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# PARTICIPATORY SPACE EXPLORATION AND EDUCATION AT PISCES

*Presented at the Joint Meeting of the Space Resources  
Roundtable and the Planetary and Terrestrial Mining  
Sciences Symposium  
Golden, Colorado  
June 8-10, 2010*

**Frank Schowengerdt, PISCES Director (Presenting)**  
**Robert Fox, PISCES Deputy Director**  
**John Hamilton, PISCES Operations Manager**



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# OUTLINE

- **Context**
- **Role of Analogs**
- **Attributes of PISCES**
- **Participation Through Education**
- **Outreach to Increase Participation**
- **Not Your Father's Space Program!**

# PARTICIPATORY

## *Defined*

- **Pull In Non-Aerospace Folks**
- **Get More Kids Involved**
- **Promote STEM Education**
- **Inspire the Next Generation Again**
- **Excite the General Public Again**



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# CONTEXT

## *From President's FY2011 Budget Request*

- **New Space Technology Office**
- **Expanding and Building on IPP**
- **More Prizes and Demonstrations**
- **Education Increase for STEM**
- **Participatory Exploration in ESMD**

# MISSIONS

## *That Can Enhance Participation*

- **Precursor Robotic Missions**
  - **Teleoperated Lunar Lander with Live Video**
  - **ISRU Processing Lander**
  - **Asteroid or Mars Moon**
- **Enabling Technologies**
  - **ISRU**
  - **Materials**
  - **More Open Competitions**



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# THE ROLE OF ANALOGS

- **Analog test sites are critical proving grounds for complex space-bound systems.**
- **Analogs can increase public participation in exploration-related activities.**
- **Analogs can serve to inspire kids to study STEM disciplines to enable technical careers by allowing them to step into an environment that looks and feels like another world and to see what it might be like to live and work on such a world.**
- **To do this effectively, Analogs need to be more than passive test sites or empty fields.**
- **That's why PISCES is planning for a permanent analog outpost.**



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# PISCES

## *The Pacific International Space Center for Exploration Systems*

- Research and education to enable and promote the human settlement of space.
- International tests and technology demonstrations at the PISCES Test Site.
- STEM education, inspiring students by connecting Hawaiian culture to space exploration
- Spinoff technologies for the Hawaiian economy.
- Toward a full-scale, technically valid, analog lunar/Martian outpost on the Big Island.





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# ATTRIBUTES

## *of PISCES as an Analog*

- The PISCES Test Site is located at the 9,300-ft. level of Mauna Kea in an area covered by deep volcanic ash.
- Tephra has physical and chemical characteristics of lunar and Martian regolith.
- Lunar- and Martian-like Terrain with Craters and Cinder Cones Abound
- Relatively Easy Access
- Relatively Good All-Season Weather





