AAAS Mass Media Fellowship Application Questions
* You'll submit these questions into text boxes on the online application. When I applied, there was a limit of 250 words for each question (except the last question, which was limited to 50 words). I am not sure if these questions change from year to year.

1. Why are you, as a scientist or engineer, eager to participate in this program?

Curiosity and hunger for a good story inform my work as an ecosystem biogeochemist. From tropical rainforests to the Arctic tundra, Earth's ecosystems are a tangled web of relationships between plants, animals, and microscopic organisms. Studying these connections has introduced me to fascinating characters, like long-dead plankton from ancient seas who control the present-day actions of bacteria living in the soil, and resourceful mosses who construct entire ecosystems to their own specifications. Science affords me the privilege of observing and sharing their stories, which I do through scientific publications, teaching environmental science courses, and writing on my personal blog. My love of scientific storytelling, as well as recent experiences convincing me of the need for better translation of science into the public sphere, motivate me to apply to this program.

My experiences as a postdoctoral researcher have emphasized the current necessity of clear, timely scientific communication. While conducting interviews with state-level policymakers for my research in soil conservation policy, I found that current scientific consensus was not well-represented in policies intended to incentivize soil carbon sequestration activities. Conversely, policymaker concerns were not clearly addressed by scientific research. Mismatches in language used between policymakers and scientists further exacerbated this problem and prevented the exchange of knowledge and ideas between the two disciplines. This experience has convinced me to seek out opportunities to contribute to scientific communication. I am particularly interested in science journalism because I believe that quality media coverage of science is a powerful vehicle for widespread scientific literacy.

2. What in your background has prepared you for this fellowship?

Good journalism describes current events in their broader context, illuminating connections that might not be immediately obvious and providing insight into broader narratives and patterns. Biogeochemistry, the science of biological connections across space and time, is a surprisingly similar craft. Through my scientific training, I have developed the analytical skills necessary in journalism. I regularly combine seemingly disparate pieces of information, such as the identities and activity of soil bacteria, information about forest growth measured from satellites, and the chemical makeup of the bedrock underneath a forest, to see the underlying connections between organisms and environment.

I also have a strong background in communication. While pursuing my undergraduate degree in biochemistry, I simultaneously earned a degree in the liberal arts. During my graduate studies, I developed a focus on science communication, participating in research presentation competitions and teaching science writing workshops in the undergraduate courses that I instructed. After completing my PhD, I honed my public communication skills by working as a science writer, contributing articles about soil health to a blog read by farmers and farming consultants. As a postdoctoral scholar, writing research proposals and manuscripts remains a large part of my job, and I also communicate regularly with stakeholders such as policymakers and policy advocates.

Graduate school has also given me opportunities to develop other skills useful for journalism. For example, founding and directing an outreach program at UC Davis has given me experience with collaborating on a large team and completing tasks on tight deadlines.

3. How do you think the skills learned from the fellowship will impact your future career or academic plans?

My work as a scientist is driven by a fascination with the complexity and unexpected relationships of environmental systems. I am interested in exploring potential career paths in science communication and journalism that would similarly allow me to learn about and communicate recent discoveries about the natural world, particularly those relevant for conservation, climate change, and other environmental policy decisions. The experiences I will gain from this fellowship will help me evaluate if a career in science journalism is right for me, and prepare me with the skills and experience to enter that career.

Even if I continue down my current academic path, this fellowship will help me develop a strong relationship with the media in order to widely and effectively communicate my research findings. Dissemination, translation, and contextualization of scientific information is critical for public understanding and utilization of new science. As a researcher, it is important to me that my work be available and relevant to the public, and hopefully even provide spark of fascination for ecological systems in others.

4. Have you had previous media-related experiences? Please provide details.

I worked as a science writer for a soil health company, Teralytic, after completing my PhD in fall 2018. I pitched article ideas, conducted research and interviews, and wrote articles about soil health and conservation that appeared on the company blog. As farmers and agricultural consultants made up the bulk of the blog’s audience, this position allowed me to hone my skills at making scientific information interesting and accessible to non-scientists.

5. Describe any activities, other than previous media experiences, you have undertaken that involved increasing public understanding of science and technology.

I served as the 2016-2017 messaging director for Science Informed Leadership, a nationwide coalition of graduate students in the sciences united by the goal of promoting public understanding of the importance of science in creating effective policies, and providing tools for scientific advocacy at a state and national level. Our main contribution was an online app that created letters advocating on variety of science and policy issues, based on topics of concern selected by users. Anyone could use the app to create a pre-addressed letter expressing their unique concerns to their Senate and House of Representatives. I contributed to researching and writing content that users could select in the app to build their advocacy letters.

I also promoted the coalition's efforts and expanded our public reach by co-writing articles that appeared in widely-read blogs for organizations such as the Union of Concerned Scientists and Scientific American. This past year, the Union of Concerned Scientists incorporated our mailing list and advocacy tools into Science Rising, their national network organizing science-concerned laypeople and providing resources to advocate for science in their communities and beyond.

