

# Science Career Cards: Soil Theme

From the Natural Inquirer: <https://naturalinquirer.org/collector-cards>

To use with the Earth Around Us Soil Tent Follow-up Activity:  
Make a Career Connection.



## Welcome to the *Natural Inquirer* Scientist & Engineer Cards!

These cards are a product of FIND Outdoors and highlight Forest Service scientists and engineers who conduct research across the Nation and the world.

### Who is FIND Outdoors?

Formerly the Cradle of Forestry in America Interpretive Association, FIND Outdoors is a re-imagined 501(c)3 nonprofit organization based in Pisgah Forest, North Carolina. We are the Southeast's leader in providing access to public lands, environmental education, recreation, and front country camping experiences. We maintain and operate 21 recreation, education, and camping facilities across western NC, northern GA, and beyond — serving approximately 800,000 visitors each year with over 150 recreational and environmental education programs, special events and tours.

Our story is rooted in education about the **forest**.  
Our passion is to help people become **inspired**.  
Our goal is to help people connect with **nature**.  
Our drive is to help people learn through **discovery**.

We help people. . . FIND Outdoors  
We are. . . FIND Outdoors  
**[goFINDoutdoors.org](http://goFINDoutdoors.org)**

### What is the Forest Service?

The mission of the Forest Service is to sustain the health, diversity, and productivity of the Nation's forests and grasslands to meet the needs of present and future generations. There are 154 national forests and 20 grasslands in 44 States, Puerto Rico, and the Virgin Islands. National forests and grasslands make up 8.5 percent of the total land area in the Nation. Approximately 550 scientists work for the U.S. Forest Service in many different research topics.

**For more information, visit <http://www.fs.fed.us>.**





# Meet the Scientist!



Forest soil scientists study the connections of soil with forest ecosystems. Soil sustains life. I try to understand what it takes to keep forests healthy and productive.

## Dr. Mary Beth Adams

Soil Scientist/Forester

Ph.D., North Carolina State University

USDA Forest Service scientist



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### Important Scientist Characteristics

Curiosity is an important trait for me. In college, I learned how to ask questions so that I could test hypotheses. Being able to ask questions and know how to answer them is very useful to me. Also, I like spending time in the forest and doing field work. Being outside makes research much more enjoyable.

### Example of a simple research question I have tried to answer:

What are the effects of air pollution on forest growth and forest use of resources such as water, light, and nutrients? I study the effects of acid rain and ozone. Understanding the effects of pollution on soil and other resources can help us manage forests to ensure they last into the future.

### Technology or equipment used in research:

I use various types of shovels and soil sampling equipment. Once the soil sample is out of the ground, analyzing the nutrient content requires different equipment. An atomic absorption spectrophotometer measures how much light is absorbed by atoms within the soil sample.

### Most Exciting Discovery

Working on long-term experiments is exciting. Some of the experiments are older than I am, and I am able to add new knowledge to these national treasures. Also, learning by working with other scientists who also have long-term studies is really cool!

