

SUPPORTING PLANETARY EXPLORATION

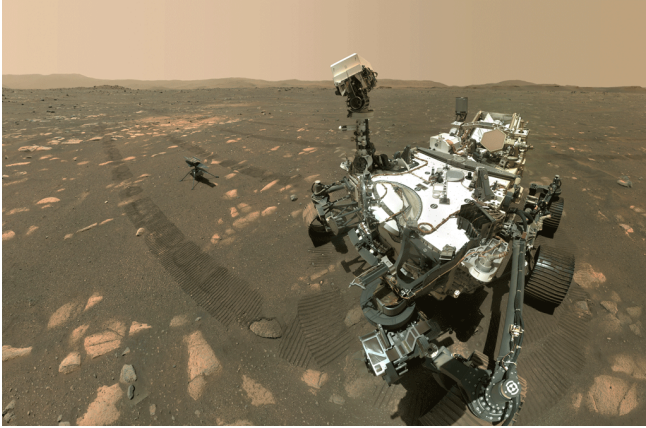


Photo by NASA/JPL-Caltech/MSSS

Position Summary. The Geological Society of America (GSA) supports planetary exploration to advance research concerning the evolution of Earth, our solar system, and beyond; to collect geologic and geophysical data on planets, moons, and other solar system objects, both remotely and on their surfaces; to explore Earth from space to detect changes and understand natural processes not easily observed from the ground; to deepen and expand human understanding of our place in the universe; to reinforce science, technology, engineering, and math (STEM) education and effective training of the next generation of scientists; to increase U.S. competitiveness in science and technology development; and to enhance the quality of life through technological innovation.

This position statement: (1) summarizes the relevance and benefits of planetary exploration to national and international leadership in science and technology research, development, and education; (2) describes workforce development and the key role that geoscientists play in both historical and future exploration missions through continued civilian exploration programs; and (3) provides recommendations for policy decisions related to the importance of science support for both U.S. and international collaborative space exploration missions to the Moon, Mars, and to other solar system bodies beyond Earth and; (4) provides a communication tool for GSA members.

CONCLUSIONS AND RECOMMENDATIONS

GSA adopts this statement as a reflection of its institutional and individual commitment to the following actions:

- **Informed public advocacy of continued government investment in planetary exploration missions.** Support for planetary studies, by necessity, requires large, sustained, and consistent expenditures at local, state, national, and international levels.
- **Increased interactions between the geoscience community and all elected government officials and lawmakers, managers, and scientists at all space agencies (e.g., National Aeronautics and Space Administration, European Space Agency, Japan Aerospace Exploration Agency, etc.), as well as higher education institutions (especially those with planetary sciences in their curricula), space grant consortia, K–12 educators, and, most importantly, the general public.** Planetary exploration and research require scientific literacy, intellectual support, public communication, and thoughtful dialogues with policy makers.
- **Expansion of public programs that utilize space exploration results to maintain science and technology growth.** Most of the world populace do not appreciate how planetary exploration has stimulated advances in numerous fields of study and supported the development of new technologies and economic growth across a broad portfolio (e.g., imaging systems, geographic information systems, new materials, advanced electronics).
- **Expansion of education programs using examples and results from planetary missions.** The integration of all basic sciences (chemistry, physics, biology) into planetary research endeavors is essential to the scientific literacy of the populace, and a major emphasis should be placed on engaging the STEM student population.

RATIONALE

Early planetary exploration missions (including the first human explorations on the Moon) were initially designed as demonstrations of technology development and global leadership in space. The underlying science, although only a tertiary objective, was largely

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geologic and geophysical in nature, with additional studies on the biology of humans in space. The subsequent 50 years of space exploration and planetary missions have supported a growing population of planetary scientists.

Planetary science also has an increasing appeal to students in geology and astronomy classes. Over this time, the U.S. and other nations have launched many successful exploration missions to planets, moons, comets, and other objects throughout our solar system and beyond, with return to Earth of samples of solar wind particles, asteroids, comets, our Moon, and in the next decade, Mars. Today, planetary missions are designed to collect data on planetary materials by remote sensing (flybys, orbiters) and in situ (landers, rovers) to better understand the history and workings of our entire solar system, to gain insight into the formation and evolution of early Earth and the other planets, to understand how and when life began on Earth, and to determine whether extraterrestrial habitable environments and life forms exist (or ever did exist) elsewhere in the solar system or beyond. The search for and study of exoplanets is also carried out within the context of geologic knowledge.

To support these missions, and to provide context, planetary scientists engage in both terrestrial field studies and Earth observation to examine geologic features and processes that are common to Earth and other planets. This includes studies of impact structures, volcanic landforms, tectonic structures, and glacial and fluvial deposits and landforms. Geochemical studies include investigations of extraterrestrial materials now on Earth, including returned lunar samples, tens of thousands of meteorites, cosmic dust particles, and, most recently, particles returned from comets and asteroids. It is clear that planetary exploration has successfully stimulated research across diverse geoscience topics and disciplines, including research on terrestrial analogs of planetary environments, studies that relate to early Earth environments, as well as the definition and study of “extreme environments,” like deep-sea vents and sub-glacial Antarctic lakes, and the life that they may harbor.