6. What community outreach or educational activities have you participated in, science-related or otherwise?

I served as a mentor in the Students and Landowner Education for Watershed Sustainability (SLEWS) program at the Center for Land-Based Learning from 2013-2018. The SLEWS program pairs high school classes with local ecosystem restoration projects, and engages youth in environmental education and stewardship. I also served as an educator with the Insight Garden Program from 2014-2017, a program that teaches ecology and gardening to incarcerated people to promote connection to nature and reduce recidivism in California. Both of these outreach experiences have helped me develop skills in teaching complex scientific topics to learners of diverse educational backgrounds. I also co-taught a bioinformatics workshop at Expanding Your Horizons, an annual event that exposes elementary school girls to careers in science and technology, from 2014-2018.

In 2017, I co-founded Girls' Outdoor Adventure in Leadership and Science, (GOALS) program with a group of UC Davis graduate students and staff. GOALS provides a free, wilderness-based science education and leadership program in Sequoia National Park for high school girls and gender-expansive youth from backgrounds underrepresented in sciences. I recruited and managed a volunteer team of ~50 graduate students and early career scientists, developed a new collaboration between UC Davis and Sequoia National Park, and helped design place-based environmental science curriculum for high school students.

7. How did you find out about the program?

I found out about this program through a colleague who participated in 2018.

Writing Sample: How Microbes Make Soils—and Crops—Healthier

Like the human body, soils are home to a teeming microbiome providing services that scientists are just beginning to understand. A single teaspoon of soil contains more microbes than there are humans on Earth, representing tens of thousands of distinct microbial species. Though invisible to the naked eye, these microbes make up a diverse belowground ecosystem responsible for many of soil's important functions. As research into the soil microbiome continues, scientists are discovering countless ways that this invisible ecosystem supports the development of healthy soils and crops.

The soil microbiome consists of various too-small-to-see organisms that include arthropods, nematodes, bacteria, fungi, and archaea, each contributing unique capabilities to the soil ecosystem. These diverse organisms interact with each other in complex networks that can break apart plant matter and then chemically digest it, mine soil minerals, and create brand-new chemical compounds. In doing so, the soil microbiome actively contributes to soil and crop health by building up the physical structure of soils, driving soil nutrient recycling and producing compounds that help crops persist against environmental stressors.

Microbes Build Soil Physical Structure

Soil's ability to store water and oxygen comes from its structure, which typically consists of soil particles stuck together in stable formations called aggregates. Microbes play a key role in the development of these formations by releasing glue-like sugar substances that can stick soil mineral particles together and create new aggregates. Some of the benefits of aggregate formation include improved water infiltration rates and water-holding capacity, as well as reduced soil compaction and runoff.

Proper soil structure also depends on having sufficient soil organic matter. Like aggregates, soil microbes also play a major role in the formation of soil organic matter. Many of the microbes in soils are what's known as decomposers—they eat old plant material, like dead roots and fallen leaves, to build up their biomass, storing the carbon they consume in their bodies. When these microbes die, their carbon-rich bodies add to the soil organic matter, with recent research demonstrating that microbial bodies are actually the main ingredient in stabilized soil organic matter.

Microbes Recycle Soil Nutrients

Microbes are also active participants in soil nutrient cycling and play a key role in the storage, and eventual release, of plant-essential nutrients. When decomposer microbes consume plant material in their quest for carbon, they release some of the nutrients locked in those tissues back into the soil, making them available for future plant consumption. These recycling transformations can help maintain a steady supply of plant-available nutrients in the soil.

This microbial recycling can also help growers use applied fertilizers more efficiently. Scientists at the Berkeley Lab are currently investigating how soil microbes can resolubilize leftover phosphorus from fertilizer. When phosphate fertilizer is applied to crops, some of it cannot be absorbed through their roots and remains locked away in the soil. Certain microbes can release enzymes that transform this unavailable phosphorus into a form that crops can absorb. The Berkeley Lab researchers are looking into the creation of microbial soil amendments to accelerate this recycling, helping growers get the most from their fertilizer applications.

Microbes Strengthen Crop Health

The soil microbiome can also act as an immune system for soils, helping ward off pests and pathogens that can cause plant diseases.

In a study of a sugar beet field that had grown resistant to a root fungus pathogen, researchers discovered that disease suppression came not from the crops, but from the soil microbes. Microbial biodiversity was the key to this service; the scientists found that not one, but 17 different types of microbes that contributed this disease suppression. “Individual organisms have been associated with disease-suppressive soil before, but we demonstrated that many organisms in combination are associated with this phenomenon,” commented Gary Andersen, one of the researchers at the Berkeley Lab involved with the study.

Soil microbes can also contribute to plant resiliency against other environmental stressors such as drought. In a recent meta-analysis, researchers at Northern Arizona University discovered that when crops were inoculated with certain bacteria, yields increased up to 45 percent. The benefits of these growth-promoting bacteria becoming more pronounced when crops were grown under drought conditions. The scientists suggested that the bacteria were able to provide this benefit by producing special biofilms that increased crop drought resistance, and they are now looking into developing microbial amendments that can confer this drought resistance to more crops.

Building Up Your Soil’s Microbiome

Understanding the wide range of soil microbes, their individual functions, and their relationships to each other is a massive scientific undertaking.

