

National Aeronautics and  
Space Administration

# EXPLORE MARS

**Eric Ianson**

NASA Planetary Science Division Deputy Director

Mars Exploration Program Director

Planetary Science Advisory Committee

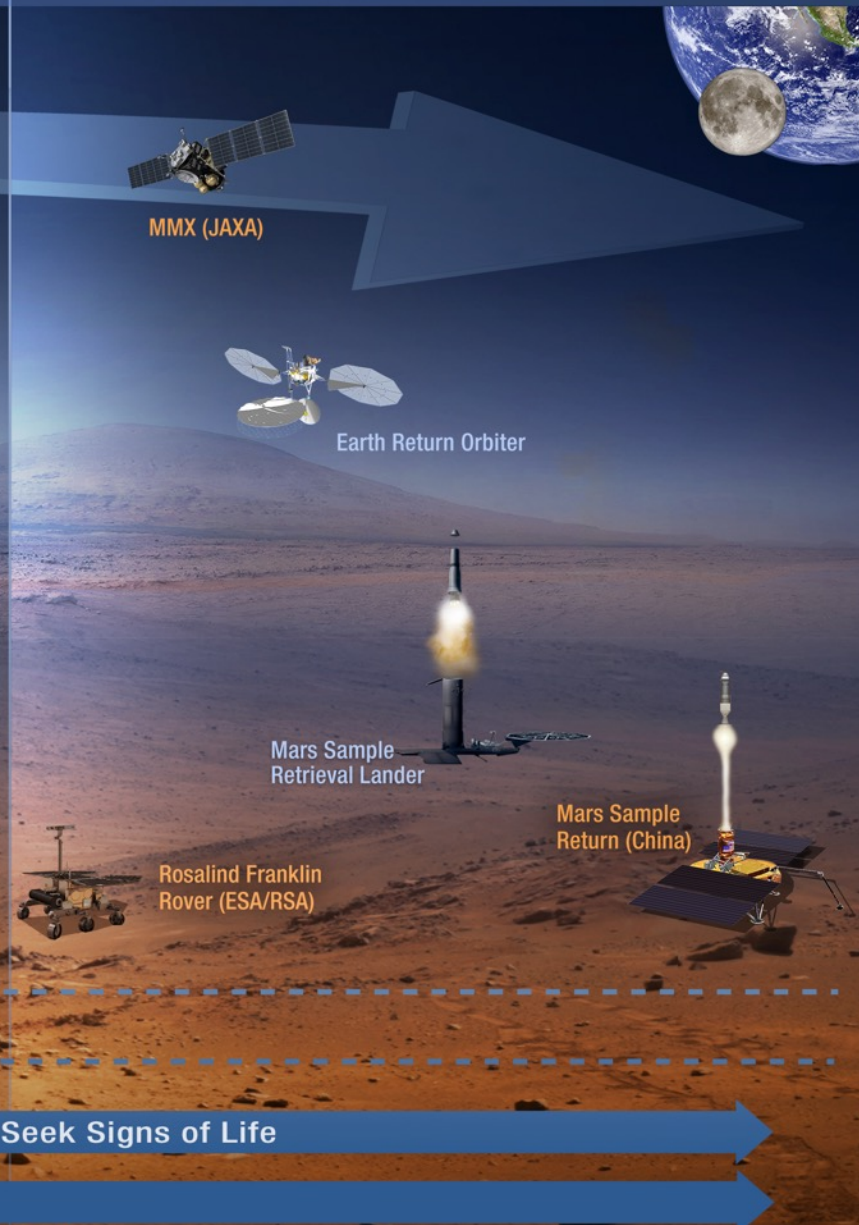
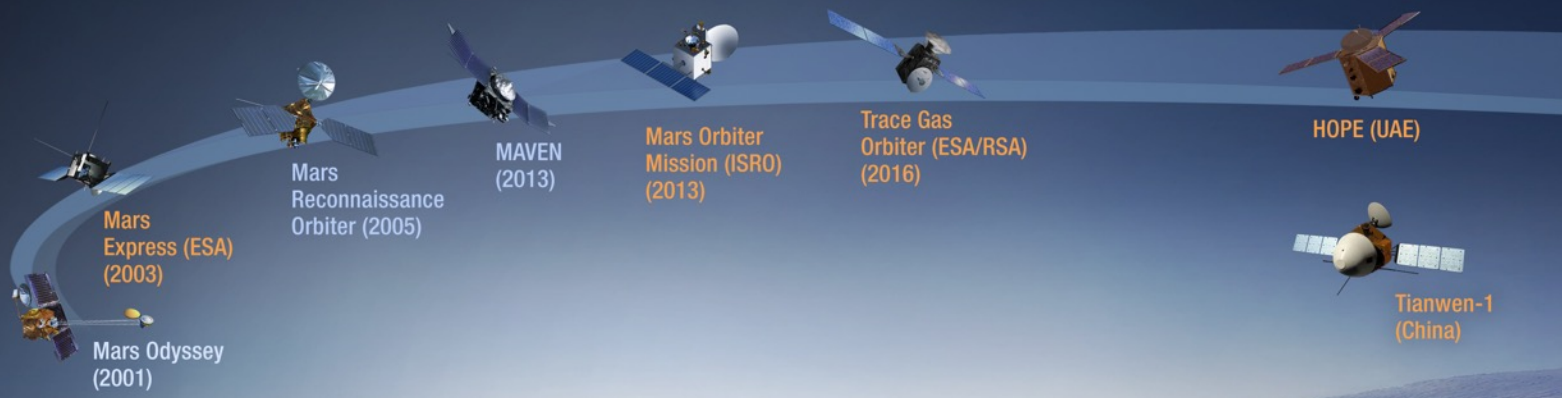
November 30, 2020