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# TERRAIN

## *Haiwahini Craters*





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# TEST SUPPORT

## *Base Facilities*



*High-Bay*



*Institute for Astronomy*



*Electronics*



*Machine Shop*



*Office*



*Clean Room*





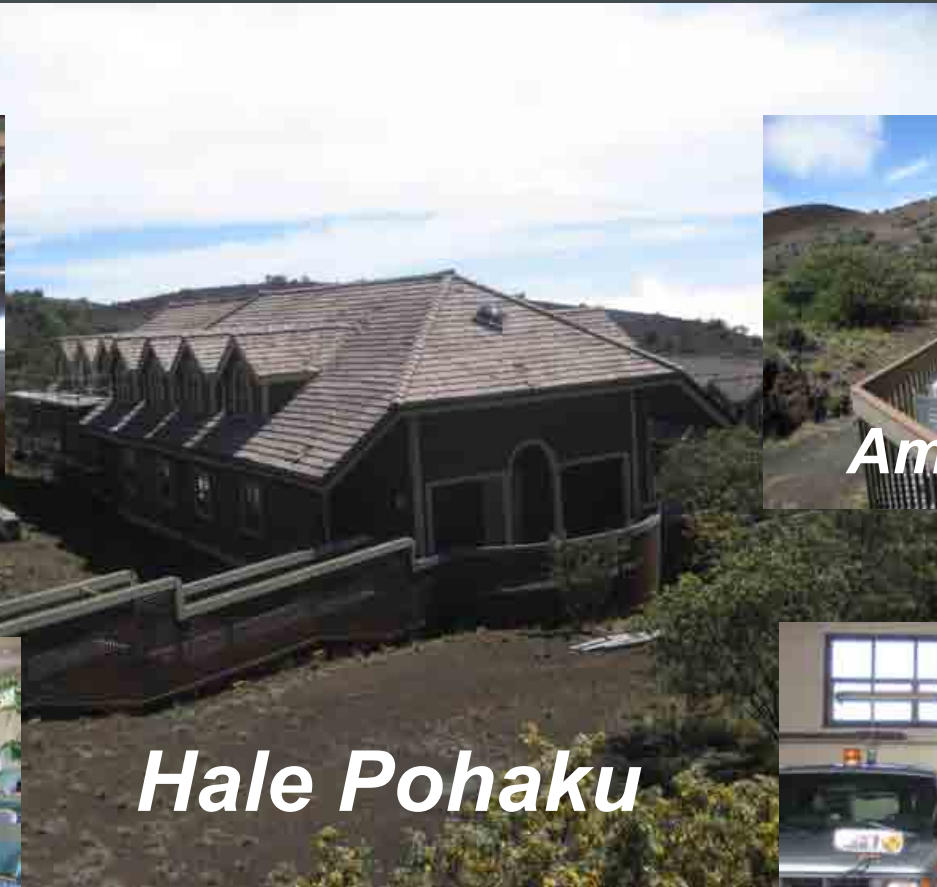
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# TEST SUPPORT

## *Lodging Near Test Site*



*Lobby*



*Hale Pohaku*



*Amenities*



*Dining Hall*

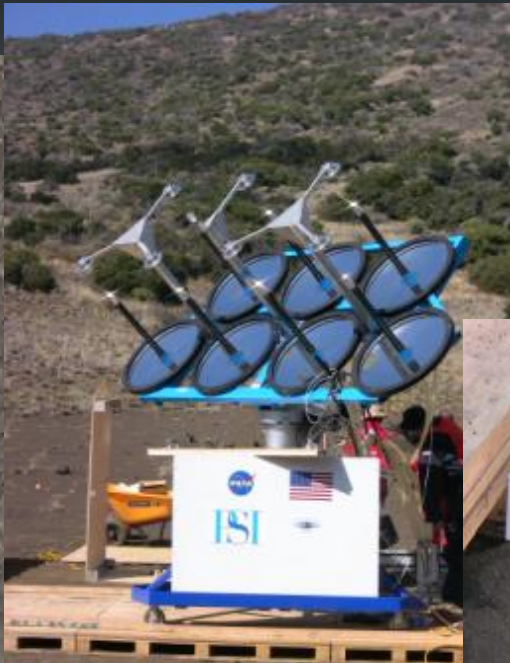


*Vehicle Shops*



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# 2010 TESTS



*NASA, CSA/NORCAT, DLR and Many Companies*



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# PARTICIPATION

## *Through Education*

- **National Space Seminar at UHH**
- **UH Space Studies Curriculum**
- **UHH Engineering Program**
- **SpaceClass**





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# National Space Seminar at UHH

- **First offered Spring 2009, Co-Sponsored and Co-Organized by NASA-Ames**
- **Video Teleconferenced to UH Manoa and NASA Ames Research Center**
- **Guest lecturers included major names in space exploration, including director of Ames.**
- **Well attended by UHH students.**
- **Offering on continuing basis.**



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# UH Space Studies Curriculum

