



Lunar Surface Innovation

C O N S O R T I U M

Extreme Access Focus Group Introductory Telecon

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Today's Agenda

- Introductions
 - Who we are as a Focus group
- Overview: The purpose and role of LSIC and the Extreme Access focus group
 - Why NASA has asked this be set up.
 - Why it's relevant to you.
 - The organizational structure of LSIC and other opportunities for you
- The Extreme Access FG
 - Our Objectives, where we fit within LSIC
 - Goals for the group
- Communications Strategy – What to expect
- Upcoming meetings and other notes

Introductions

- Please provide an introduction (in the chat) to the group including
 - What is your name
 - Where do you work
 - What is your interest and/or experience in this focus area
 - Specific things you want to get out of the LSIC focus group

Dr. Angela Stickle, JHUAPL Focus Group Facilitator

- Educational background: Aerospace/Mechanical Engineering, Planetary Geology
- Moon cred:
 - Co-I on Mini-RF Radar and LAMP UV Spectrometer on LRO
 - Worked with RP, and Discovery mission proposals for exploring the Moon
 - Interested in helping enable sustained lunar presence, including robotic and crewed assets

 - Focus Group Goals: Identify gaps in needed technologies and technology development and help generate plans to fill them
 - Get to know the wider lunar community and build relationships



LSII Objectives

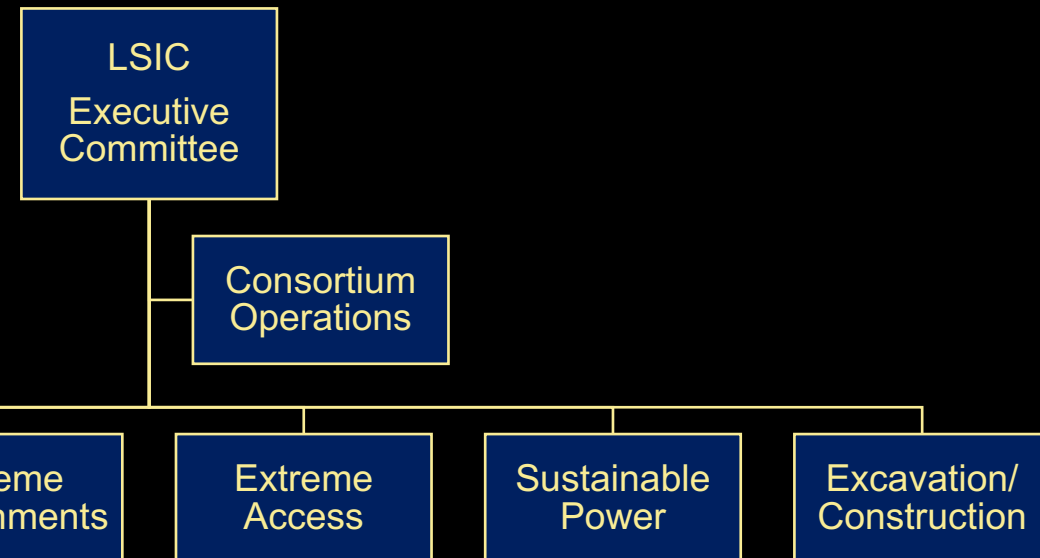
1. Harness the creativity, energy and resources of academia, industry and government in order for NASA to keep the United States at the forefront of lunar exploration
2. Identify lunar surface technology developments most in need of sponsor support and communicate those to NASA
3. Provide a central resource for gathering and disseminating information, results, and documentation



Charter & Structure

- **Technology** – Accelerate the development of key lunar surface infrastructure capabilities
- **Collaboration** – Enable meaningful partnerships across industry, academia, and government that leverage common goals and objectives for establishing lunar surface infrastructure capabilities
- **Communication** – Create information paths and relationships to best match needs with opportunities
- **Future Workforce** – Ensure that the U.S. maintains the workforce needed for sustained space exploration

The LSIC is a nationwide alliance of universities, non-profit research institutions, commercial companies, NASA centers and program offices, and other government agencies with a vested interest in our nation’s campaign to establish a sustained presence on the Moon.