### When did you know you wanted to be a scientist?

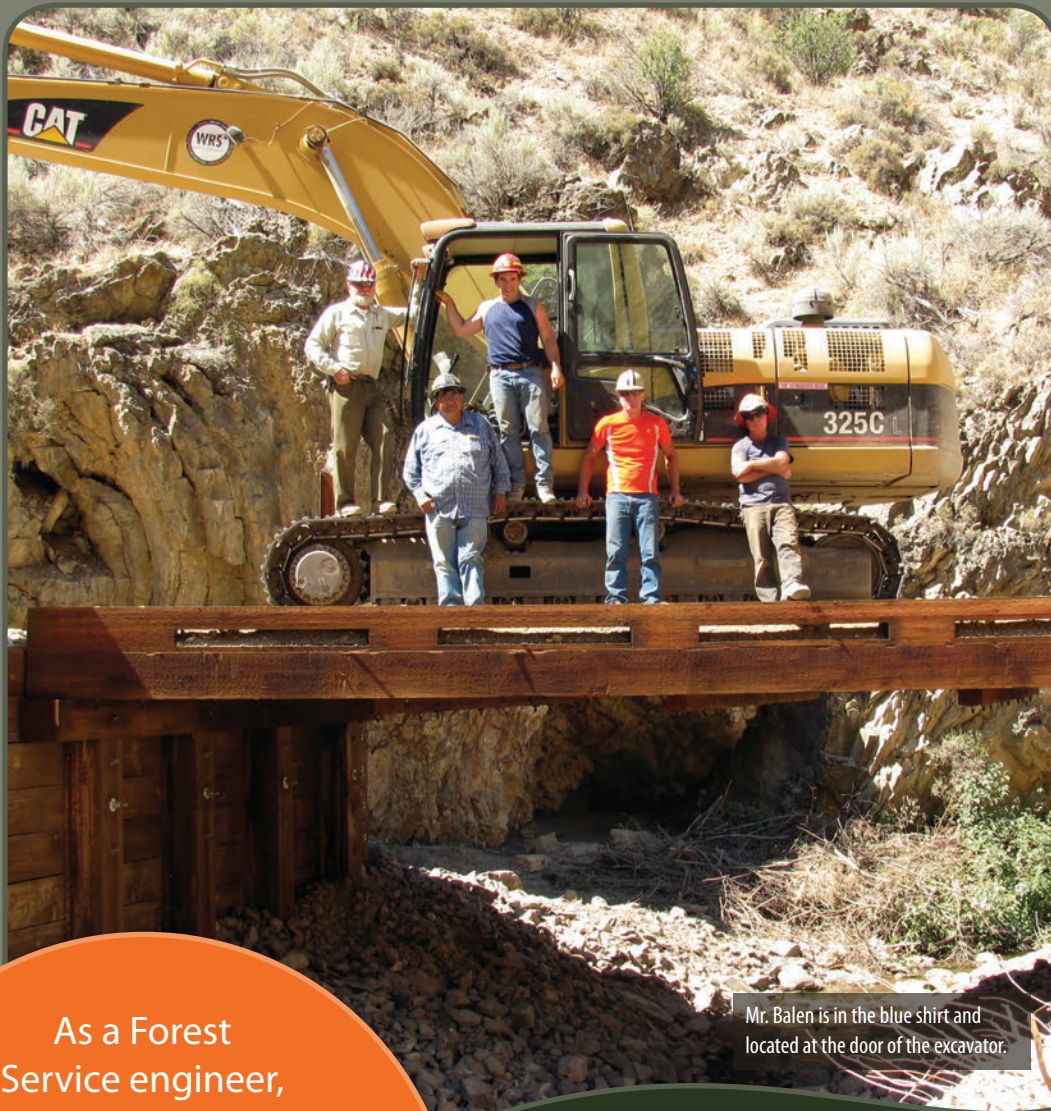
I have always been curious, and my parents encouraged me to ask questions. I had a summer job with the Youth Conservation Corps in high school. In that job, I discovered how much I liked working outdoors and my questions about ecosystems were encouraged. So, I put the two together.



# Meet the Scientist!



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Mr. Balen is in the blue shirt and located at the door of the excavator.

As a Forest Service engineer, I manage the built environment, including the roads, bridges and facilities, that connect people to the national forest landscape and enable Forest Service employees to do their jobs.

## Michael Balen Civil, Mining, and Geological Engineer

B.S., University of Alaska, Fairbanks  
USDA Forest Service engineer

### Important Engineer Characteristics:

Important characteristics that enable me to do my work include the ability to work well with others, see the big picture, break large problems into manageable pieces, define achievable goals and objectives, develop logical plans to efficiently get things done, and creatively seek new ways to solve old problems that block the pathway to success.

### Example of a simple question I have tried to answer:

How can I improve a road to be more environmentally friendly? I developed means and methods to reconstruct roads in remote areas surrounded by sensitive habitat using special construction techniques. The work reduces erosion, replaces bridges and culverts that limit aquatic organism movement, enhances riparian function, and protects water resources from pollution.

### Technology or equipment used in my work:

I use heavy equipment to build bridges, stabilize stream banks, demolish unneeded buildings, improve stream passages for aquatic organisms, decommission unneeded roads, restore sensitive habitat areas, repair flood damage, construct flood management structures, and fight fires.

### Most Exciting Work

My most exciting work was completing 13 multi-million dollar improvement projects in the Spring Mountains National Recreation Area near Las Vegas, Nevada. The project involved 350 professional engineers plus dozens of contractors. Working together, we completed projects worth more than \$100 million, under budget and in four years.

