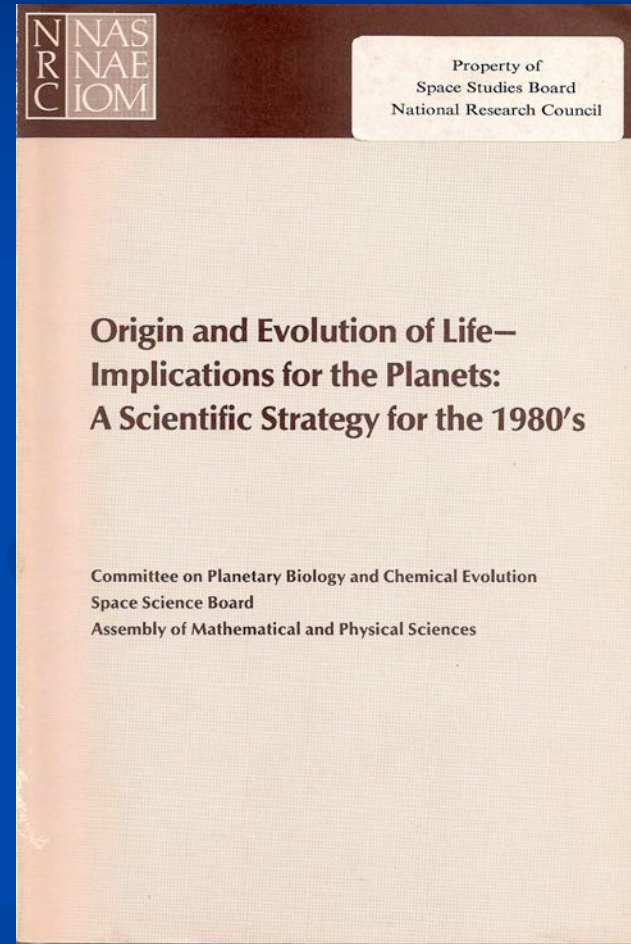
**Purpose** To describe the emerging science of life as a planetary phenomenon and outline how space technology can be used to study biological process on the global scale.

**Study Group** Committee of 9

**Chair** Lynn Margulis

**Study Period** ? to ?

**Final Report Issued** 1981



# *The Search For Life's Origins*

**Origin** Self Initiated

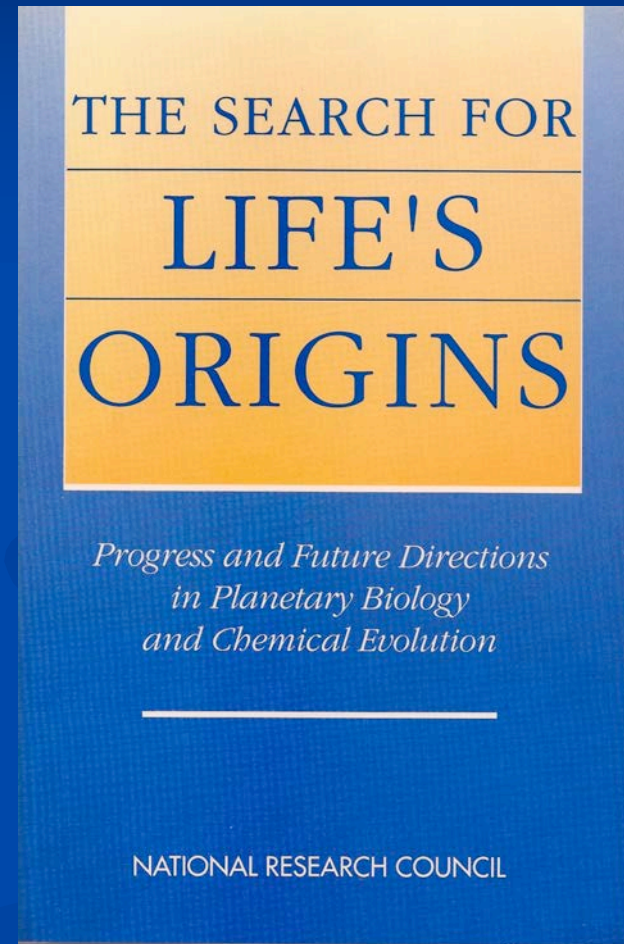
**Purpose** To review and evaluate progress made in studies relating to the origin, evolution and distribution of life in the universe and to identify and prioritize key scientific issues for the coming decade.

**Study Group** Committee of 19

**Chair** Harold P. Klein

**Study Period** 6/86 to 12/88

**Final Report Issued** 1990

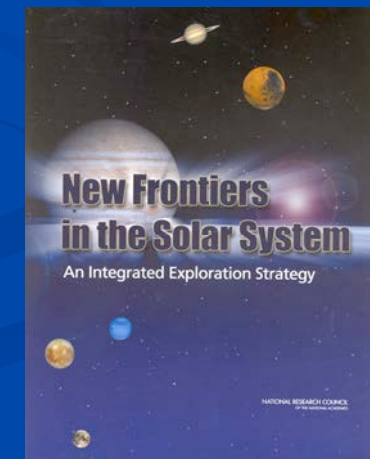
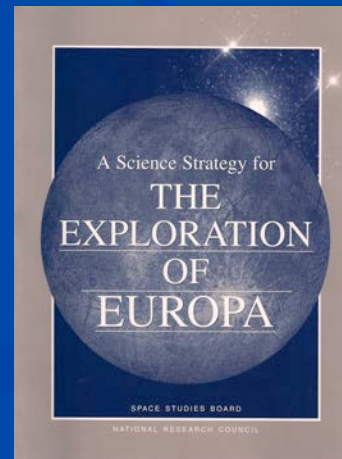
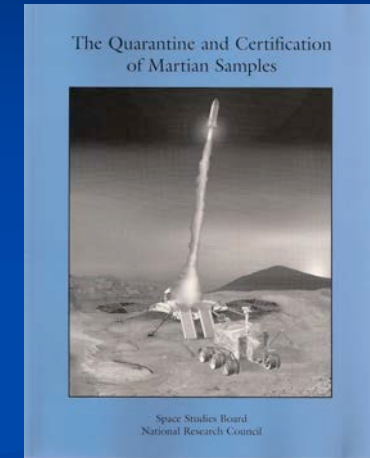
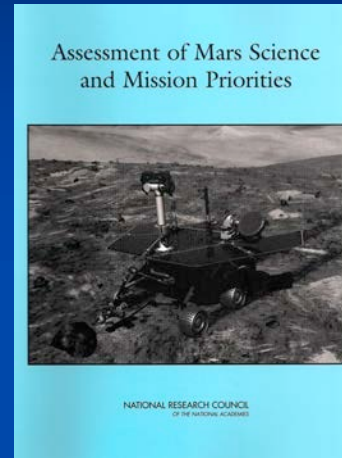