Technology Focus Groups ➤

ISRU

Dust Mitigation

Extreme Environments

Extreme Access

Sustainable Power

Excavation/Construction

General FG Goals

- Identify technology needs
- Develop talent
- Build community
- Serve as an information clearinghouse
- Establish collaborative relationships among members

Focus Groups are the primary means through which LSIC interacts with the community.

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STMD is developing technologies enabling humans or robotic systems to efficiently access, navigate, and explore previously inaccessible lunar or planetary surface or subsurface areas.

- Connect industry, academic institutions and NASA to help technology development and build collaborations
- Identify critical challenges for accessing and exploring the lunar surface
- Enable and facilitate all categories of members.
- We do not do technology development as a group.

STMD is developing technologies enabling humans or robotic systems to efficiently access, navigate, and explore previously inaccessible lunar or planetary surface or subsurface areas.

- Technologies needed for accessing and navigating the lunar surface and subsurface
 - Mobility technology
 - Autonomous navigation technology
 - Communications
 - Operating in the lunar night/PSRs
 - ...What else?
- Technologies that enable a sustained, strategic presence at the lunar South Pole
 - Similar to above...
- What are the technology needs to enable sustained access and navigation?
- What technology already exists?
- What is being worked on?
- Where are the gaps?
- Is there technology that cross-cuts other focus groups?
- Other things you want out of this focus group?

Examples of LSII Demonstrations



Capability Area	Activity	Flight Demo Timeline
ISRU	Polar Ice to Water Demonstration (includes Polar Resources Ice-mining Experiment -1)	CLPS FY22 (PRIME); FY24-26
	Regolith Extraction Processes & Technologies (O2 extraction, Ionic Liquids, Electrolyzer, Reactor)	FY20-23 Ground Dev; Flight FY24+

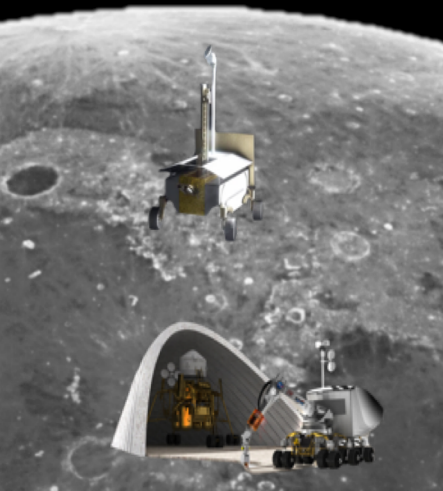
Extreme Access	Surface Robotic Scouts Technology Demonstrations	FY24+
	Advanced Materials for Surface Suits	FY25+
	Technologies Enabling Exploration of Lunar Pits	FY24+
	Smart Video Guidance Center	FY22+
	Day/Night Lunar Rover Obstacle Avoidance	FY24+
	Lunar Surface Mobility Systems Demonstration(s)	FY26+