Remote sensing studies of planetary surfaces has had a synergy with understanding changes on our own planet. Earth observing satellites not only add to the basic knowledge of the Earth’s surface but also improve people’s way of life by monitoring changing resources and conditions. Such satellite systems include, but are not limited to, LANDSAT (earth surface), GOES (weather), and CALIPSO (clouds), and inform us on weather, storms, and lightning; wildfires; smoke and atmospheric pollutants; lake and reservoir levels; flooding; vegetation and ice coverage and change; ocean features such as temperature, sea level, and algal blooms; and bedrock mapping in remote locations. Refinement of these Earth-observing technologies has subsequently allowed them to be utilized in missions to other solar system objects, which facilitates further improvement of their capabilities and application to Earth-focused studies.

In addition, technological spin-offs derived from planetary exploration are a part of modern life. For example, spacecraft camera design has stimulated many developments in charge-coupled devices (CCDs), the basis for practically every modern imaging device, whether used in a pocket camera, a smart phone, or security systems. The scientific and technological advancement of a nation is often greatly benefited by developments used to support various aspects of planetary exploration: the reduction in size, weight, and energy expenditure of devices as well as ability to operate in extreme environments.

Although a majority of the U.S. electorate knows of and takes pride in space program accomplishments, few reflect on or know about the fundamental geoscientific research conducted during exploration and the importance of geoscientists in creating new knowledge that bears directly on our understanding of Earth’s formation and habitability as well as that of other objects throughout the solar system. It is a natural extension of the basic goals of GSA to extend geosystems knowledge of the rest our solar system, as well as to the exoplanets now being discovered around other stars.

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ABOUT THE GEOLOGICAL SOCIETY OF AMERICA

The Geological Society of America, founded in 1888, is a scientific society with members from academia, government, and industry in more than 100 countries. Through its meetings, publications, and programs, GSA enhances the professional growth of its members and promotes the geosciences in the service of humankind. Headquartered in Boulder, Colorado, USA, GSA encourages cooperative research among earth, life, planetary, and social scientists, fosters public dialogue on geoscience issues, and supports all levels of earth science education. Inquiries about GSA or this position statement should be directed to GSA’s Director for Geoscience Policy, Kasey S. White, at +1-202-669-0466 or kwhite@geosociety.org.

OPPORTUNITIES FOR GSA AND ITS MEMBERS TO HELP IMPLEMENT RECOMMENDATIONS

To facilitate implementations of the goals of the position statement, The Geological Society of America recommends that its members take the following actions:

- Become informed about opportunities to meet with elected officials at all levels, and tell them about the importance of sustained support by space-faring nations for exploration missions and the analysis of scientific data obtained from planetary exploration efforts. Elected government officials need to hear from their constituents that continued support is essential for the maintenance of a healthy planetary exploration program, with specific information regarding planetary exploration initiatives. Highlight the broad scientific value derived from planetary exploration and emphasize the need for consistent funding levels to sustain long-term exploration efforts. Letters, phone calls, and emails to representatives make a difference, particularly when they come from constituencies not in proximity to a major space facility.
- Encourage all scientists to take more active roles in various governmental agencies and in interactions with Congress. Not every GSA member can be a congressional liaison, but everyone can take an active role in participating in various governmental efforts at local, state, and federal levels. In particular, planetary scientists should get involved in whatever aspect of government might interest them and watch for any opportunity to highlight the broad scientific value derived from planetary exploration.
- Look for any opportunity to share the results of planetary exploration. The GSA community represents a very special intellectual medium through which the science knowledge of all people can be expanded. GSA members can play a pivotal role in communicating both the scientific and educational benefits derived from space exploration missions to the worldwide populace, including to elected officials. Members are encouraged to take advantage of all venues of communication regarding what has been learned during five decades of planetary exploration. Through classrooms, in public forums, professional meeting presentations, and social media, GSA members can be proactive in emphasizing how results from planetary exploration have contributed to science in general and the geosciences in particular and how this exploration has provided exciting new material for education. GSA members should consider including planetary exploration subjects in their public lectures, in articles in popular magazines and newspapers, in talks given to K–12 school classrooms, as well as within undergraduate- or graduate-level science courses, particularly any subject related to the geosciences.
- Be prepared to explain how technological spin-offs derived from planetary exploration are a part of modern life. The scientific and technological advancement of a nation is often greatly benefited by developments used to support various aspects of planetary exploration.

REFERENCES AND RESOURCES

1. National Aeronautics and Space Administration, www.nasa.gov. For information specific to planetary exploration, see either <https://www.nasa.gov/topics/moon-to-mars> or www.nasa.gov/topics/solarsystem.
2. European Space Agency, esa.int.
3. Japanese Aerospace Exploration Agency (JAXA), global.jaxa.jp.
4. Planetary Science Decadal Survey 2013–2022, solarsystem.nasa.gov/science-goals/about/. Results of a recent survey of planetary scientists for plans for the next ten years. New decadal survey 2023–2034 underway at National Academies of Science, www.nationalacademies.org/our-work/planetary-science-and-astrobiology-decadal-survey-2023-2032.
5. NASA Planetary Photojournal, photojournal.jpl.nasa.gov. Site to access images and explanatory text for publicly released planetary data.
6. Chronology of Lunar and Planetary Exploration, nssdc.gsfc.nasa.gov/planetary/chrono.html.
7. NASA Science Space Place for children and educators: spaceplace.nasa.gov/en/menu/spinoffs/.
8. NASA Scientific and Technical Information Program Repository, www.sti.nasa.gov.
9. NASA’s Earth Observing System Project Science Office, eospso.nasa.gov/.