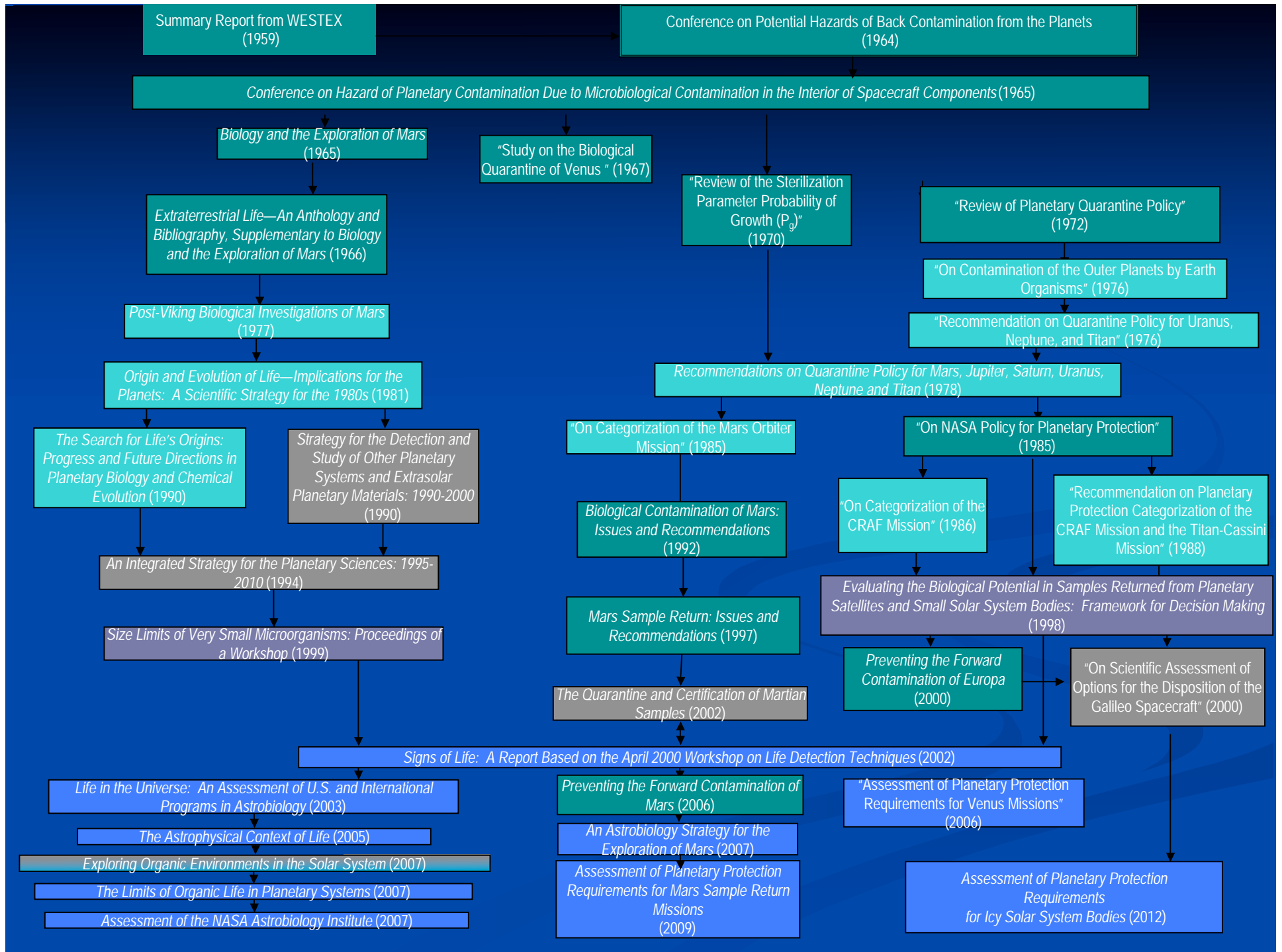
# COMPLEX Assumes Responsibility for Exobiology

- In 1988 the Space Science Board merged with the Space Applications Board to create the Space Studies Board
- In the process, the SSB assumed responsibility for Earth remote sensing and microgravity research and as a result established two new standing committees, the Committee on Earth Studies and the Committee on Microgravity Research
- For reasons that are not entirely clear, the SSB disestablished two of its existing standing committees, the Committee on Data Management and Computation and the Committee on Planetary Biology and Chemical Evolution
- CPBCE's responsibilities were transferred to the Committee on Planetary and Lunar Exploration
- COMPLEX implemented its new responsibilities by reserving two membership slots for exobiologists, one from the physical sciences and one from the life sciences.

# COMPLEX and Astrobiology

- Many of the studies drafted by or organized by COMPLEX have strong astrobiological roots
- The use of the concept of the search for origins—i.e., of life and planetary systems—was first proposed as a major organizing theme for the planetary science research in COMPLEX's 1994 report *An Integrated Strategy for the Planetary Sciences: 1995-2010*
- The search for origins is a major organizing theme in both planetary decadal surveys