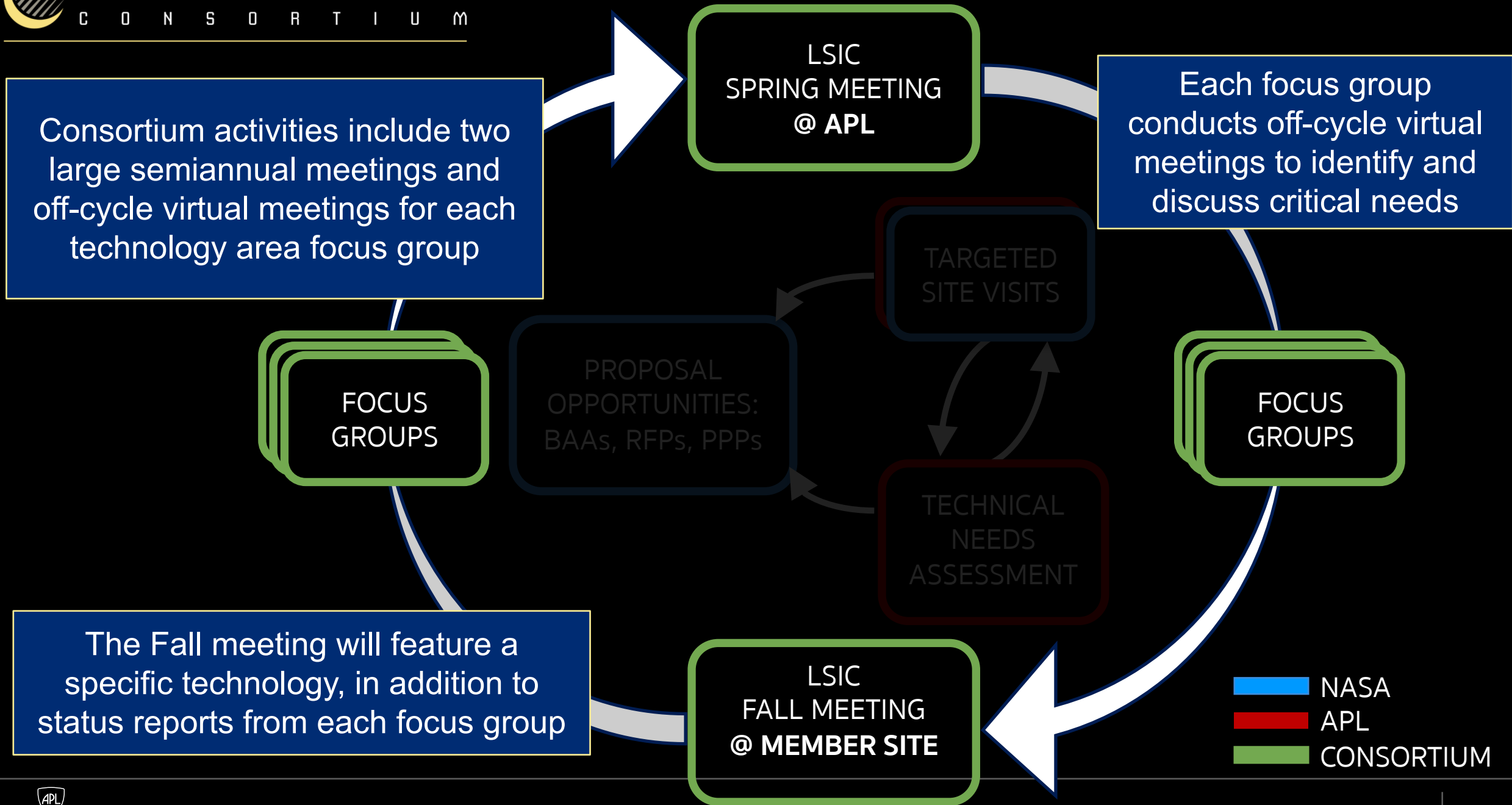
Extreme Environments	Lunar Night and Material Survivability	FY22+
	Planetary & Lunar Environment Thermal Toolbox	FY23+
	Bulk Metallic Glass (BMG) for Rovers	FY23+
	Extreme Environments System Demonstration(s)	FY26+
	Surface Robotic Scouts Technology Demonstrations	FY24+

