Written Testimony for the hearing on
"Supporting Careers in Conservation: Workforce Training, Education, and Job Opportunities"
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Soil Science Society of America K-12 Committee

Chairwoman Spanberger, Ranking Member LaMalfa and Members of the Subcommittee, thank you for inviting me to speak to you today. My name is Dr. Margaret Holzer, and I serve on the of the Soil Science Society of America K-12 Committee. For over 30 years, I taught secondary and higher education courses in Earth and space science, environmental science, and physical geography. Currently I am a science standards specialist at Great Minds PBC.

The Soil Science Society of America (SSSA) is an international scientific society that fosters the transfer of knowledge and practices to sustain global soils. Based in Madison, WI, and founded in 1936, SSSA is the professional home for 6,000+ members and 800+ certified professionals dedicated to advancing the field of soil science. The Society provides information about soils related to conservation, crop production, environmental quality, forestry, ecosystem sustainability, bioremediation, waste management, urban uses, mining and reclamation, and more. SSSA is dedicated to making soil a dinner table topic in every household. Members share the story of soil through the Soils Matter blog and through outreach to K-12 students and teachers in addition to supporting scientific knowledge exchange through an annual meeting and several scholarly journals.

Soils are more than the material under our feet; as a matter of fact, without soils, we would be "Hungry, Naked, Homeless, and Breathless," as a colleague on our committee stresses during his K-12 outreach programs. By acting out this little skit, students come to the "ah-ha" moment that soils are vital to our survival. We can no longer assume students will learn about the soil beneath their feet through the light touches found in textbooks and local curricula; we need to explicitly integrate soil science across all grade levels taking advantage of a variety of entry points in doing so. For more than 16 years, the Soil Science Society of America (SSSA) K-12 Committee has been on the frontline designing instructional resources, providing professional development for teachers, and supporting soil scientists who provide K-12 outreach. I am excited to share a little about our organization, our committee, our work, and some challenges ahead in encouraging our next generation of soil scientists and conservationists.

In July 2008, *Dig It! The Secrets of Soil* exhibition opened for an 18-month run at the Smithsonian Institution's National Museum of Natural History (of which SSSA was a Founding Sponsor). In preparation for the exhibit, SSSA was eager to build resources for those viewing the exhibit and resources for K-12 teachers. Thus, the SSSA K-12 Committee was formed in 2006 and is made up of a group of SSSA members passionate about telling the story of soils. Through my professional affiliations, I was asked to serve on this committee in 2006, and I have served on it ever since. Soil science has been a part of my life since I was a little girl when my father was a PhD candidate at Rutgers University studying soil science applications for his dissertation. Soil samples and soil sieves were regularly fixtures in our kitchen. Once I became a teacher, soil science was always a central part of my curricula.

The charge to our committee is to increase interest and awareness of soil science as a scientific pursuit and career choice, especially among K-12 teachers and their students and work to integrate more information on soil science into biology, chemistry, physics, and Earth science areas taught at multiple

grade levels. In addition, the American Society of Agronomy and Crop Science Society of America have also developed K-12 committees to provide teachers with resources for their classrooms and spark interest in their specific sciences as a pathway to career interest. Since the committee formed, we have developed:

- Three K-12 websites (with over 800,000 visits in 2020)
- Published four K-12 focused books (for use in formal or informal classrooms or at home)
- Developed two train-the-trainer workshops, two webinars, and two teachers guides
- Curated over 200 lessons, activities, and reading resources for K-12 teachers
- Developed state soil booklets for all 50 states and Guam
- Partnered with other organizations to develop and disseminate materials for K-12 teachers
- Produced I "Heart" Soil stickers in 15 languages and have distributed over 500,000 stickers
- And developed twelve 2-minute animated videos on various aspects of soil, as part of the 2015 International Year of Soils.

(Please see the Appendix for a detailed description of these activities.)