### When did you know you wanted to be an engineer?

I discovered an interest in the natural world as a toddler. My parents loved the outdoors and took me camping. Trips to the mountains and seashores taught me about the world beyond the classroom. I knew early on that my life would be spent protecting these special places.

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# Meet the Scientist!



Forest soil scientists observe, measure, and analyze forest soils. We do this to make sure that forest management activities, such as trail building and timber harvesting, do not negatively affect the forest soil.

## Dr. Claudia Cotton

Forest Soil Scientist

Ph.D., Virginia Tech

USDA Forest Service scientist



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### Important Scientist Characteristics

Seeing the “Big Picture” and being a clear communicator are two important skills in this career. Soils are just one part of what is occurring in a forest. The ability to see how soils interact across a landscape with water, plants, rocks, and humans is important to good decision making. Clear communication among different scientists and the public is also important for a project to be successful.

### Example of a simple research question I have tried

**to answer:** What are the long-term effects of acid rain on forest soils across the Daniel Boone National Forest in Kentucky? I’ve found that although acid rain has decreased over the past decades, the soils are still showing negative effects from this phenomenon.

### Technology or equipment used in research:

I often use a Global Positioning System (GPS) unit and ArcMap to get to remote locations on the forest. GPS units use satellites to determine my location on the ground and guide me to the site. A map on a smartphone probably uses similar technology. ArcMap is a computer program that can create a map of an area’s characteristics, such as geology, slope, and soil type.

### Most Exciting Discovery

Unlike a research soil scientist, I do not regularly discover scientific phenomena. However, I am constantly learning new things that I come across while working in the forest. For example, some mushroom species glow in the dark!

### When did you know you wanted to be a scientist?

As a child I often hiked with my family, some of whom could name the trees, rocks, flowers, and mushrooms. I wanted to be able to do the same. As I got older, I became aware that I had a connection to the woods, and I decided to make it my career. At age 30, I went back to school to get my Ph.D. in forestry.

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# Meet the Scientist!



Soil scientists study how soil is interrelated with how plants grow, how harvesting changes the soil, and how we can improve forest health by taking care of the soil.

**Dr. Debbie Page-Dumroese**  
Soil Scientist  
Ph.D., The University of Idaho  
USDA Forest Service scientist



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## Important Scientist Characteristics:

My most important talent is observation. Seeing how the soil looks, feels and tastes (sometimes) helps me understand why plants grow in some places and not others.

## Example of a simple research question I have tried to answer:

How does ground-based timber harvesting change soil physical, chemical, and biological properties?

## Technology or equipment used in research:

Our most important tool is a shovel, but that's not very high-tech! However, we also look at how soil gas exchange is affected by land management and for this we use (1) a CO<sub>2</sub> analyzer that determines how much CO<sub>2</sub> is leaving the soil and (2) we use a flame ionization detector for looking at the release of greenhouse gases such as methane (we actually measure termite farts!).