- |   |                                    |
|---|------------------------------------|
| <b>1. Physics/Astronomy 111 Studies (UHH)</b> | <b>Intro to Space</b>              |
| <b>2. Physics/Astronomy 224 (UHH)</b>         | <b>Space Flight</b>                |
| <b>3. Physics Astronomy 230 (UHH)</b>         | <b>Applied Electronics</b>         |
| <b>4. Kinesiology 224 (UHH)</b>               | <b>Physiology and Space Flight</b> |
| <b>5. Computer Science 136 (UHH)</b>          | <b>Computing with Robots</b>       |
| <b>6. Astronomy 281 (UHM)</b>                 | <b>Astrobiology</b>                |
| <b>7. English 760Q (UHM)</b>                  | <b>Science Fiction</b>             |
| <b>8. Philosophy 255 (Honolulu CC)</b>        | <b>Cosmology</b>                   |
| <b>9. Political Science 342 (UHM)</b>         | <b>Space Settlements</b>           |





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# New UHH Engineering Program

- **Agricultural and Biological Engineering**
- **Systems Engineering**
- **Areas of Major Emphasis**
  - Sustainable Energy and Food Security
  - Robotics and Artificial Intelligence
- **Linkages**
  - USDA Installations on the Big Island
  - Mauna Kea Telescopes
  - PISCES



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# SpaceClass

***(<http://www.SpaceClass.org>)***

- **Web-Based Classes for K-12**
- **Offered Free to Schools by PISCES**
- **Development Paid for by Industry**
- **Some Classes Offered:**
  - **“Orion’s Path”**
  - **“Journey to a Black Hole”**
  - **“Asteroid Challenge: Target Earth”**
  - **“Mission to Mars”**
  - **“Bones in Space”**



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# OUTREACH

## *To Increase Participation*

- **K-12 Schools**
- **Hilo Community**
- **Hawaiian Community**
- **Student Design**
- **International**



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# K-12 Outreach

## *Waiakea Intermediate School*



**Lutz Richter and Frank Schowengerdt**



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# K-12 Outreach

## *Kanu o ka Aina Public Charter School*



**Bill Larson**





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# K-12 Outreach

## *Waimea Middle School*



**Jerry Sanders**



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# K-12 Outreach

## *Nawahi Middle School*



**Kim Binsted**





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# HILO COMMUNITY

## *Some PISCES Outreach Events*

- **Big Island Science Fair**
- **Robotic Competitions**
- **Onizuka Day**
- **Polynesian Voyaging and Space Exploration**
- **Journey Through The Universe**