# Astrobiologically Relevant Science in the News in 1996

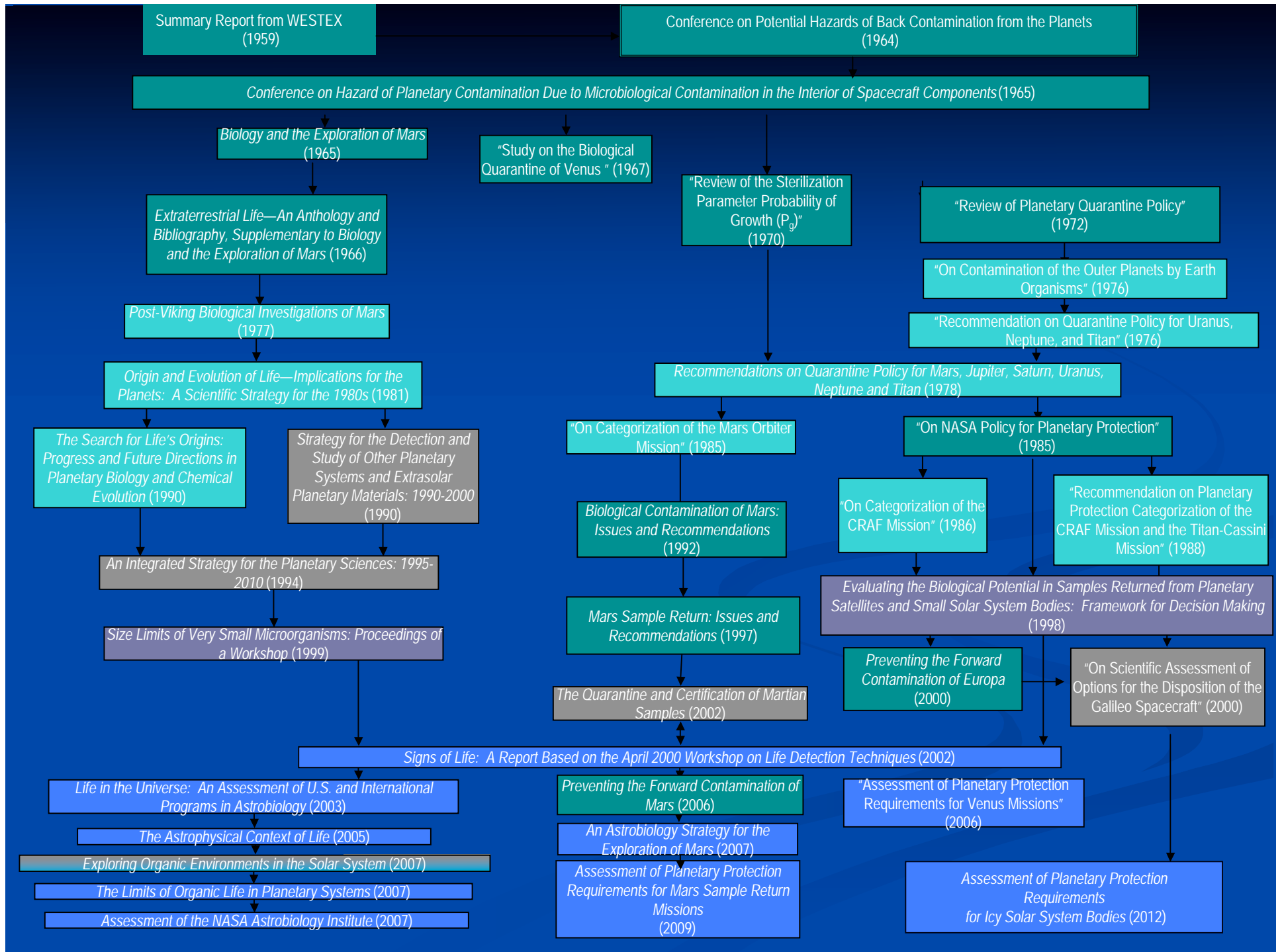
- Discovery of the first extrasolar planets
- Suggestions that liquid water exists below Europa's surface
- Increasing interest in Antarctica's Lake Vostok
- HST observations of protoplanetary disks
- Increasing realization that life exists in extreme terrestrial environments
- Claims of evidence of fossils in martian meteorite ALH84001 announced on 7 August, 1996.

# Post-ALH84001

- **September, 1996:** First Astrobiology workshop held at Ames Research Center—Astrobiology Roadmap in draft.
- **October, 1996:** OSTP and NASA ask SSB to hold a workshop to discuss recent scientific advances—Conclusion, study of “Origins” is a powerful organizing theme for NASA’s space-science activities.
- **December, 1996:** Vice President’s Space Science Symposium. Key SSB-workshop participants brief Al Gore on recent advances in Origins. Summary message—recent “breakthroughs are astonishing returns being reaped from years of investment in many scientific disciplines. Now is the time to leverage that investment and to pursue the quest for ORIGINS into the 21st Century.”
- **January, 1997:** NSF initiates Life in Extreme Environments program
- **February, 1997:** NASA 1998 budget proposal includes funds for an “Origins Initiative”—significant funding increases for Mars, Europa, and astrophysical missions and initiation of a major program in astrobiology.
- **October, 1997:** NASA issues first NAI Cooperative Agreement Notice.
- **October, 1997:** SSB establishes the Steering Group on Exobiology and Evolutionary Biology. Name soon changed to Steering Group on Astrobiology
- **July, 1998:** NAI opens for business.

# Steering Group on Astrobiology

- Not a committee but rather a subgroup of SSB members charged to provide a broad-based, cross-disciplinary focus for Board activities related to the life sciences and to coordinate the resources of the Board and its committees for application to issues in evolutionary biology and exobiology.
- The Steering Group did not conduct studies but, rather, recommended actions for the Board's consideration.
- The Steering Group also provided a focus within the board for the development and review of astrobiology-related.
- Was generally seen as the precursor for a fully-fledged astrobiology committee.



# *Size Limits of Very Small Microorganisms*

**Origin** NASA request

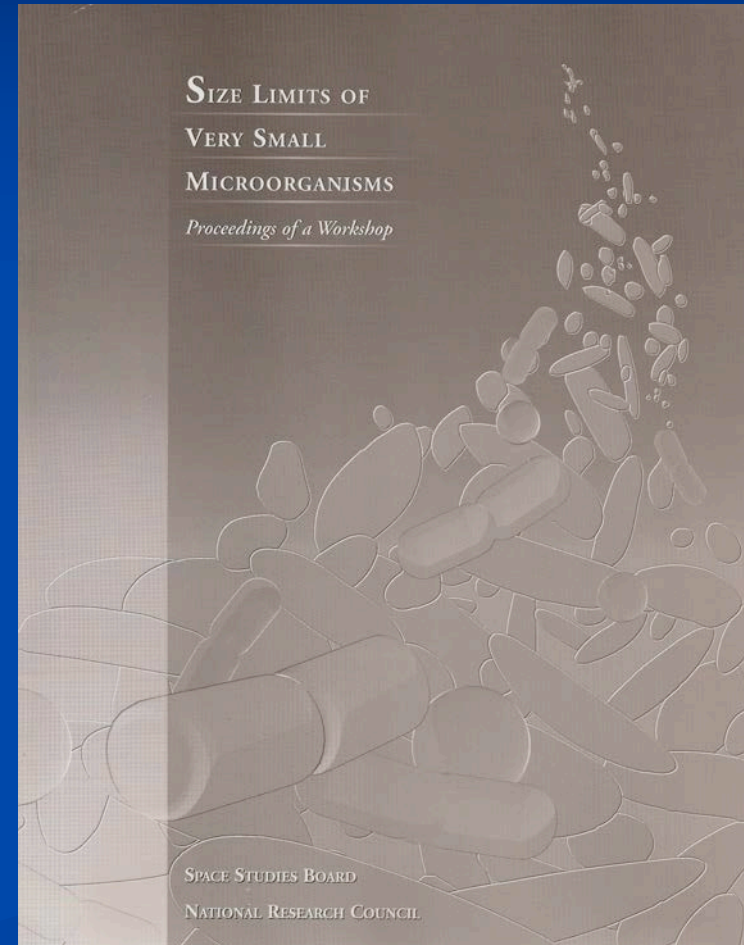
**Purpose** To organize a workshop to discuss issues relating to the minimal size for microorganisms.