## Most Exciting Discovery

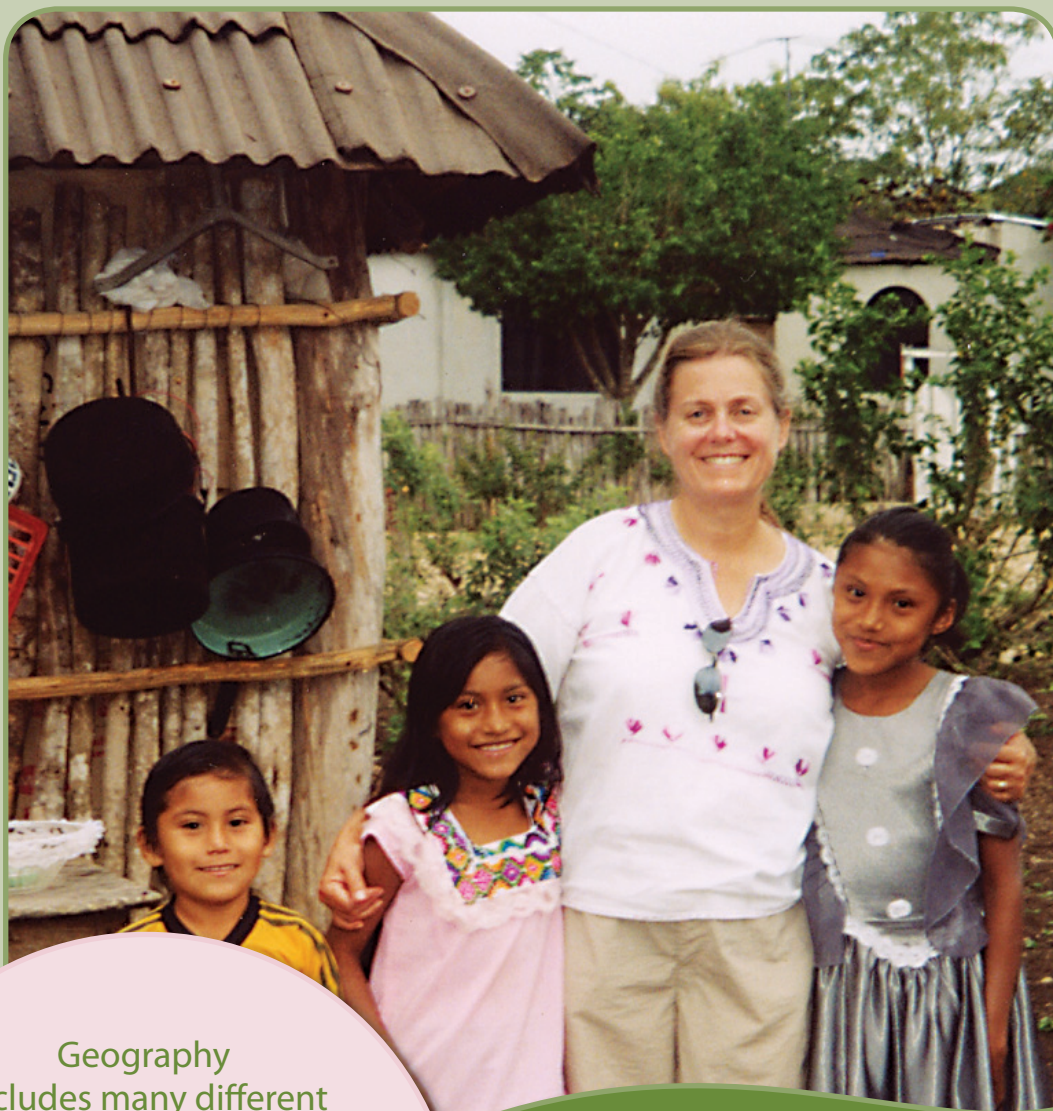
Learning that not all soils are created equal and that some soils are very resilient and others are very sensitive to land management. Finding out which one is which and where they are located is important for making sure we maintain soil quality.

## When did you know you wanted to be a scientist?

When I was in ninth grade I took a class in limnology at high school. It was pretty cool to see what lived in stream and pond waters.



# Meet the Scientist!



Geography includes many different things like geographic information systems (GIS) and maps. However, one important focus of geography is the relationship between people and nature – how human beings and their activities affect nature and how nature affects human beings.

## Dr. Marla R. Emery Geographer

Ph.D., Rutgers University  
USDA Forest Service scientist



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### Important Scientist Characteristics

- ★ Listen carefully and respectfully to people from diverse cultures
- ★ Thorough record-keeping and organization
- ★ Attention to detail
- ★ Critical thinking

**Example of a simple research question I have tried to answer:**  
How do people use wild plants and mushrooms?

### Technology or equipment used in research:

Audio recording equipment is very important to my research because interviews with people who use wild plants and mushrooms are my most important source of data. Software that helps me analyze interview data in a thorough, rigorous fashion is also essential for my work.

### Most Exciting Discovery

Even today, people gather a lot of wild plants and mushrooms! Gathering creates deep connections between people and nature and can play an important role in human health and wellbeing.

### When did you know you wanted to be a scientist?

In the late 1980s, I worked on a United Nations project to reduce damage and deaths from natural disasters. I was captivated by the power of science to analyze a problem and suggest solutions that would make a positive difference in the world.

<http://nrs.fs.fed.us/people/memery>



# Meet the Engineer!



As a biological and agricultural engineer, I explore, design, and study interactions among all aspects of biological systems.

## Dr. J.M. Grace III Biological and Agricultural Engineer

Ph.D., North Carolina State University  
USDA Forest Service engineer



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### Important Scientist Characteristics:

The skills contributing most to my work are curiosity, mathematical and critical thinking, creativity, and effective communication. These traits combine to help my teams identify gaps in understanding, isolate questions, and provide solutions.