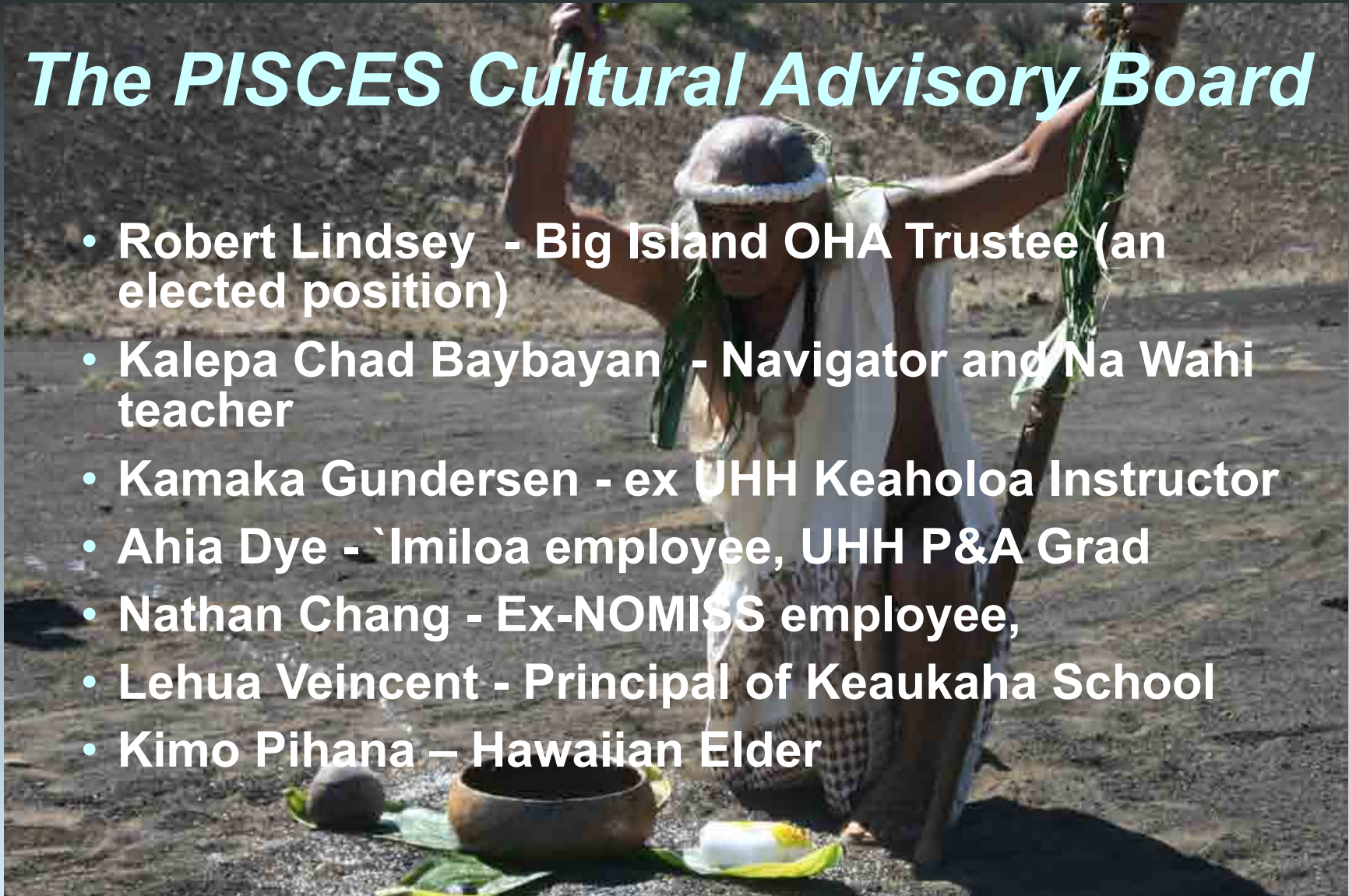


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# PAPA A'O A'O

## *The PISCES Cultural Advisory Board*

- Robert Lindsey - Big Island OHA Trustee (an elected position)
- Kalepa Chad Baybayan - Navigator and Na Wahi teacher
- Kamaka Gundersen - ex UHH Keaholoa Instructor
- Ahia Dye - `Imiloa employee, UHH P&A Grad
- Nathan Chang - Ex-NOMISS employee,
- Lehua Veincent - Principal of Keaukaha School
- Kimo Pihana – Hawaiian Elder