**Study Group** Steering Group of 6

**Co Chairs** Andrew Knoll and Mary Jane Osborn

**Study Period** 3/98 to 6/99

**Final Report Issued** 1999



# *Sample Returned from Planetary Satellites and Small Solar System Bodies*

**Origin** NASA request

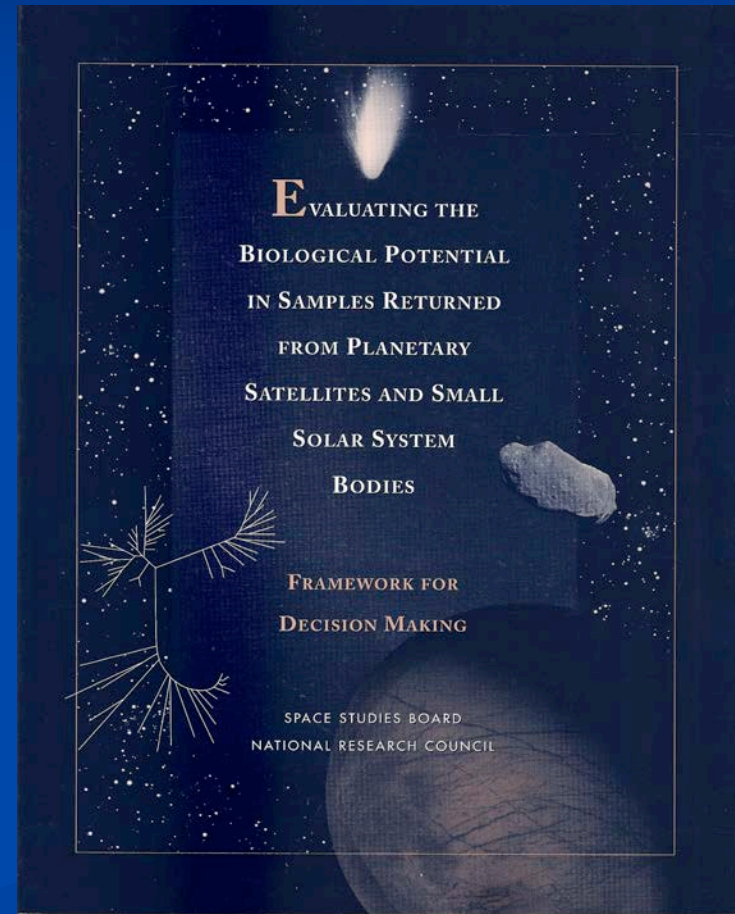
**Purpose** To discuss and make recommendations relating back-contamination issues relating to samples returned from planetary satellites and small solar system bodies.