### Example of a simple research question I have tried to answer:

What is the influence of human activities on our soil and water resources? Our work has found that human activities, including management, can result in both positive benefits and negative impacts to our soil and water resources.

### Technology or equipment used in my work:

Modeling and geospatial mapping technology are critical to my work. These tools provide visual representation of multiple characteristics (e.g., water, vegetation, soils, elevation, population, pollutants) at many scales. This information helps define areas of interest for detailed study.

### Most Exciting Work

My team's pursuit to describe the influence of forest road infrastructure, and its management, on water resources comes to mind as the most exciting work. This work has spanned my career, and there remains unanswered road infrastructure questions due to continually changing conditions.

### When did you know you wanted to be an engineer?

I chose engineering as the profession I would pursue during my senior year in high school after being introduced to a discipline (agricultural engineering) that nurtures my passion for natural resources and my ability to grasp theoretical concepts and mathematics.

<https://www.srs.fs.fed.us/staff/242>



# Meet the Scientist!



<http://www.naturalinquirer.org>



A hydrogeologist is a person who studies the ways that groundwater (hydro) moves through the soil and rock of the earth (geology). Hydrogeologists evaluate the quantity, quality, reliability, and sustainability of groundwater.

## Joe Gurrieri Hydrogeologist

M.S., University of Connecticut  
USDA Forest Service scientist

### Important Scientist Characteristics:

A hydrogeologist must have scientific knowledge across a range of disciplines, the ability to visualize geology and conceptualize groundwater flow in three dimensions, and the skill of drawing conclusions from incomplete information.

### Example of a simple research question I have

**tried to answer:** How fast does groundwater move through the ground, and what flow path does it take on its journey? I have been asked to answer this question many times for different reasons including tracking the movement of pollutants and determining groundwater connections to surface water.

### Technology or equipment used in research:

My hiking boots are the most important piece of equipment. A geoscientist needs to spend time in the field to be able to understand how natural systems operate. Wells are also important. Wells are used to sample groundwater quality and measure the depth to the water table.

### Most Exciting Discovery

Large mines are my favorite projects to work on. Mining huge holes and tunnels in the ground can severely reduce or pollute groundwater in aquifers. Analyzing the effects of mining on groundwater dependent ecosystems like springs, streams, lakes, and wetlands is very challenging and rewarding.

### When did you know you wanted to be a scientist?

When I was a young boy, I watched TV shows about scientists doing all kinds of exciting things like going to exotic places, climbing mountains, and scuba diving. I remember saying to myself, "I want to be a scientist when I grow up."

<https://www.fs.fed.us/geology/groundwater.php>



# Meet the Scientist!



Archaeology is the study of history and the period before written history, known as prehistory, using artifacts and other physical objects.

## Margaret Hangan Archaeologist

M.A., California State University, Bakersfield  
USDA Forest Service scientist



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### Important Scientist Characteristics

Curiosity and the ability to cooperate well with others has served me very well. My curiosity drives me to ask research questions and to seek information. It's also important to be able to get along and work well with my colleagues.

### Example of a simple research question I have tried

**to answer:** The most important research questions for an archeologist are: How was an artifact or archaeological site used? To what culture does a historic or prehistoric artifact or site belong to?

### Technology or equipment used in research:

A very important part of archaeological research is understanding the relationship between archaeological sites and their geographic locations. Therefore, an important piece of equipment for an archaeologist is a Geographic Positioning System (GPS) unit. GPS units are used to map the location of archeological sites when they are discovered.

### Most Exciting Discovery

Every discovery is exciting, from the smallest shard of pottery or rusty tin can to a large pueblo or a historic timber logging site that no one has visited in several hundred years. It all has the potential to teach us something about the ways of life of the people who once called the southwest United States home.

