



NASA'S JOURNEY TO

MARS

The background of the slide features a photograph of the surface of Mars. The terrain is a reddish-brown color with various rock formations and small craters. In the upper center, the planet Earth is visible as a small, yellowish-orange sphere. The sky is a dark, hazy blue-grey, suggesting the atmosphere of Mars.

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**Committee on the Review of Progress Toward Implementing the
Decadal Survey Vision and Voyages for Planetary Sciences**

July 13, 2017

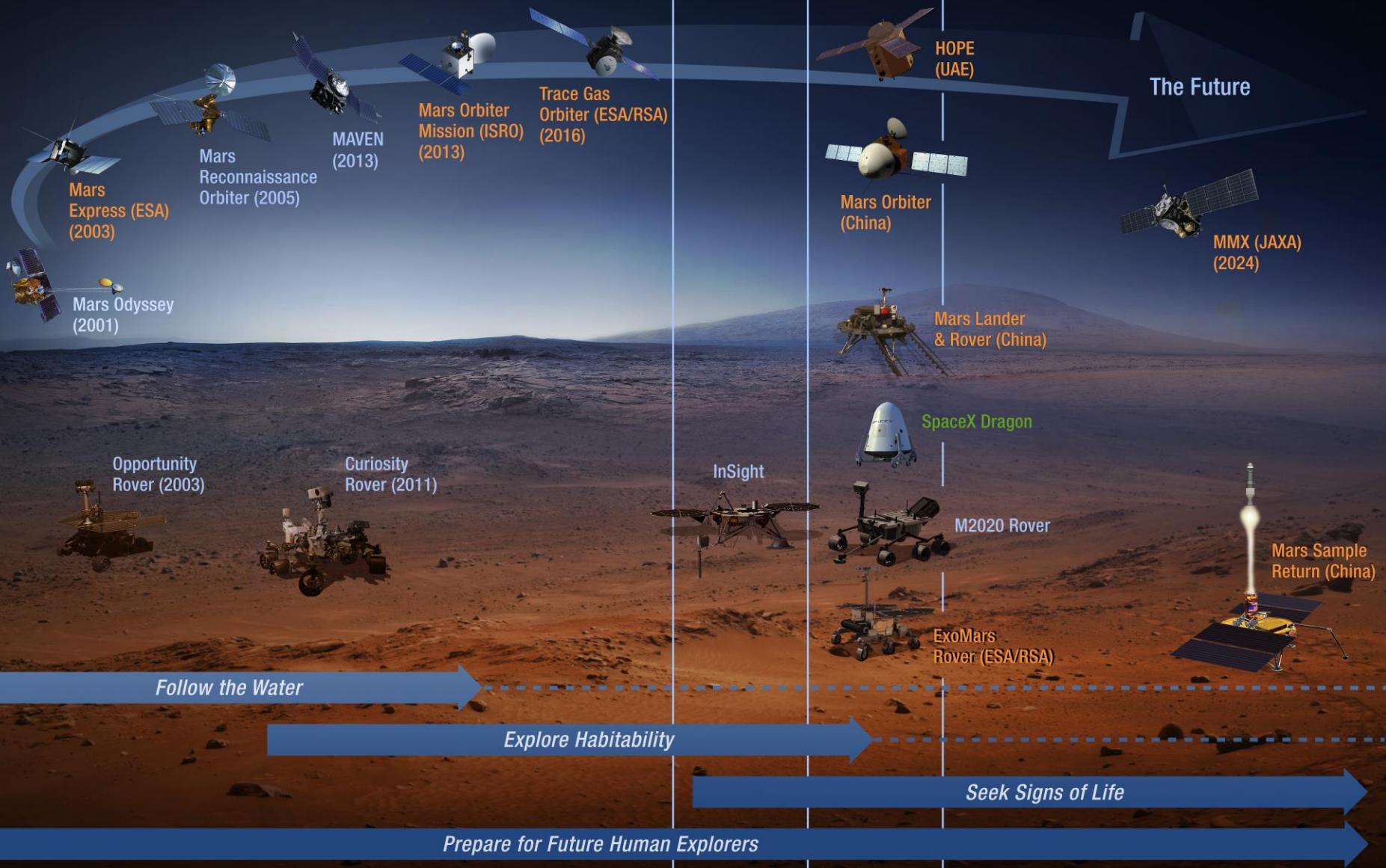
Mars Missions

Operational 2001–2017

2018

2020

...and Beyond



International Collaboration on Mars Missions

To address the *Committee on the Review of Progress Toward Implementing the Decadal Survey Vision and Voyages for Planetary Sciences* task concerning the Mars Exploration Program:

- *the long-term goals of the Planetary Science Division's Mars Exploration Program and the program's ability to optimize the science return, given the current fiscal posture of the program;*
- *the Mars exploration architecture's relationship to Mars-related activities to be undertaken by foreign agencies and organizations; and*
- All operating Mars missions have involved some degree of cooperation, anywhere from navigation support, to participating scientists/co-investigators, to instrument contributions, to joint mission formulation and partnerships.
- Working through the International Mars Exploration Working Group, communications standards have been well coordinated
- For US missions, competed instruments have been open, whether foreign or domestic.

International Collaborations: US Operating missions

- Odyssey
 - High Energy Neutron Detector, HEND
- Opportunity
 - Alpha Particle X-ray Experiment, APXS,
 - Mössbauer Spectrometer
- Mars Reconnaissance Orbiter
 - Shallow Radar sounder, SHARAD
 - Shared investigators between CRISM and OMEGA
 - Landing sites for ExoMars EDM & ExoMars 2020 rover
- Curiosity
 - Alpha Particle X-ray Spectrometer, APXS
 - Rover Environmental Monitoring Station, REMS
 - Dynamic Albedo of Neutrons, DAN
 - Chemistry and Camera, ChemCam
 - Sample Analysis at Mars, SAM
- MAVEn
 - MOM & Mars Express collaboration

International Collaborations: Non-US Operating Missions

- Mars Express, ESA
 - Mars Advanced Radar for Subsurface and Ionosphere Sounding, MARSIS
 - Joint Team Meetings between SHARAD & MARSIS investigations
 - Analyzer of Space Plasma and Energetic Atoms, ASPERA
- Trace Gas Orbiter, ESA/RSA
 - Nadir and Occultation for MArs Discovery, NOMAD
 - Colour and Stereo Imaging System, CaSSIS
 - Provision of Electra relay packages to augment relay for NASA & ESA landed missions

International Collaborations: Developing Missions

- InSight – US Discovery Mission
 - Heat Flow and Physical Properties Package, HP3
 - Seismic Instrument for Interior Structure, SEIS
- Mars 2020 – US, all instruments were competed
 - Radar Imager for Mars Subsurface Experiment, RIMFAX
 - Mars Environmental Dynamics Analyzer, MEDA
 - SuperCam
- ExoMars Lander- ESA
 - Mars Organic Molecule Analyzer
 - Landing site reconnaissance by MRO, ODY, and MEX
- Martian Moons eXploration (MMX) - JAXA
 - Neutron and Gamma-ray Spectrometer
- Hope – UAE
 - Like MOM, have contracted navigation and communication support
 - NASA has contributed to major reviews
 - Collaboration among orbiters is anticipated

International Collaborations: Future

- As in the past, NASA is open to, and has encouraged, international collaboration on Mars missions
- In recognition of the number one priority in the Vision and Voyages Decadal Survey and strong interests in the international community, we are studying concepts for Mars Sample Return (MSR) within the framework of potential partnerships
- In the August meeting of this committee, architectures capable of MSR will be presented



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Questions?



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