**Study Group** Committee of 10

**Chair** Leslie Orgel

**Study Period** 5/97 to 6/98

**Final Report Issued** 1998

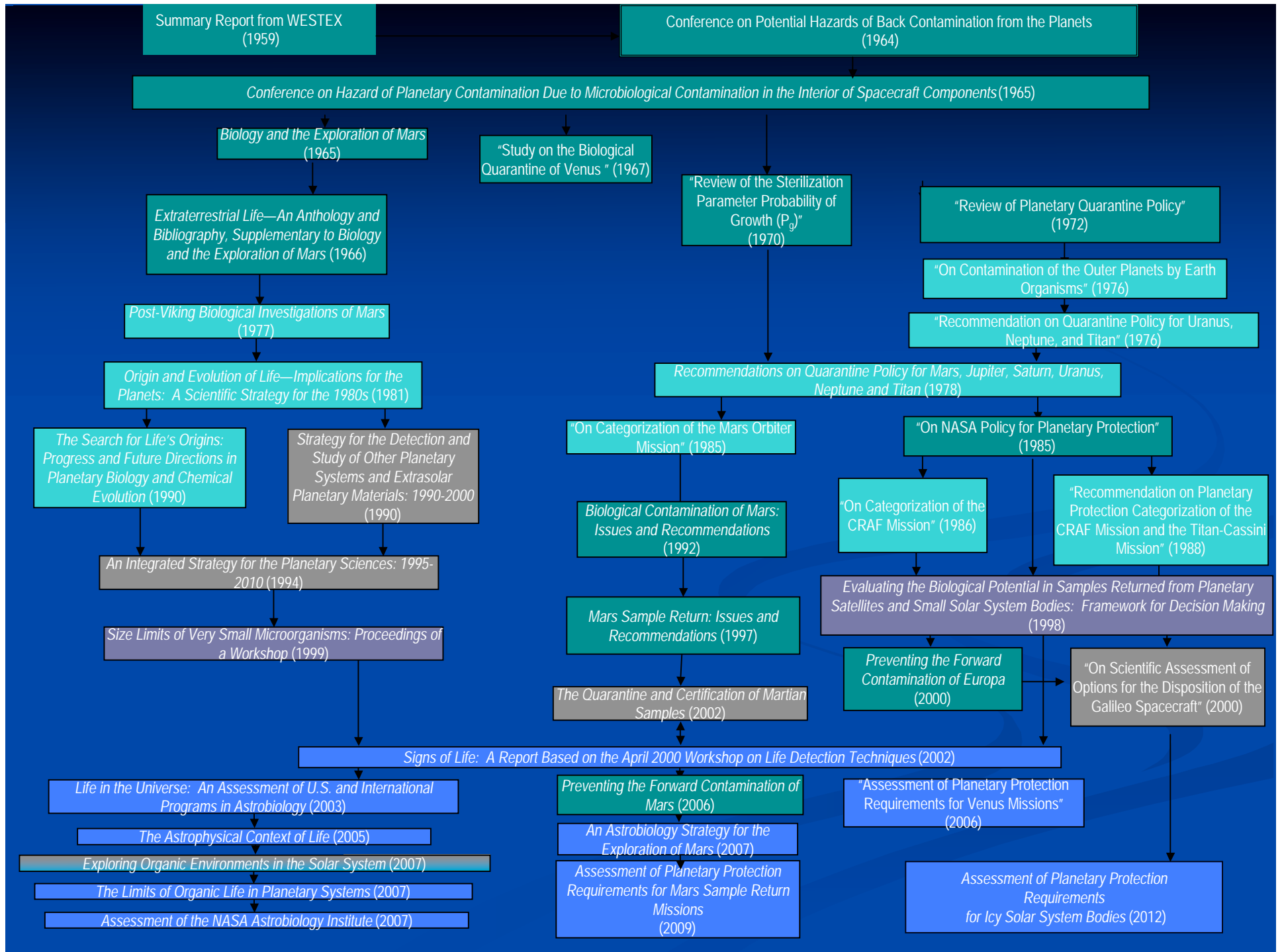


# Committee on the Origins and Evolution of Life

- COEL is a joint activity of the NRC's Space Studies Board and the Board on Life Sciences
- COEL exists to organize and provide oversight of studies on research opportunities and programs in astrobiology and related topics
- COEL monitors development and implementation of related research strategies, advanced technology and research program plans when these topics do not readily fall under the auspices of an existing NRC committee
- COEL was established in 1999 and held its first meeting in 2000

# COEL Co-Chairs

- 2000-2002  
**Jonathan I. Lunine**  
University of Arizona
- 2002-2005  
**J. Craig Wheeler**  
University of Texas
- 2005-2008  
**Bruce M. Jakosky**  
University of Colorado
- 2008-2011  
**Robert T. Pappalardo**  
Jet Propulsion Laboratory
- 2000-2002  
**John A. Baross**  
University of Washington
- 2003-2005  
**Jack W. Szostak**  
Massachusetts General Hospital
- 2006-2008  
**Kenneth H. Nealson**  
University of Southern  
California
- 2009-2011  
**J. Gregory Ferry**  
Pennsylvania State University



# *Life in the Universe*

**Origin** Congressional request

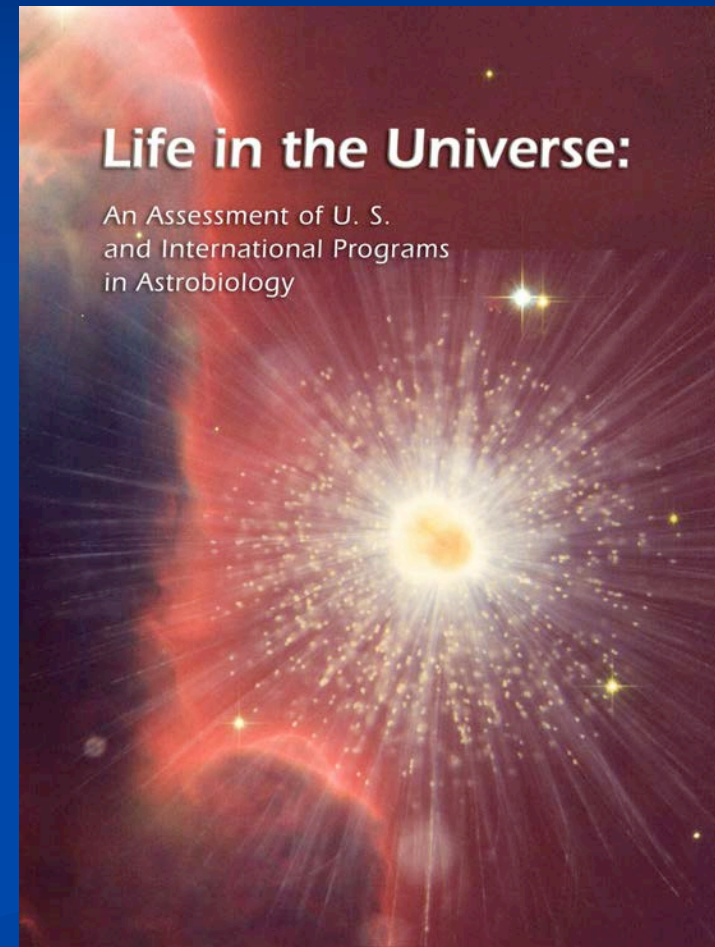
**Purpose** To review NASA's programs to "determine the extent of life in the universe," identify overlaps with activities of other groups and suggest enhancements

**Study Group** Committee of 14

**Chair** Jonathan Lunine & John Baross

**Study Period** 7/01 to 7/02

**Final Report Issued** 2003



# *Assessment of the NASA Astrobiology Institute*

**Origin** Requested by NASA

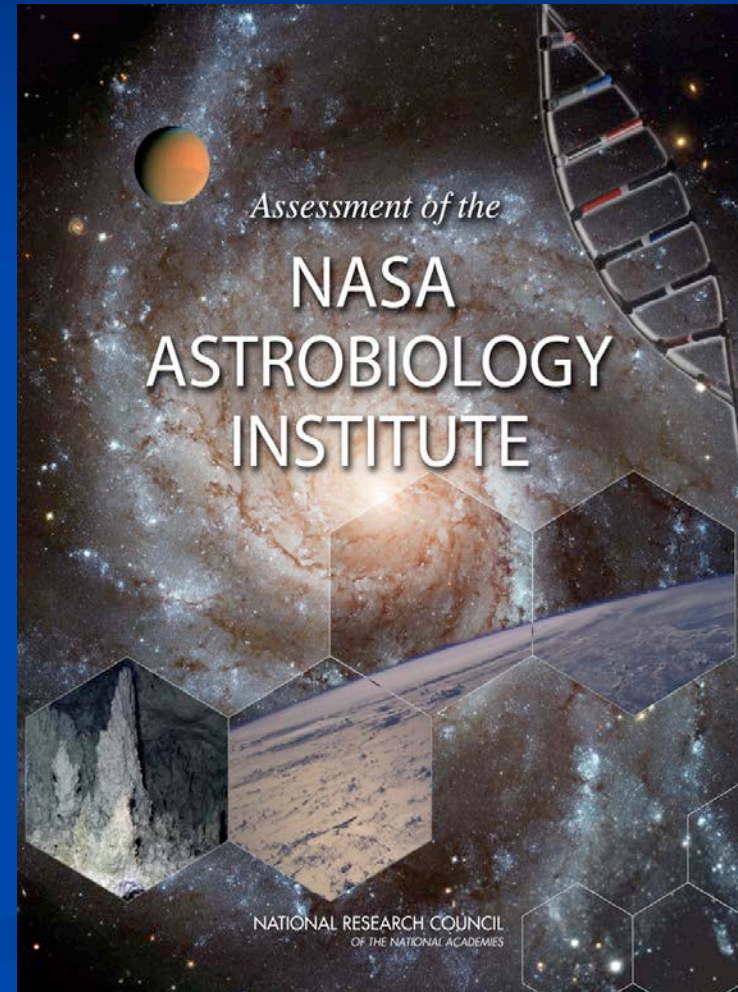
**Purpose** To determine the progress made by the NAI in developing, conducting, supporting and catalyzing the field of astrobiology and in providing scientific leadership for NASA spacecraft missions relevant to astrobiology.