# MARS MISSIONS

OPERATIONAL 2001–2020

2022 AND BEYOND



Follow the Water

Explore Habitability

Seek Signs of Life

Prepare for Future Human Explorers

■ U.S. Missions    ■ non-U.S. Missions



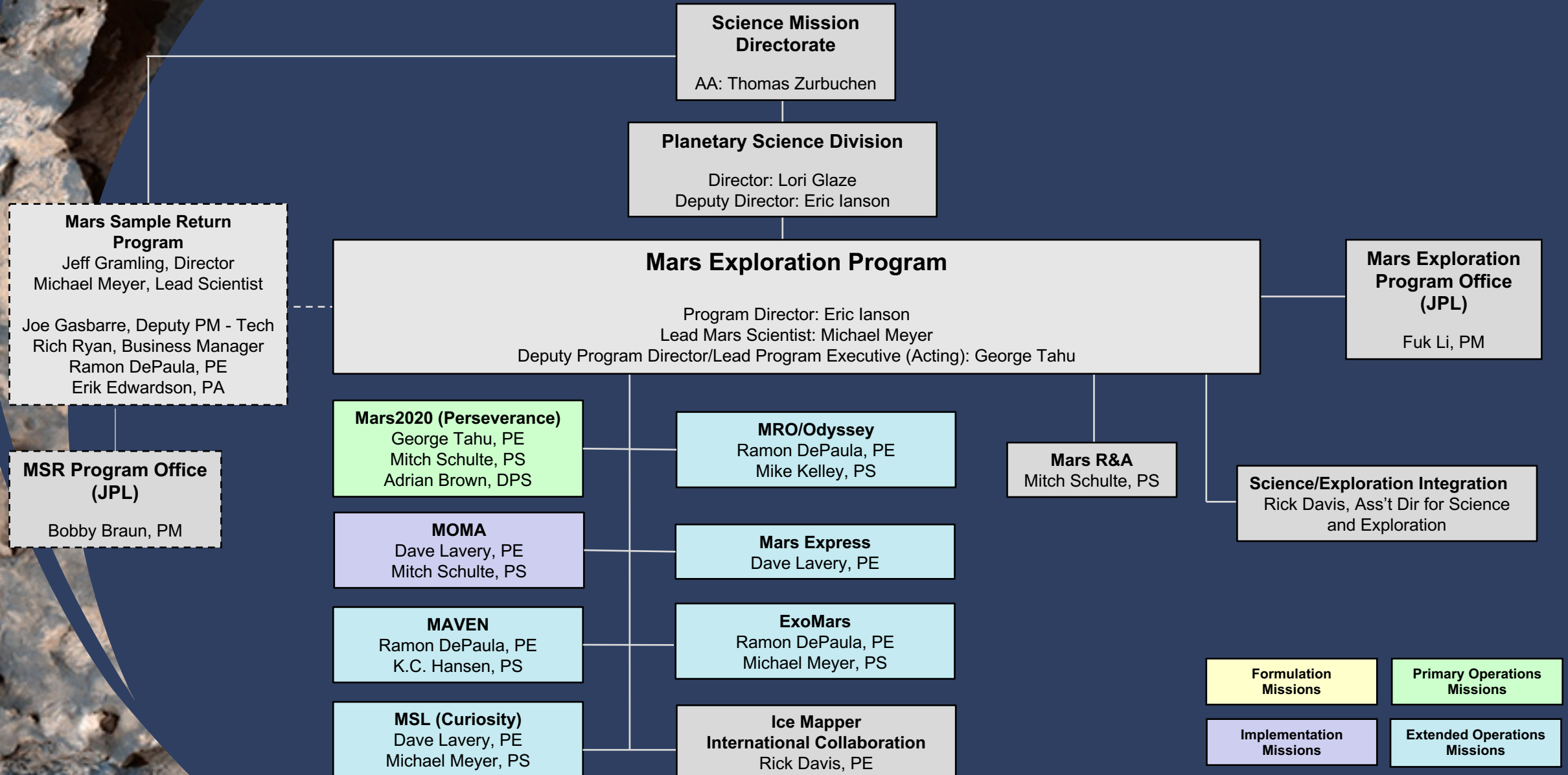
# Recent News (1 of 2)

