

The 12 questions earth scientists should ask in the next 10 years

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The National Science Foundation should invest in new initiatives, partnerships and infrastructure to answer 12 priority research questions relevant to society in the next decade, according to a new report from the

National Academies of Sciences, Engineering, and Medicine. [A Vision for NSF Earth Sciences 2020-2030: Earth in Time](#) says that a scientifically and demographically diverse group of researchers will be required to answer the questions.

"Geologic understanding of the earth has [profound implications](#) for people all across the globe," said James A. Yoder, dean emeritus of Woods Hole Oceanographic Institution and chair of the committee that authored the report.

"The 12 questions all have a direct bearing on societal needs," said Paul Olsen, a geologist at Columbia University's Lamont-Doherty Earth Observatory and member of the committee. "Understanding that the earth is a system and analyzing it in that capacity reflects the interconnection between climate, life, and the deeper earth."

Some of the recommended questions go to enhancing our basic understanding of the planet, such as when and how [plate tectonics](#) developed; how geologic processes influence biodiversity; and how critical chemical elements are distributed and cycled. But all aim to advance understanding of how the earth impacts society. Other questions: What is an earthquake? What drives volcanism? What does the past reveal about the dynamics of the climate system? How is the Earth's water cycle changing? How can earth [science](#) reduce the toll of geohazards?

The NSF's Division of Earth Science (EAR) is the primary federal group for funding and providing essential infrastructure capabilities to the [earth](#) science community. The report recommends that EAR undertake initiatives to address gaps between existing and needed infrastructure. Several of these initiatives, such as funding a national consortium for geochronology, focus on supporting collaborative research. EAR should also fund facilities that provide new access to technical capabilities, such

as a giant press to study rock and mineral behavior under pressure, and a near-surface geophysics center, says the report. These initiatives should not be developed at the expense of EAR's core disciplinary research programs, and will require new funding, it says.

Highly trained STEM professionals will be central to future breakthroughs, but the field faces challenges in recruiting and retaining an inclusive workforce. The report recommends that EAR enhance its existing efforts to provide investment and centralized guidance to improve diversity and equity. EAR should also fund technical staff for grantees on a long-term basis, the authors say.

All the priority questions will require advances in high-performance computing, improved modeling capabilities, and enhanced data curation. EAR should initiate a standing committee to advise on cyber infrastructure needs, and implement a strategy to support data standards across the research community, the report says.

The authors say that joining with other [federal agencies](#) and NSF divisions, and international partners will allow for more efficient leveraging of facilities and infrastructure.

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