As impressive as our work is, there are challenges to overcome in building awareness of soil science and conservation, and the careers possibilities in each. I personally love soil science and connecting my students with the role soils play in every aspect of their lives. But how do we engage classrooms located where the landscape includes lawns, asphalt, and concrete, and agricultural products come in little cellophane covered trays? Fortunately, those who wrote the *A Framework for K12 Science Education* (2012)[1] and the subsequent standards adapted or adopted in 44 states and the District of Columbia (represents 71% of our students), included soil science in the Earth science core ideas for learning. Although Earth and space science is on equal footing with life and physical science in elementary and middle school, at the high school level, it has taken a backseat to biology, chemistry, and physics in many states. The intention is for all students to develop proficiency in all science standards, and therefore our high school biology, chemistry, and physics teachers must integrate teach Earth and space science topics in their courses, while having little to no training in the Earth and space sciences. The domino-effect of this course sequence is that our high school students are not introduced to fields of study such as soil science and conservation. A solution to this career barrier is to rethink our high school science course sequence such as combining physics and chemistry into one course, which will ensure students receive quality instruction in Earth and space science while in high school and build that awareness of career pathways in this field of study.

In my situation, it was easy to get my students outside to dig soil samples, and handle soil with the purpose of figuring out the role soils play in their existence, and to recognize that we need to conserve it through effective strategies in land-use development, forestry, and agriculture. However, for many teachers who would like to include soil science in their curriculums, there is a challenge in accessing outdoor spaces and laboratory materials needed to run basic soil labs in their classrooms. Our K-12 Committee efforts have most certainly played a role in this needed support, but those state and local entities that can share their expertise, provide access to soil samples, and basic laboratory supplies, their efforts are welcome too. Teachers need to know that these resources are available, and county extension offices might consider an awareness campaign to alert schools to the resources they may have to offer.

[1] National Research Council. 2012. *A Framework for K-12 Science Education: Practices, Crosscutting Concepts, and Core Ideas.* Washington, DC: The National Academies Press. https://doi.org/10.17226/13165.

As much as the career pipeline for soil science and conservation are in the forefront of our work on the K-12 Committee, there is a challenge to connect our efforts with the efforts elsewhere. Our instructional materials include careers; however, it is up to the classroom teacher to enact our materials. A workaround for this is to engage students in events that are extensions of the classroom. For example, the World Food Prize Global Youth Institute is a phenomenal opportunity for students from around and outside our country to discuss solutions for food security issues and learn about the extensive opportunities and careers available in agriculture. This awareness is especially impactful for those students who live in areas covered by lawns, asphalt, and concrete. Another impactful program is the national competition called Envirothon which has five topic areas, of which soils and land use is one. The mission of the Envirothon is as follows:

> "The Envirothon mission is accomplished by developing in young people an understanding of the principles and practices of natural resource management and ecology and through practice dealing with complex resource management decisions. The following goals and objectives should be used as a guide to develop effective curricula, educational resources, and testing scenarios."[2]

Students participating in this competition learn about available careers, while working directly with real issues that have meaning to their lives. In each of these competitions, mentors support students and are role models who could influence career choices of their mentees. Ongoing funding of programs such as these will ensure more students are engaging with soils and our environment.

While students are in high school, they are gravitating towards their initial college major and are considering colleges that house those majors. Students do not know what they do not know. For example, if they are unaware that they could major in soil science or are unaware of the myriad of career choices they would have, then they are not going to select a college to major in soil science. Similarly, if soil science is intertwined in an agriculture department in a university, and students are not interested in agriculture as a major, then they will not select that university. Solutions that may encourage additional majors in soils science and careers, are strategic marketing of higher-education soil science and conservation programs, connecting soil science professionals with high school students, build awareness in teachers of soil science and conservation careers, support for dual-credit programs that provide high school students with semester or year-long soil science and conservation courses and the college credit that goes with them, and provide high school student internships in conservation fields. These solutions could work for students who live in regions of our country where agriculture is prominent, or in regions of our country where urban and suburban landscapes are most prominent. However, the key is that we need to identify a portfolio of solutions since it is difficult to clearly identify what connects a student to a college or a career. For some students it may have been the dynamic teacher, or participating in a competition, or visiting a college soil science laboratory that provided that needed connection. We on the SSSA K-12 Committee are committed to finding and supporting the items found in a portfolio of solutions to help fill the pipeline with our next generation of soil science and conservation careers and stewards of our natural environment. We love soils, and we want others to love it too!