**Study Group** Committee of 8

**Chair** John Klineberg

**Study Period** 7/07 to 9/07

**Final Report Issued** 2008



# *Signs of Life*

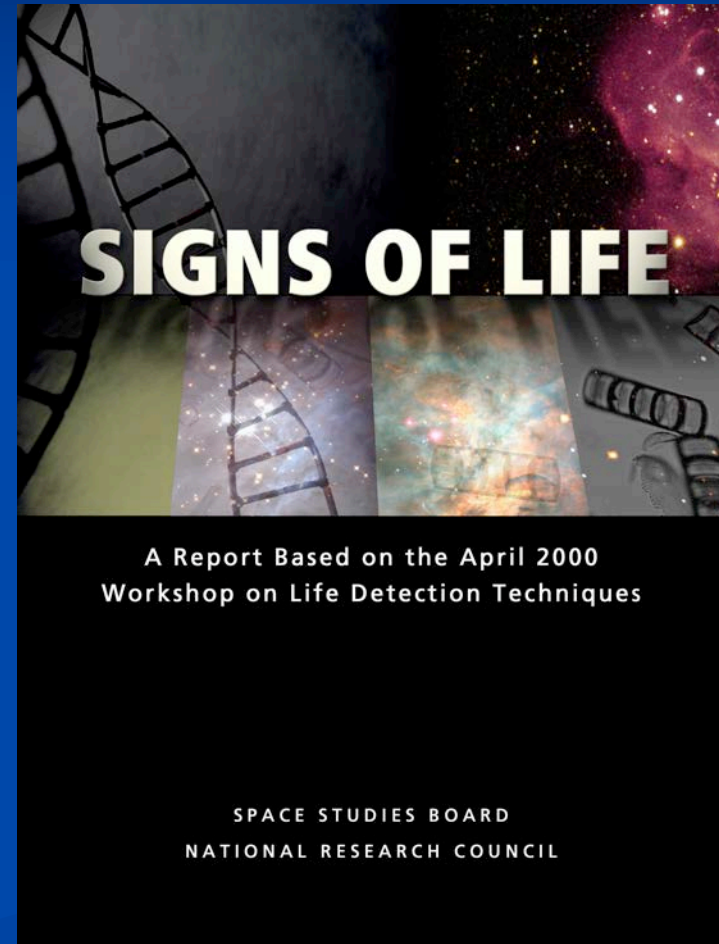
**Origin** Self initiated

**Purpose** To explore recent advances in biology, biotechnology, medicine, and the environmental sciences relevant to the detection of life or its remnants. (Also, a bonding experience for a new committee working in a new area.)

**Study Group** Committee of 8 support by 26 Workshop presenters.

**Study period** 1/00 to 6/01.

**Final Report Issued** 2002.



# *The Astrophysical Context of Life*

**Origin** Self initiated

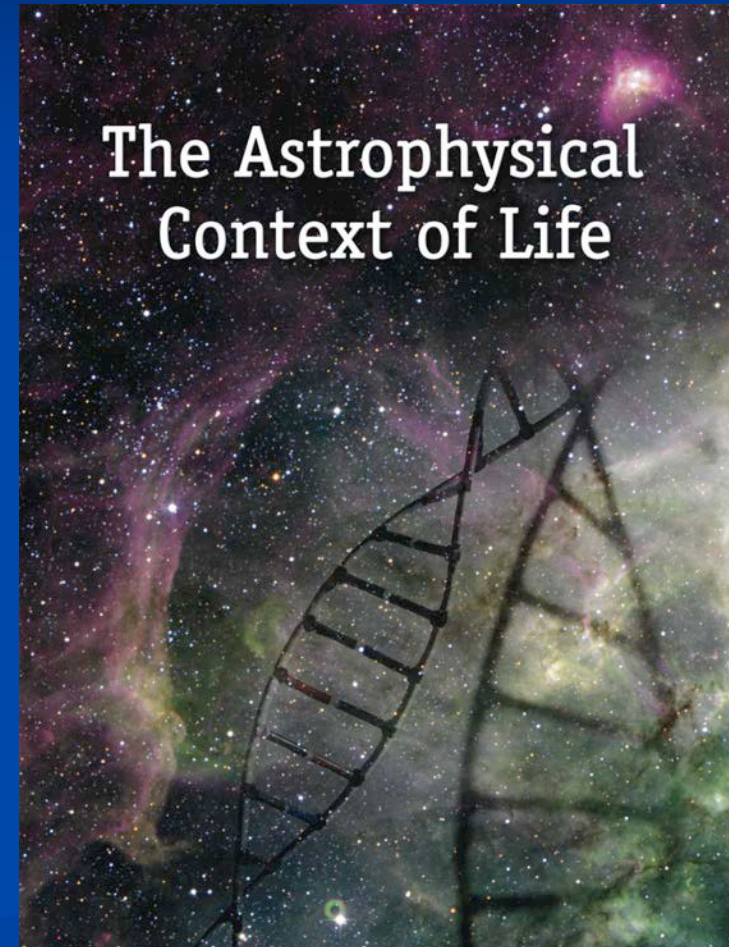
**Purpose** To investigate the means to augment and integrate the activity of astronomy and astrophysics in the intellectual enterprise of astrobiology, in NASA's Astrobiology Program and relevant programs in other federal agencies.