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# STUDENT DESIGN

## *Winners*

2007

**Honolulu Community College  
Colorado School of Mines  
University of Colorado**

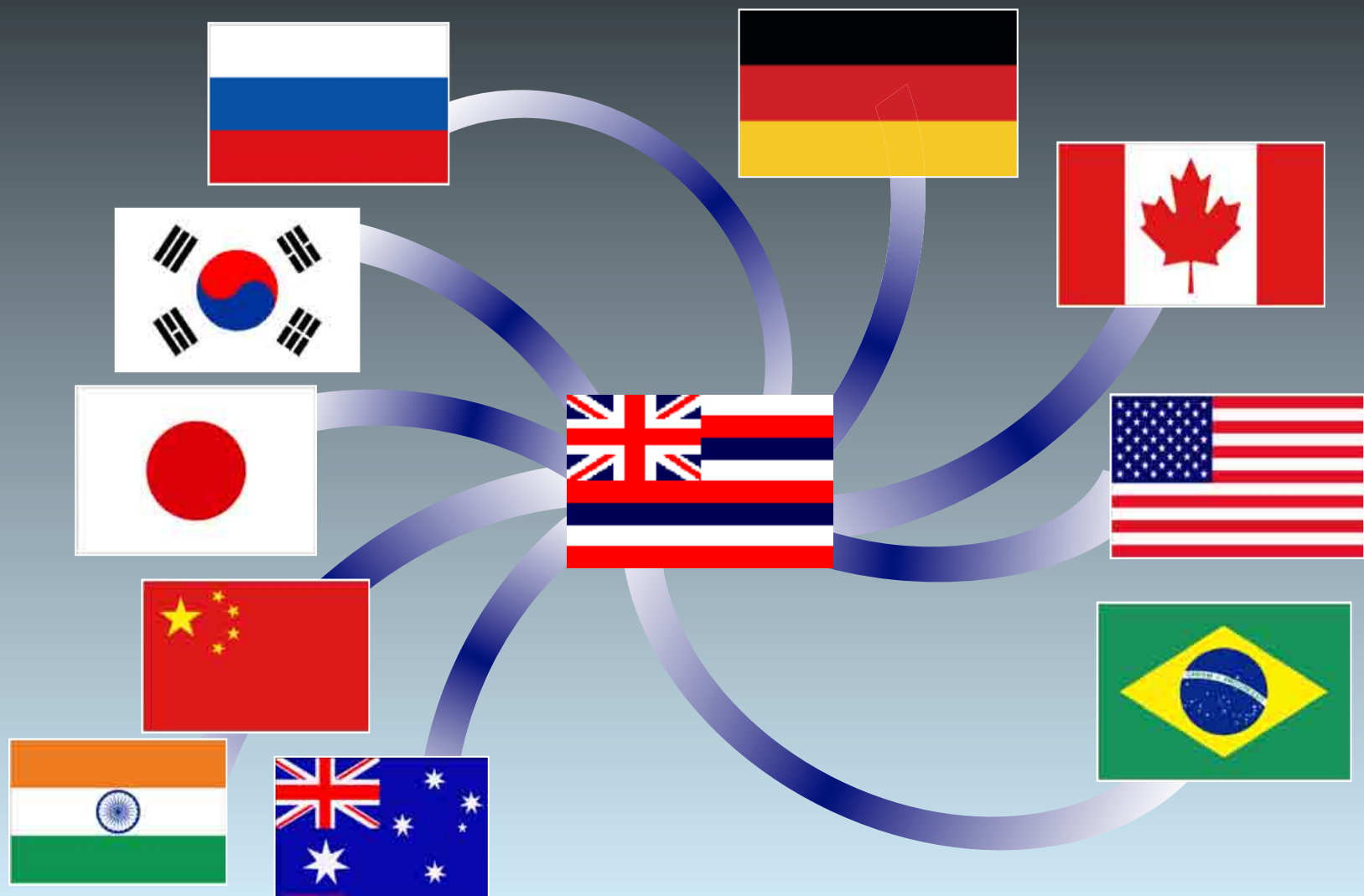
2008

**Virginia Polytechnic Institute  
Massachusetts Institute of Technology**

2009

**University of Wisconsin-Madison**

# INTERNATIONAL





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# SUMMARY

## ***Not Your Father's Space Program!***

- Participation will be much broader: public, private, commercial, academic, international.
- NASA will lead, but with many new partners.
- Space Technology development will allow us to go to a much wider array of destinations, and to stay there for much longer periods.
- Meanwhile, precursor robotic missions to the Moon will enable development of infrastructure for science, exploration, commerce and permanent human settlement.
- Terrestrial analogs will play a key role in all.



# Thank You!

*From the PISCES Community*