My intention was to provide an outline our committee work and highlight some career challenges and solutions through the lens of the K-12 arena. Our discussions today will bring to the table additional lenses as others share their experiences, and together we can build a robust portfolio of solutions to the soil science and conservation career pipeline issue. Thank you for the opportunity to testify before this panel. I would be glad to address your questions and I look forward to the discussion.

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[2] Envirothon webpage: https://envirothon.org/about-us/missions-goals-and-objectives/

Appendix:

Soil Science Society of America K-12 Committee
Additional Information

History

In July 2008 through December 2009, *Dig It! The Secrets of Soil* exhibition was presented at the Smithsonian Institution's National Museum of Natural History (of which SSSA was a Founding Sponsor). In preparation, the SSSA Board of Directors approved a K-12 Committee in 2006 and a group of SSSA members got to work. The charge to the committee was to increase interest and awareness of soil science as a scientific pursuit and career choice, especially among K-12 teachers and their students and work to integrate more information on soil science into biology, chemistry, physics, and Earth science areas taught at multiple grade levels. The American Society of Agronomy and Crop Science Society of America have also developed K-12 committees to provide teachers with resources for their classrooms and spark interest in their specific sciences as a pathway to career interest.

Activity Centers

Activities center around five areas:

- **Assessment and Standards** – connecting soil to state and national standards
- **Curriculum Development** – developing new curricula for K-12 instruction
- **Website Development** – enhancing the K-12 website resources
- **Books** – publish books relevant to the K-12 audience
- **Develop and Disseminate Soils Information** – for all audiences

Accomplishments

During the 16 years the SSSA K-12 Committee has been active, they have achieved an exceptional amount. Read on to learn more.

PUBLICATIONS AND LESSON PLANS

Soil! Get the Inside Scoop and supplemental Teachers Guide

The book explores the basics of soil and how soil is part of our life – the food we eat, the air we breathe, the water we drink, the houses we live in, and more. A free online teachers guide is available for each chapter of the book—with accompanying Powerpoints, definitions, activities, quiz questions, and more.

Know Soil, Know Life and supplemental Educators Guide

This 200-page book is targeted at high-school students. Chapters include Physical Properties of Soil and Soil Formation, Soil Ecosystems/Biology, Chemical Properties of Soil and Soil Fertility, Classification/Soil Mapping/Interpretation, Environmental Science/Soil Conservation/Land Use Management, Soils and Biomes, Soil in History and Modern Life, and Career Opportunities. An online educators guide is free for all educators to use, with overviews, Powerpoints, activities, standards integration, and worksheets.

Curated Collection of Resources

We've curated a collection of lessons, hands-on activities, labs, readings, and more - all about soils and topics related to soils - and in a searchable database. Some are posted directly by SSSA others we have reviewed and recommend. Searchable areas include by grade level, topic area, resource type, and NGSS standard. Over 200 resources are in the database. In addition, the SSSA K12 committee reviews submissions for the addition of resources to the database.

Soils Unit
Designed for middle-school, this soils-focused unit with lessons that provide students with a basic understanding of the fundamentals of soil science through the integration of disciplinary core ideas, science and engineering practices, and crosscutting concepts in the lessons, investigations, and activities

Coolbean the Soybean (Crop Science Society of America)
Coolbean the Soybean is a super bean! Find out how Coolbean became so special with the help of scientists, how to farm to help the environment, photosynthesis, how agronomists keep Coolbean safe, a soybean's life cycle, and how soybeans feed billions of people and are used for many products. All in alignment with common core standards for reading and science. Aimed at Grades 3-5.

Agronomy Grow with It! (American Society of Agronomy)
Explore the science of agriculture – Agronomy! Agronomy is the science we use to grow the crops that feed us, feed our livestock, and even fuel our cars. It's a science that tackles the big challenge of our future: How can we grow enough food to end world hunger—and, at the same time, adapt to a changing climate and protect our environment? Meet 20 real agronomists who face that challenge every day. Seven sections cover main topics in agronomy and align with basic science topics in the Next Generation Science Standards: Agronomists Feed the World • Crops: Sooo Much More than Food • Problems with Pests • Bringing Crops and Livestock to the Farm... Together • Water Matters! Getting Enough...Keeping it Safe • Soil: We Gotta Have It, But Will We? • Coping With Climate Change Audience: Aimed at Grades 6–8, of interest to older and younger students alike!