- Jim Watzin has departed the Mars Exploration Program (MEP) and PSD for a position supporting NASA's Associate Administrator for Strategy and Plans (Tom Cremins) on efforts associated with human exploration of Mars
- Eric Ianson named Director of the MEP in addition to his existing role as Deputy Director of PSD
- Michael Meyer serves as Lead Scientist for MEP and Mars Sample Return (MSR)
  - Provides the science bridge between the programs
  - Ensure coordination of M2020 caching with MSR
  - Preparing science recommendations for facility and management of returned samples with MEP
- George Tahu appointed Acting Deputy Director / Lead Program Executive for MEP

# Recent News (2 of 2)

- Mars Sample Return has been established as a new program
  - Jeff Gramling named as the Program Director; reports directly to SMD Associate Administrator Thomas Zurbuchen
  - Close coordination remains with PSD and MEP
  - MSR Independent Review Board convened
  - Mission Concept Review successfully conducted October 9-13
  - Key Decision Point A planned for December 2020

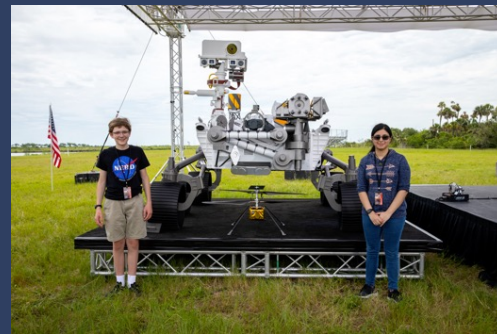
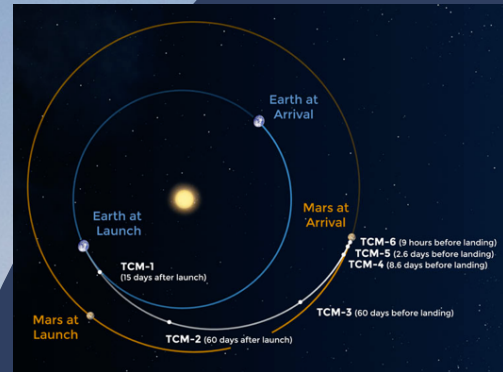
# SMD Mars Exploration Organization





# Mars 2020 / Perseverance

- Successfully Launched on July 30, 2020!
  - Spacecraft is healthy and in cruise to Mars
  - Landing at Jezero Crater on February 18, 2021
  - First leg of the Mars Sample Return campaign
- *Ingenuity* Mars Helicopter (technology demo) will attempt up to five powered, controlled flights
- Virtual launch experience highly successful; some metrics as of July 31:
  - 7.1M social media engagements over launch week
  - 5.3M views of launch across all platforms
  - 66.2k virtual launch guests