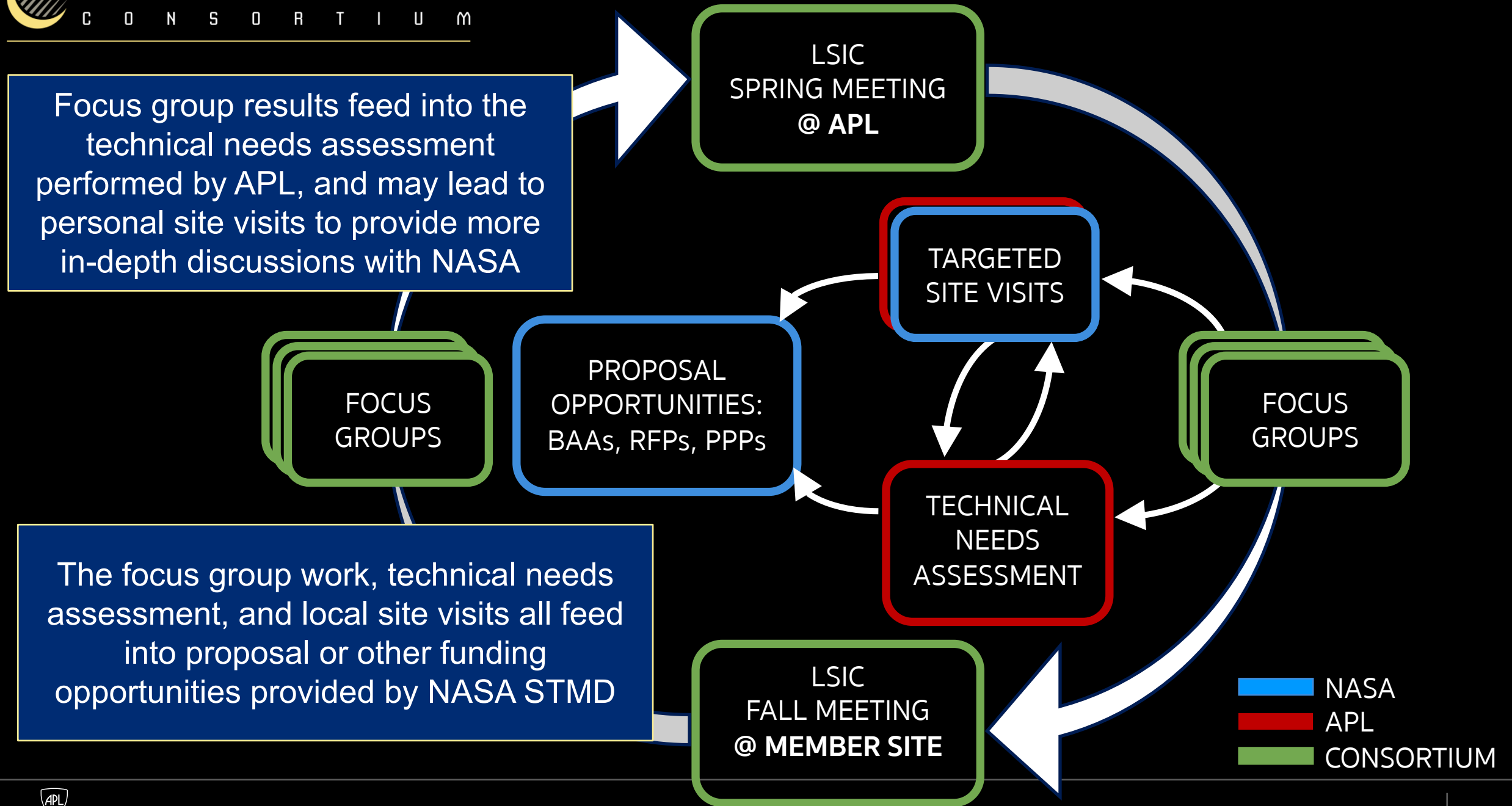
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	Lunar Surface Mobility Systems Demonstration(s)	FY26+

Excavation & Construction	Robotic Excavation on Lunar Surface (Centennial Challenge)	FY19-21
	Lunar Surface Excavation Development & Demo	FY22+
	Lunar Surface Construction Development & Demo	FY27+



Contextual Role of the Focus Group





Community Diversity within the Extreme Access Focus Group*

Doodle Poll Respondents

Industry ~ 52%
NASA ~ 7%
Academia ~ 7%
Non-profit ~ 34%



*Based on the doodle poll responses (29 people)