STATE SOIL BOOKLETS
An in-depth, easy to read booklet (4-8 pages each) with information on each state soil. The booklets include a brief history of the origin of the state soil, where the state soil is found, importance and uses, limitations, management, soil formation, ecoregions and land use, a glossary, and additional resources.

WEBINARS
The K12 committee has produced two webinars for K-12 educators, focused on soil science at different grade levels:

- Soils: Fundamental for Life
  This webinar focused on basics, formation, characteristics, and fertility (the ability of a soil to sustain plant growth by providing plant nutrients and favorable habitats for plant growth).
- Soil Physics, Chemistry, and Biology … Oh My!
  Soil is so much more than what food is grown in, we walk on, or move out of the way to build houses or buildings on. It's complex, life-giving, and is critical for a balanced ecosystem. Attendees learned about each area, why each is important, and ideas for classroom activities. In addition, they heard about career opportunities in soil science.

PARTNERSHIPS
- **National Association of Conservation Districts (NACD)** – Stewardship Week on Soils (2009), review panel on scientific resources
- **National Science Teachers Association (NSTA)** – exhibiting, annual workshop
- **National Earth Science Teachers Association** – webinars, share-a-thons, articles, promotions
- **American Geological Institute (AGI) -** AGI hosts Earth Science Week in cooperation with sponsors as a service to the geoscience community. As an AGI member we develop a soil science activity for the annual calendar and contribute to the Earth Science Week kits which are

distributed to 10,000+ teachers. Earth Science Week is held annually in October with each year having a unique theme.

Dig It! Exhibition Activities

Two Train-the Trainer Workshops were conducted at the Smithsonian Exhibition – with over 60 teachers in the Washington DC area participating, January and June 2009, with Project Learning Tree members as the facilitators of the workshop.

The exhibit has also traveled to the Durham Museum, Omaha, NE, Northwest Museum of Arts and Culture, Spokane, WA and will be heading to the Bell Museum, St. Paul, MN. Staff and Members have participated in educational events (such as "Let's Get Dirty" day) and SSSA has provided educational materials, promotional items and books for giveaways and raffles.

OUTREACH ACTIVITIES

Websites

Soils for Teachers: Our teachers website features soils topic areas, lessons/activities collection, free classroom resources, definitions, an Ask a Soil Scientist feature. www.soils4teachers.org

Soils for Kids: Our kids website features areas including all about soil, fun with soil (activities), soil experiments, soil games, career exploration, and soil in your community. www.soils4kids.org

Agronomy for Teachers and Students: Our Agronomy and Crop Science K-12 website features sections on what is agronomy, understanding crops, pests and weeds, livestock, nutrients, water, soil health, climate change and provides lessons and activities – both for teachers and for students at various grade levels. It also features scientists in different careers. www.agronomy4me.org

Member Outreach Activities

- Developed an online Career Profiles format for members to tell their career story and have them upload to the SSSA websites.
- **Ask a Soil Scientist program online** – members volunteer, select regions and topic areas – answer questions from general public, students, and teachers. They may also volunteer to speak in classrooms. 135 Members have registered to date.
- A group of committee members participated in a NGSS standards review via the SSSA Science Policy Office.

International Year of Soils – 2015

The Soil Science Society of America played an integral part the success of the 2015 International Year of Soils! We worked on raising awareness of and promoting the sustainability of our limited soil resources. SSSA members, recognizing that we all have a valuable role in communicating vital information on soils, came together to develop new activities and pull together already developed resources to assist everyone interested in learning more about soils. All the resources on our site are available for use. Key components included:

- 12 monthly videos on various aspects of soil and associated activities.
- K-12 Educators kit of resources
- Coloring and Activity Book
- Careers in Soil Science Career Poster

I "Heart" Soil

https://www.soils.org/stickers

Fifteen "I Heart Soil" stickers in different languages – another fun way to get people excited about Soils!