# Mars Exploration Status Updates (1 of 2)

- Operating missions did well in the 2019 Planetary Missions Senior Review. Odyssey, MRO, Curiosity, and MAVEN recommended for extended missions.
- Ongoing NASA missions are healthy and productive.
  - Odyssey: Continues to provide data on Martian geology, climate, and mineralogy, as well as thermal properties of Phobos. Also providing most of the relay support for InSight.
  - MRO: Providing radar 3D subsurface mapping of ice deposits and imagery and spectroscopy of surface features and weather; also supporting landing site assessments. Developing “Bent Pipe Communications” in support of Mars 2020 landing. Will continue to serve as major relay asset for surface missions (Curiosity, InSight, Perseverance, ExoMars).
  - MSL: Curiosity has traversed 23 km, climbed nearly 400 m, and just acquired a sample from its 29th drill hole. Continuing investigation of a clay-bearing unit on the side of Mount Sharp and will reach the transition to sulfate-bearing layers within several months.
  - MAVEN: Beginning 7<sup>th</sup> year in orbit; extended measurements have provided complete picture of global electric current system around Mars. Exciting science ahead during solar cycle 25; also providing relay for surface assets.
  - ExoMars/TGO (ESA): Providing ~50% of relay data from Curiosity & InSight
  - InSight (Discovery Program): Detected more than 450 marsquakes; measured the thickness of the crust for the first time; first observations of surface magnetic field; ongoing weather observations. HP<sup>3</sup> mole now beneath the surface; burrowing efforts to resume.

# Mars Exploration Status Updates (2 of 2)

- Mars Architecture Strategy Working Group (MASWG) formed in response to Decadal Survey Mid-Term Review
  - Defined four “mission arc” scenarios as examples of cost-effective Mars exploration that could be pursued beyond (in addition to or after) the sample return campaign
- ExoMars 2020 (rover named Rosalind Franklin) ESA launch delayed to 2022
  - NASA MOMA-MS contribution delivered and integrated into ESA rover
- Martian Moons eXploration (MMX) partnership with JAXA for launch in 2024
  - NASA MEGANE instrument approved to enter Phase C in May 2020
  - NASA Pneumatic Sampler (P-Sampler) tech demonstration successfully completed Preliminary Design Review in May 2020
- Mars Ice Mapper
  - International partnership Statement of Intent expected to be finalized soon
  - Pre-Acquisition Strategy Meeting planned for early 2021
- Integration of Mars activities (HEOMD, SMD) across the Agency
  - NASA has established a Federated Board to better integrate Lunar and Mars activities
  - Significant studies are underway to better understand Moon-Mars exploration synergies and to guide future work and collaboration



# Mars Sample Return

- **Mars 2020 Phase E operations remain under the Mars Exploration Program, reporting to the Mars Program Director**
- A separate, dedicated MSR program office will be established at JPL
  - Will report to MSR Program Director at HQ
  - Will be the system-level 'project' organization for MSR
- MSR continues to work towards two launches in 2026 (NASA lander + ESA orbiter) and is on track to enter Phase A this Fall
- MSR Program will end with the initial containment of the samples (and Earth Return Vehicle) at the Earth landing site
- **Returned Sample Receiving Facility, along with curation and sample science investigations, remains under the Mars Exploration Program**

Soaring above Mars.

Recon for arriving explorers.

Finding water, seeking habitats for life.

Monumental data streams for discovery.

# MARS Ice Mapper

- Numerous studies have identified near-surface ice (top 10 m) as a critical element of the human exploration of Mars.
  - Accessible Ground Ice as Rich in Science Potential
    - Astrobiology, Geologic & Climate History, & Modern Processes for both remote sensing and eventual human investigations “in the (Martian) field”
  - Accessible Ground Ice as an In Situ Resource for Human Exploration
  - Accessible Ground Ice as a Potential Driver for Human Landing Site Selection

- Planning for Human Exploration in the mid-2030s requires knowledge about the location, character, and extent of accessible ice beforehand, in the 2020s

**\*Reconnaissance = “What We Need to Know Before We Go”**

Relies on planetary science and contributes to it, with objectives targeted to high-priority science applications for human exploration.