Value to You

- Communication and information
- Access to contextual information for lunar surface
- Understanding the technology landscape and development plans for other sectors
- Early identification and collaboration with developers of emerging technologies
- Influence into setting of standards together with greater community
- Ability to identify technology gaps and suggest technical priorities for NASA
- Partnerships for maturation and implementation of new technology
- Recruiting of new talent
- Frequent communications with sponsor
- Visibility into technology development

- (at least) Monthly emails from me to the whole listserv
 - Announcements, notes, reminders
- Monthly LSIC newsletter
- Mailing list
 - The listserv goes to all participants. Use with caution. But feel free to use!
 - If we need smaller, focused lists we can set those up
 - Follow the Rules of the Road (soon to be on the website)
- Monthly teleconferences will include (a subset of):
 - Short presentation from participants on technology relevant to extreme access
 - Working sessions to advance focus group goals
 - Open forum for brainstorming
 - Lightning round updates from various participants
 - Opportunity to voice issues to be brought to NASA
 - Give NASA POC for Focus Area a standing slot for NASA updates
- Wiki (in progress)
 - Dissemination of information
 - The main archive for all focus group activities and FG calendar
 - Provide collaboration space in addition to email list
- Follow the Rules of the Road for all Focus Group communications
- We can look into other communications tools also!!

Defining Our Focus Group Goals

For discussion at next month's telecon

- Collaboratively decide on a 1-year goal for us to work on as a group
 - Actionable
 - Impactful
 - Relevant to focus area
 - Doable within 1 year
 - Uses capabilities of focus group members
 - Can be accomplished with existing resources
 - Inspired by current issues
 - Beneficial broadly to all stakeholders
- Won't be the only thing we work on! But it can be a focus/consensus need.

Potential Example:

NASA needs XX to ensure robotic exploration of the Moon. Today, this does not exist, and there is no accepted path to its completion. We will provide specific recommendations to NASA for maturing technologies to achieve...

Upcoming Meetings

- Focus Group Telecons (2nd Thursday each month, 3-4 pm EDT)
 - July 9, 2020
 - August 13, 2020
 - Recent conflicts arose with NASA sponsors, so may have to shift. Look for another poll!
- LSIC (virtual) meeting, September 2020 (dates still TBD)

- Funding Opportunities:
 - NASA Innovative Advanced Concepts (NIAC) Step A Proposal due July 22, 2020 5 pm EDT
 - Lunar Surface Technology Research (LuSTR) - scheduled for early summer release 2020
- NASA/NAS Planetary Science & Astrobiology 2023-2032 Decadal Survey white papers
 - “Community input in these areas and related activities—including, theory, computing, **technology development**, laboratory studies, planetary defense, **and human exploration activities**—are critical for the success of the survey.”
 - Science white papers due July 15
 - Mission concepts due August 15
 - Technologies, infrastructure, etc. due September 15
 - <https://www.nationalacademies.org/our-work/planetary-science-and-astrobiology-decadal-survey-2023-2032>

Contact information

LSIC Director: Rachel Klima, SES-LSIC-Director@jhuapl.edu
<http://lsic.jhuapl.edu>

Focus Group Area	Listserv address	Facilitator
In-Situ Resource Utilization	LSIC_ISRU@listserv.jhuapl.edu	Karl Hibbitts
Surface Power	LSIC_Power@listserv.jhuapl.edu	Wes Fuhrman
Extreme Environments	LSIC_ExtremeEnvironment@listserv.jhuapl.edu	Ben Greenhagen
Extreme Access	LSIC_ExtremeAccess@listserv.jhuapl.edu	Angela Stickle
Excavation and Construction	LSIC_ExcavationConstruction@listserv.jhuapl.edu	Athonu Chatterjee
Dust Mitigation	LSIC_DustMitigation@listserv.jhuapl.edu	Jorge Núñez

Next Steps

- Before the next Focus Group meeting, by email, wiki, etc.
 - Think about/decide on other communication tools we want to utilize
 - Discuss the Year-1 goal
 - Decide on next discussion topics (such as update from NASA on strategy and funding)
- At the next Focus Group meeting, let's
 - Decide on the Year-1 goal
 - Decide on meeting structures