**Study Group** Committee of 17

**Chair** Craig Wheeler & Jack Szostk

**Study Period** 2/03 to 7/04

**Final Report Issued** 2005



# *Exploring Organic Environments in the Solar System*

**Origin** Self initiated (with NASA concurrence)

**Purpose** To determine what processes account for the reduced carbon compounds found in the solar system.

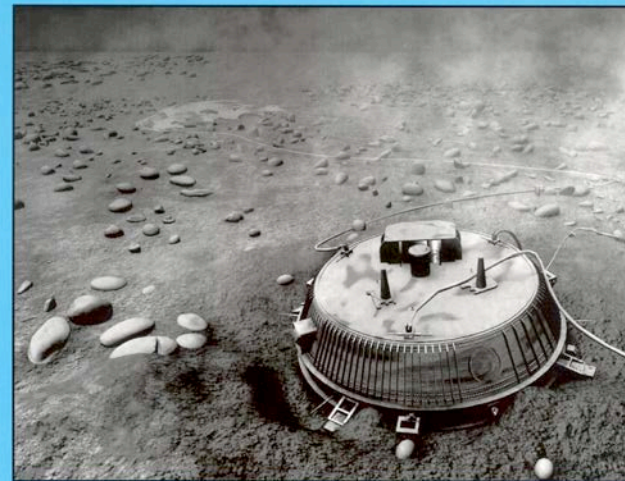
**Study Group** Committee of 11 (drawn from COEL, COMPLEX and BCST)

**Chair** James Ferris

**Study Period** 10/00 to 11/03

**Final Report Issued** 2007

Exploring Organic Environments  
in the Solar System



NATIONAL RESEARCH COUNCIL  
OF THE NATIONAL ACADEMIES

# *An Astrobiology Strategy for the Exploration of Mars*

**Origin** Requested by NASA

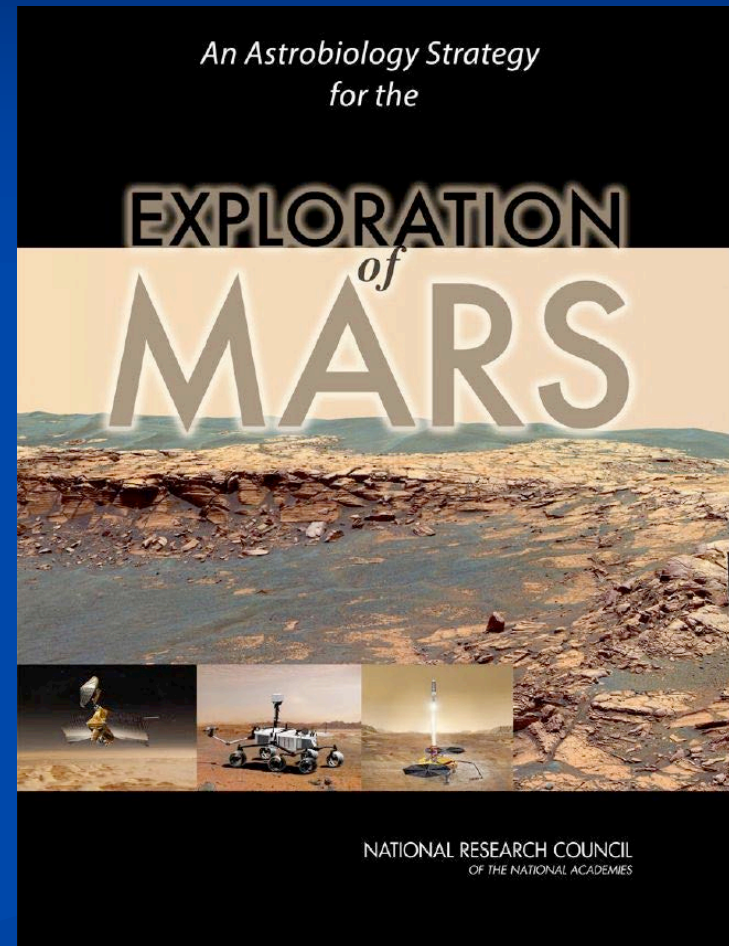
**Purpose** To develop an up-to-date strategy that integrates the diverse threads of astrobiology-relevant Mars studies into a single source for science mission planning.

**Study Group** Committee of 15

**Chair** Bruce Jakosky

**Study Period** 1/06 to 11/06

**Final Report Issued** 2007



# *Limits of Organic Life in Planetary Systems*

**Origin** Self initiated

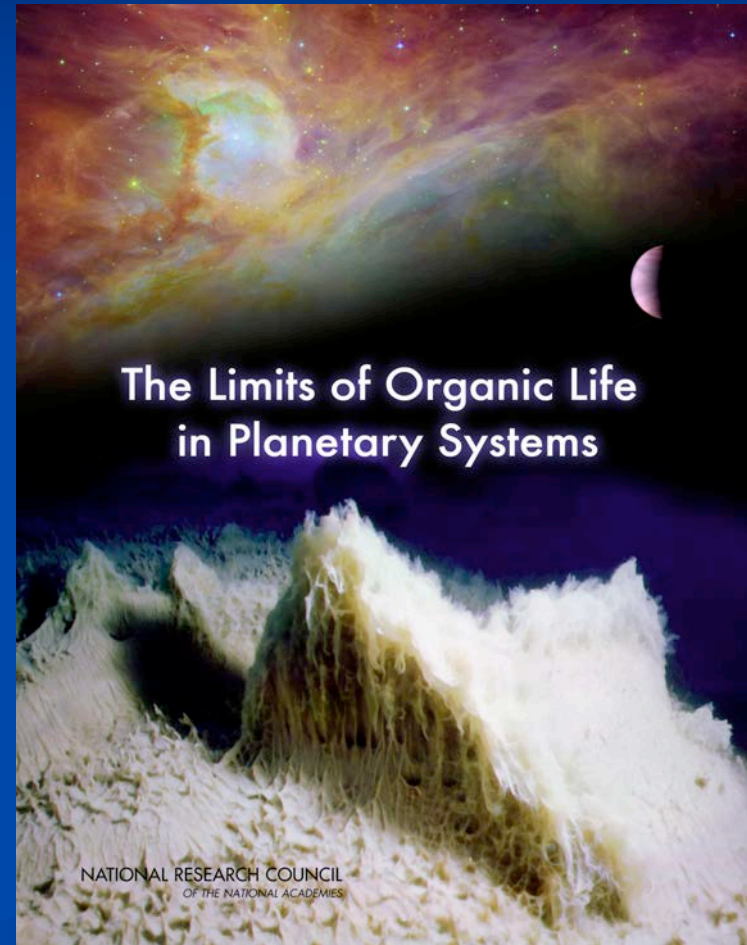
**Purpose** To evaluate the possibility that non-standard chemistry may support life in known terrestrial and conceivable extraterrestrial environments.

**Study Group** Committee of 11

**Chair** John Baross

**Study Period** 1/04 to 7/05

**Final Report Issued** 2007



# Assessment of Planetary Protection Requirements for Venus Missions

**Origin** Requested by NASA

**Purpose** To assess the ability of Venus to support Earth-origin microbial contamination and comment on forward- and back-contamination issues for future spacecraft missions to Venus.