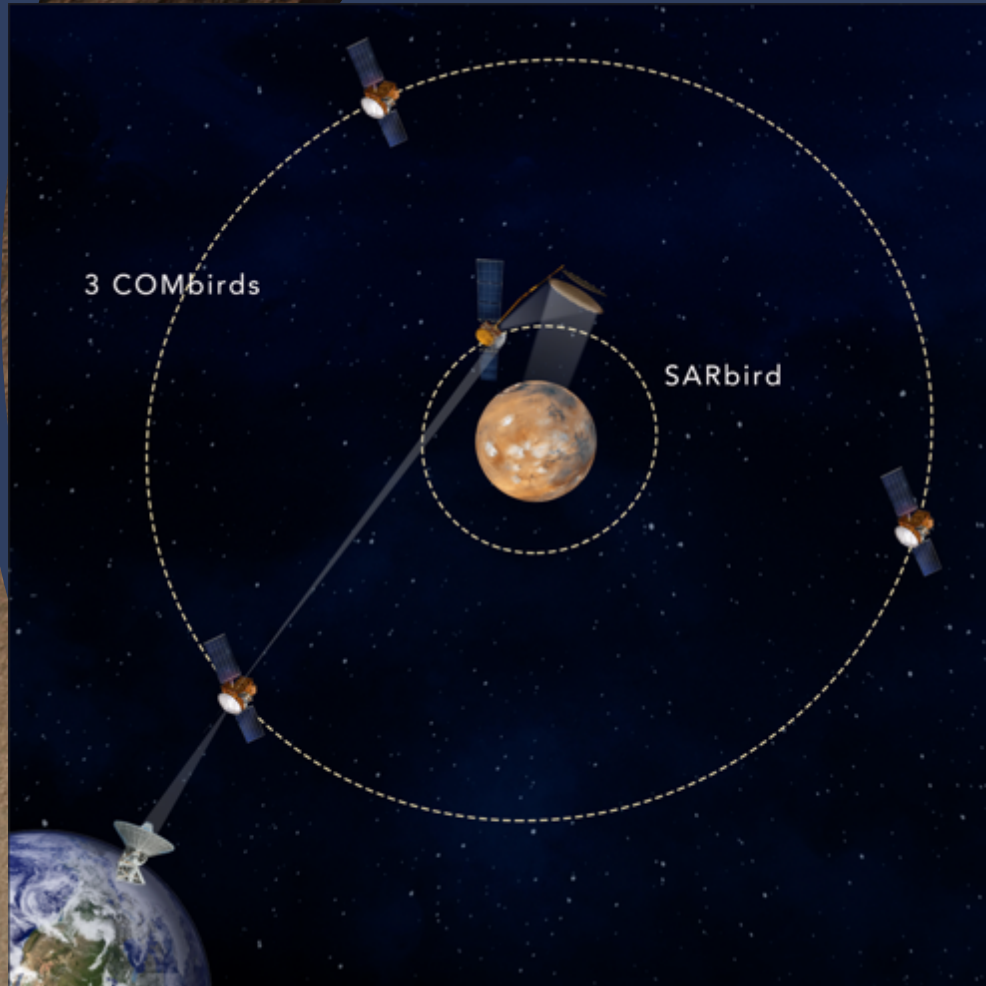
- An emerging multilateral partnership is beginning to plan for the mission (launch as early as 2026), as well as studying next-gen communications needs that could provide robustness for Mars Sample Return and a critical infrastructure for future Mars missions.
  - Leveraged prior NASA/CSA collaboration studies to jump start planning
  - Both NASA & CSA have received funding for planning and preparation
  - ASI, CSA, JAXA, and NASA are in the process of signing a Statement of Intent

INNOVATIVE  
PARTNERING  
AMONG WORLD LEADERS





# MARS *Ice Mapper* CONCEPT OF OPERATIONS



Schematic Diagram of Ice Mapper Concept

## Synthetic Aperture Radar (SAR) reconnaissance spacecraft in Low Mars Polar Orbit (benefits highly from upgraded data pipeline below)

- Deliver on reconnaissance priorities while maximizing science return
- Survey the depth, breadth, and purity of water-ice in the upper 5-10m of Martian subsurface
  - ISRU for propellant, back-up life support, civil engineering, mining, manufacturing, and eventually, agriculture
  - Identify water-ice-rich sites for high-value human-led, robot-assisted science investigations at candidate human landing sites
  - Seek potential “special regions” for possible habitable refuges
- Reveal details of Mars’ geologic and climate history

## Constellation of Linked Comm Relay Spacecraft in a High-altitude Equatorial Orbit

- Enable continuous connectivity from Mars surface and low Mars orbit to/from Earth
- Generate data rates and data return, orders of magnitude greater than present capability
- Provides robustness for Mars Sample Return as well as critical infrastructure for future Mars missions, including large SAR data sets.

# Advanced Studies / Technology Development

Mars Program Office at JPL provides advance planning, assessment, and analysis of mission alternatives and concepts for future Mars missions. Recent activity includes:

- Mars Returned Sample Handling studies (ground recovery, receiving facility, etc.)
- Access to previously unexplored regions
  - Missions to date have been limited to surface and near-surface access in regions compatible with current lander/rover capabilities
  - Next phases of Mars exploration can be enabled by capabilities for accessing new regions (e.g., extreme terrain, subsurface sounding/drilling, aerial via rotorcraft)
- Low-cost Access to Mars
  - Small spacecraft missions have potential to achieve significant science objectives
  - Leverage emerging commercial cubesat/smallsat spacecraft subsystems
  - Utilize low-cost methods to reach Mars (rideshares, new low-cost launch, etc.)
  - Can be further enabled by improved relay capabilities for small landers/orbiters
- Connections with human exploration (water mapping, telecommunications relay)