JOHNS HOPKINS
APPLIED PHYSICS LABORATORY

University-led efforts to improve critical systems and components or to catalyze development of new technologies that address high priority lunar surface challenges

Technical Characteristics:

- Unique, disruptive or transformational lunar surface technologies: autonomous excavation and construction, mitigation of lunar dust hazards, in-situ resource utilization, surface power, and accessing and surviving the extreme lunar environment.
- Low to mid Technology Readiness Level (TRL): TRL 2-5
- Post-award infusion opportunities

Eligibility

- Organization submitting proposal must be an accredited U.S. university
- PI must be a professor at the submitting university; co-Is are permitted
- $\geq 70\%$ of budget must go to accredited U.S. universities
- Up to 30% paid teaming with other universities, industry and non-profits encouraged

Award Information

- Expected duration: **2 years**
- Anticipated awards: **10-15 awards** valued at up to **\$1-2M** each
- Oversight: Annual reviews by NASA/APL team and semi-annual briefings at LSIC meetings
- Award instrument: Grants
- Release Date: **Early summer 2020**

Specific Goals

- Identify technology needs
- Serve without bias
- Develop talent
- Build community
- Serve as an information clearinghouse
- Host regular cross-community meetings
- Lead and coordinate focus groups
- Enable site visits from LSIC and LSII leadership
- Establish mentoring relationships among members



Value to Industry

- Access to contextual information for lunar surface
- Early identification and collaboration with emerging technologies from academia
- Influence into setting of standards together with greater community
- Ability to identify technology gaps and suggest technical priorities for NASA
- Mentoring by established companies
- Recruiting of new talent
- Frequent communications with sponsor

With a value proposition for each constituency, the LSIC will have the support needed to carry it forward, and in turn, to sustainable operations on the surface of the Moon.

Value to Academia

- Gain insight into gaps where R&D is needed
- Job/internship placement for students
- Partnerships with industry for maturation and implementation of new technology
- Communication with the sponsor
- Means to build reputation for their programs
- Insight into upcoming university-targeted funding opportunities

With a value proposition for each constituency, the LSIC will have the support needed to carry it forward, and in turn, to sustainable operations on the surface of the Moon.

Value to Government

- Finger on the pulse on the community
- Visibility into technology development
- Opportunity to suggest early course corrections
- Conversations with the community as they set standards and interfaces
- A readily available resource for rapidly addressing emerging needs
- Effective venue to communicate their needs to the providers

With a value proposition for each constituency, the LSIC will have the support needed to carry it forward, and in turn, to sustainable operations on the surface of the Moon.

Next Steps

Consortium Year 1 Activities:

- Establish Executive Committee (EC) and hold first EC meeting.
- Build membership.
- Establish focus area groups. Hold virtual quarterly meetings for each group.
 - In Situ Resource Utilization
 - Sustainable Power
 - Extreme Access
 - Extreme Environments
 - Surface Excavation/Construction
 - Lunar Dust Mitigation
- Schedule initial round of site visits by NASA and APL (as needed).
- Hold first Fall Meeting (hosted by Arizona State University).
- Develop consortium website to centralize resources, communicate LSIC information.

Discussion

- How can this consortium work for your institution?
- How can your institution contribute to the community?
- What are potential impediments to participating in focus groups?
- What kinds of focus groups activities would be most productive for LSIC objectives?

LSIC Objectives

1. Harness the creativity, energy and resources of academia, industry and government in order for NASA to keep the United States at the forefront of lunar exploration
2. Identify lunar surface technology developments most in need of sponsor support and communicate those to NASA
3. Provide a central resource for gathering and disseminating information, results, and documentation

Discussion

- What are the critical development needs in specific technological focus groups?
- Should the consortium participate in establishing standards?
- How do we protect proprietary information while enabling collaboration?

Focus Areas

- In Situ Resource Utilization
- Sustainable Power
- Extreme Access
- Extreme Environments
- Surface Excavation/Construction
- Lunar Dust Mitigation