**Study Group** Committee of 6

**Chair** Jack Szostak

**Study Period** 2/05 to 10/05

**Final Report Issued** 2006

THE NATIONAL ACADEMIES  
Advisors to the Nation on Science, Engineering, and Medicine  
Space Studies Board

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Washington, DC 20001  
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www.national-academies.org

February 8, 2006

Dr. John D. Rummel  
Planetary Protection Officer  
NASA Headquarters  
300 E Street SW  
Washington, DC 20546

Dear Dr. Rummel:

As originally written in your letter of February 7, 2005, to Space Studies Board (SSB) Chair Lennard Fisk and reiterated at the February 9-11, 2005, meeting of the SSB's Committee on the Origin and Evolution of Life (COEL), you asked for advice on planetary protection concerns related to missions to and from Venus. In particular, you asked that the National Research Council (NRC) address three issues in terms of their implications for planetary protection:

1. Assess the surface and atmospheric environments of Venus with respect to their ability to support Earth-origin microbial contamination, and recommend measures, if any, that should be taken to prevent the forward contamination of Venus by future spacecraft missions.
2. Provide recommendations related to planetary protection issues associated with the return to Earth of samples from Venus, and
3. Identify scientific investigations that may be required to reduce uncertainty in the above assessments.

In response to your request, the Task Group on Planetary Protection Requirements for Venus Missions was formed (the membership of the task group is listed in Attachment 1) and met at the Southwest Research Institute in Boulder, Colorado, on October 3-5, 2005. The task group's deliberations and discussions relating to the conclusions and recommendations contained in this letter report were confined to the Boulder meeting. To set the context for and define the scope of this study, presentations were given and discussions were held at two meetings of COEL earlier in 2005—the February 9-11 and May 31-June 2 meetings at the National Academies' Keck Center in Washington, D.C., and its Jonsson Center in Woods Hole, Massachusetts, respectively. These preliminary presentations and discussions were conducted under the aegis of COEL's standing oversight of NASA's Astrobiology program and in its role as the organizing committee for the SSB's astrobiological activities. And, since all but two members of the task group are also members of COEL, the majority of the authoring group of this letter report participated in all three meetings and heard the following presentations relevant to this study:

- *At the meeting in Washington, D.C.*, you briefed the committee on the topic "Planetary Protection Classification of Venus," and Dirk Schulze-Makuch (Washington State University) spoke on the question "A Case for Life on Venus?"

# *Assessment of Planetary Protection Requirements for MSR Missions*

**Origin** Requested by NASA

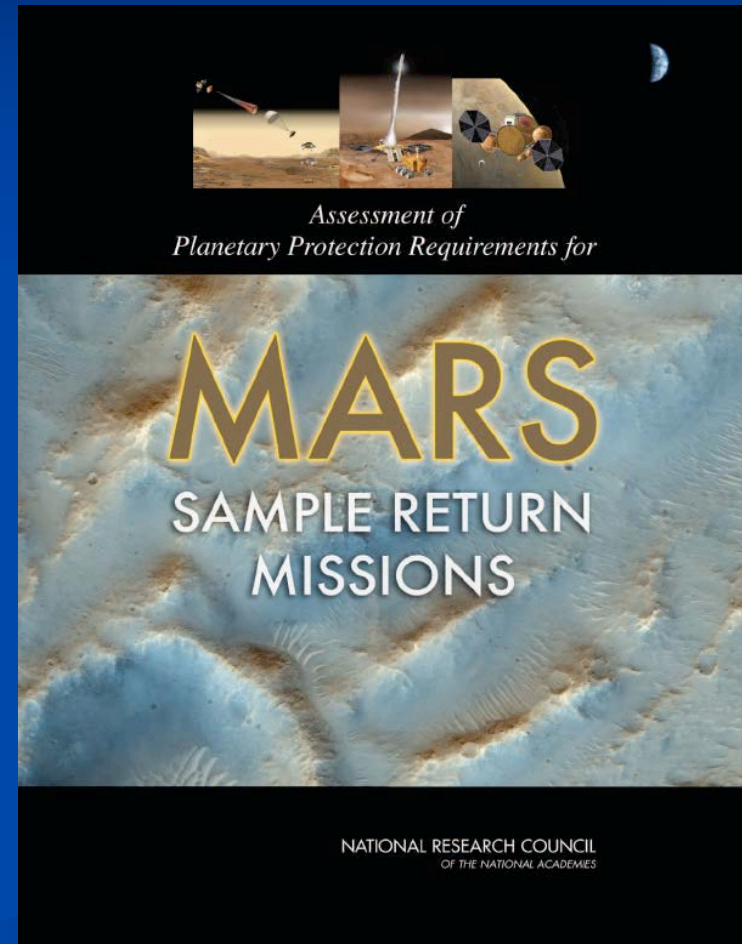
**Purpose** To review and update the recommendations relating to prevention of back-contamination by a Mars sample-return mission contained in the NRC's 1997 report Mars Sample Return: Issues and Recommendations.

**Study Group** Committee of 8

**Chair** Jack Farmer

**Study Period** 8/08-12/08

**Final Report Issued** 2009



# *Planetary Protection Requirements for Icy Solar System Bodies*

**Origin** Requested by NASA

**Purpose** To update recommendations in the NRC's 1998 and 2000 reports *Evaluating the Biological Potential in Samples Returned from Planetary Satellites and Small Solar System Bodies* and Preventing the Forward contamination of Europa in light of recent results.

**Study Group** Committee of 12

**Chair** Mitchell Sogin

**Study Period** 1/2011 to 8/2011

**Report Due** early-2012



# COEL and COMPLEX to Merge

- The SSB and its standing committees (CAA, CES, CSSP, COMPLEX and COEL) are funded through a series of 5-year contracts with NASA
- The current contract runs until 18 August, 2011.
- NASA's Planetary Science Division has indicated that it is no longer able or willing to support two of the SSB's standing committees (i.e., COMPLEX and COEL)
- NASA has requested that COMPLEX and COEL merge
- The renewal of the contract and the merger of COMPLEX and COEL does create new opportunities
- As we shall hear in more detail in the next presentation, the new merged committee will have much greater greater opportunities to write reports and make recommendations

# Committee on Astrobiology and Planetary Science

It will according to the current plan:

- Be established as a FACA-chartered committee with a 5-year lifetime
- Have co chairs, an astrobiologist and a planetary scientist
- Consist of 18 individuals, one-third astrobiologists and two-thirds planetary scientists
- Take ownership of the planetary decadal survey and COEL's reports and will monitor, interpret and oversee their implementation
- Write an annual assessment report
- Write other short reports upon request from NASA, the SSB or upon its own initiative
- It is not yet a done deal. All of the SSB standing committees are to be rechartered in an analogous manner
- However, the NRC has not yet approved this plan
- But, the NRC has already approved the rechartering of CAA in this manner.

**Thank You**