“What we're trying to understand now is whether there is a specific microbial community made up of certain organisms at certain quantities that is associated with a healthy soil,” explains Deirdre Griffin, a doctoral candidate at the University of California, Davis, studying the connection between soil microbiology and soil health.

As of now, there is no known “ideal” soil microbiome, and biotechnologies like microbial amendments for soil are still in their infancy and should be treated with caution. As the body of scientific knowledge about the soil microbiome grows, such technologies are likely to advance.

Current research seeks to combine information about microbial functions that contribute to soil health with genetic information to learn more about who some of the major players are.

Griffin adds that though we don't know exactly *which* microbes help support soil health (yet), we do know that supporting a large and diverse microbial ecosystem is important. "Giving microbes enough food, water, and nutrients will help them stay active and do many of the functions we look for," she advises. "The best rule of thumb is to think about feeding the soil with whatever organic matter inputs you're able to incorporate into your system, be it compost amendments, cover cropping, crop residue incorporation, or all of the above."

This translates to great news for growers who already utilizing soil conservation practices like reducing tillage, adding compost to fields, or incorporating cover crops. These practices can help minimize disturbance to the soil ecosystem and provide microbes with plenty of food, adding "support for a healthy soil microbiome" to the list of benefits of managing for soil health.

Underneath a maze of stunted black spruce trees in the northern reaches of Canada sits a massive vault of carbon. Across the boreal zone, the global region between 50° and 70°N, forests absorb carbon from the atmosphere and trap it in the soil below, sometimes for up to thousands of years. These forests are so good at trapping carbon that their soils contain nearly a third of the planet's supply, playing a vital role in keeping the world's climate stable. A group of North American scientists recently discovered that the rise of bigger, hotter wildfires threatens the future of this soil carbon storehouse, and the global climate system along with it.

"Northern fires are happening more often, and their impacts are changing," said Dr. Merritt Turetsky, a professor at the University of Guelph in Ontario, Canada.

One of these impacts is that the larger and more intense fires are burning deeper into the soil than their more mild predecessors did. These deep burns release ancient carbon buried deep beneath the surface back to the atmosphere, potentially causing rapid and unpredictable changes to the world's climate.

A Shifting Balance

Under normal circumstances, boreal forest soils act as what climate scientists call a carbon sink. That means that each year, the soils absorb more carbon than they release, resulting in long-term accumulation of carbon. This helps offset human carbon emissions and slow the pace of climate change.

Though wildfires are normal in the region, historically wildfires were not particularly severe, and would only release a small fraction of the carbon stored in the forest soils. Scientists call the carbon remaining in the soil after each burn "legacy carbon." When new trees grow after the fire, their roots and needles add new carbon to the soil, burying the legacy carbon. This cycle of fire and re-growth eventually results in meters-deep soils rich in organic carbon.

"Over time, this explains why the boreal forest is a globally significant carbon sink," said Dr. Jennifer Baltzer, a professor at Wilfrid Laurier University in Ontario, Canada.

That's starting to change as fires become more widespread and more severe. In 2014, record-breaking fires ravaged Canada's Northwest Territories. Turetsky, Baltzer, and their colleagues wondered if these new, bigger fires might be different from the less-intense fires that the forests are adapted to. Hotter fires can burn deeper into the ground, potentially destroying the older carbon and transforming boreal forests from a carbon sink into a carbon source – that is, an ecosystem that releases more carbon than it absorbs.

"We wanted to see whether the extreme 2014 fires tapped into these old-legacy carbon layers or whether they were still preserved in the ground," said Baltzer.

Carbon Time Machine

To see if the mega-fires had reached the legacy carbon, the team of scientists collected hundreds of soil samples from forests that had burned in the 2014 fires.

"Carbon accumulates in these soils like tree rings, with the newest carbon at the surface and the oldest carbon at the bottom," said Dr. Michelle Mack, a professor at Northern Arizona University involved in the research.

The team was able to turn these layers into a carbon time machine using a new radiocarbon dating technique. They found that young forests, those that were less than 60 years old at time of fire, were particularly affected by the mega-fires, losing stores of carbon that may have been previously trapped in the soil for hundreds, or even thousands, of years.

"In older stands that burn, this carbon is protected by thick organic soils," said Dr. Xanthe Walker, another professor involved in the research. "But in younger stands that burn, the soil does not have time to re-accumulate after the previous fire, making legacy carbon vulnerable to burning."

Unknown Futures

Wildfire frequency and intensity is growing throughout the world's boreal zone, and is expected to continue to increase as the climate becomes hotter and drier. This could make the ancient carbon stored in boreal forests across the planet more vulnerable to destruction, exacerbating climate warming in a self-reinforcing cycle.

"This pattern could shift boreal forests into a new domain of carbon cycling, where they become a carbon source instead of a sink," warned Walker.

This could also spell trouble for the computer models used to predict the effects of climate change, which assume that the boreal forests will continue to absorb carbon indefinitely. If mega-fires turn boreal forests into a carbon source, it could push the global climate system into an unknown – and unpredictable – future.