Mars Technology Development effort offers opportunities for new initiatives to advance technologies towards successful infusion on future missions. Recent activities include:

- Sample acquisition/caching/containment; Terrain Relative Navigation (TRN); fast traverse; MSR ascent; helicopter tech

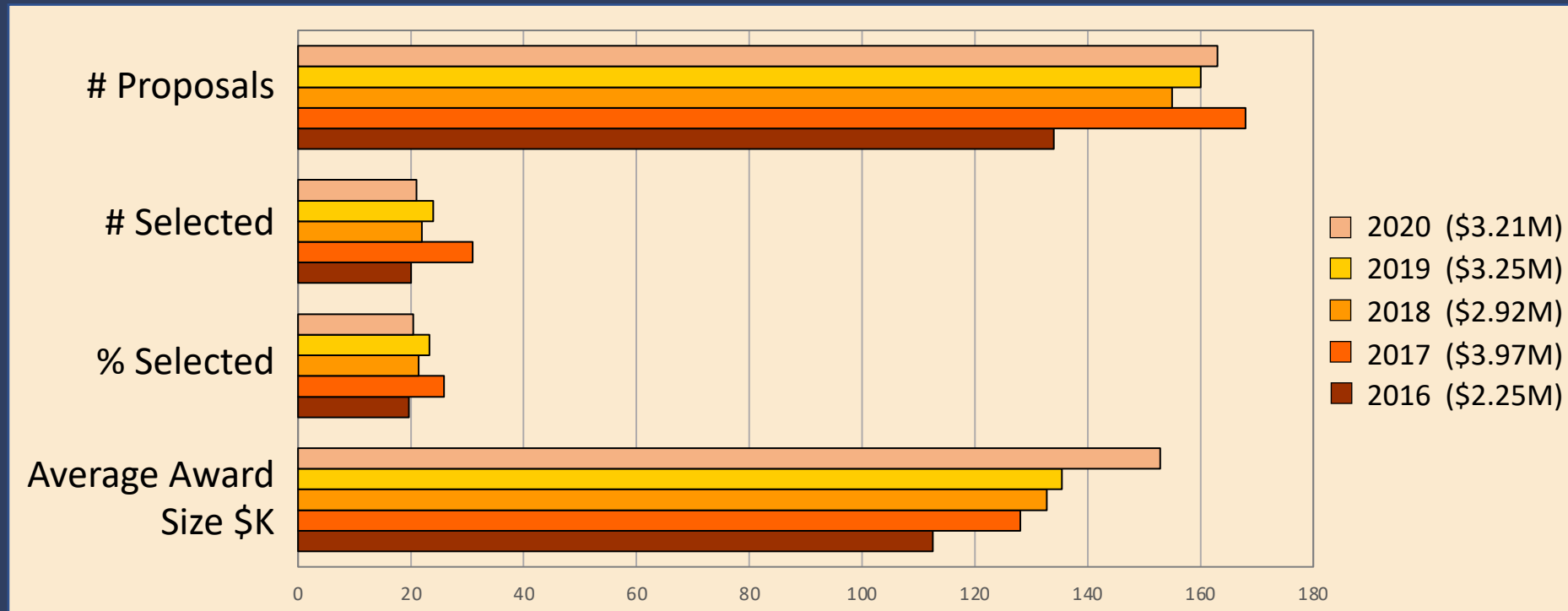


# Mars R&A / Mars Data Analysis Program

Funds the analysis of data returned from NASA and other missions to Mars.

- Enhances mission scientific return
- Broadens scientific participation in the analysis of mission datasets
- Funds high-priority areas of research that support planning for future missions

Mars-related research also supported by Solar System Workings, Habitable Worlds, and planetary instrument technology development programs.



# Priorities for Mars Exploration Program

- Maintain NASA's position as a world leader in Mars exploration
  - Champion the interests of the Mars science community
  - Ensure continued successful operation of existing orbiters, landers, and rovers on Mars
  - Support and cultivate existing and future international partnerships
  - Promote future mission opportunities for Mars science
- Close coordination with the Mars Sample Return program and Planetary Science Division
- Implement priorities established through the 2023 Planetary Science Decadal Survey
- Maintain fiscal discipline to deliver a healthy Program within available resources
  - Support existing efforts
  - Enable future capabilities