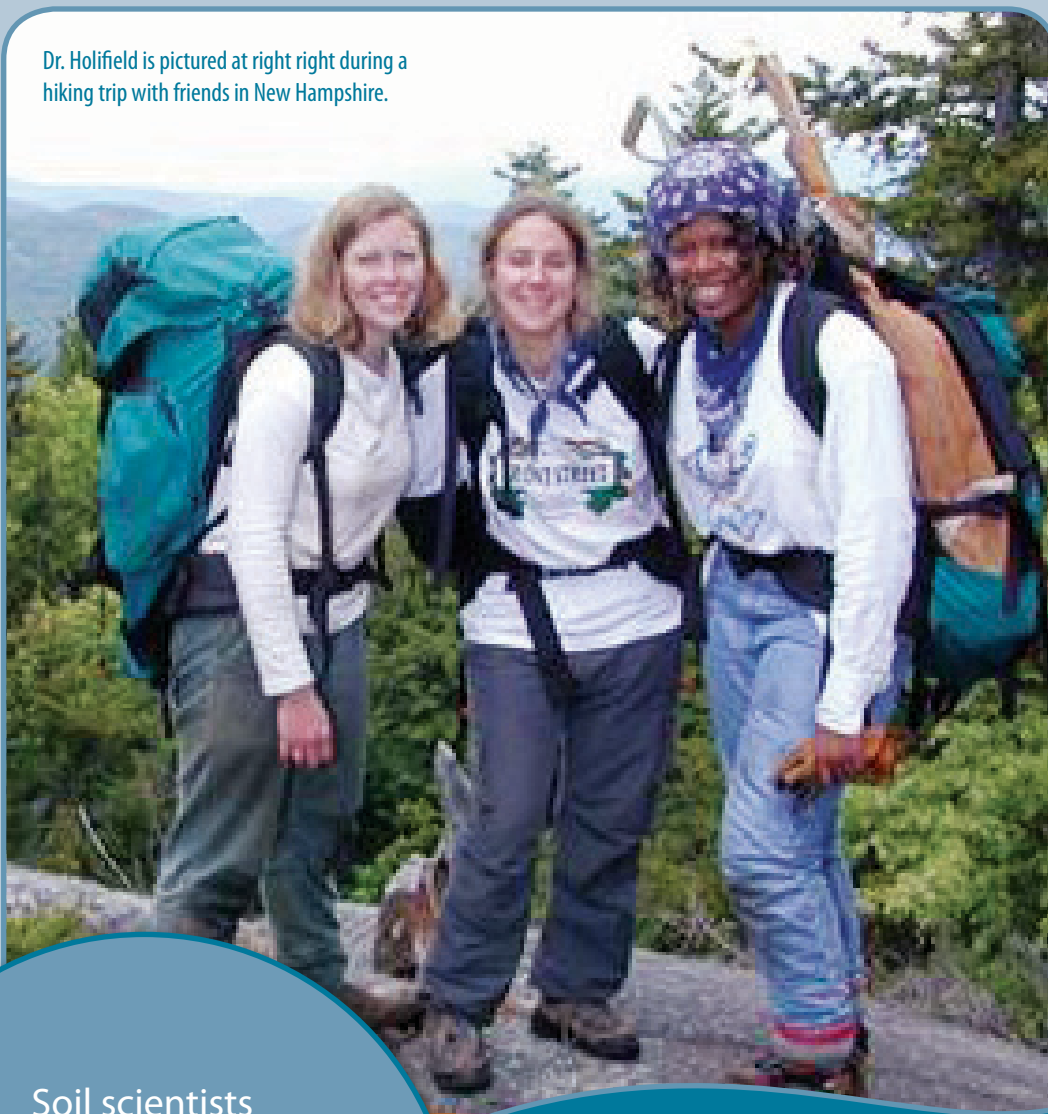
### When did you know you wanted to be a scientist?

When I was a child, I was very interested in dinosaurs and natural history. However, it was an archaeology class at a local community college that set me on my current career path.

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Dr. Holifield is pictured at right right during a hiking trip with friends in New Hampshire.



Soil scientists are concerned with the physical, chemical, and biological characteristics and behavior of soils, and their management for both agricultural and nonagricultural uses.

## Dr. Quin Holifield

### Soil Scientist

Ph.D., State University of New York College of Environmental Science and Forestry (SUNY/ESF)  
USDA Forest Service scientist

# Meet the Scientist!



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### Important Scientist Characteristics

- ★ Thinking outside of the box
- ★ Investigation
- ★ Ability to see the “whole picture”

### Example of a simple research question I have tried to answer:

Can microbial populations be used as an indicator of healthy soils and healthy trees, much like vital health signs, such as heart rate, body temperature, glucose levels and blood pressure, are used to assess human health?

### Technology or equipment used in research:

Soil scientists may use a variety of simple hand held equipment to hi-tech instruments to assess the conditions of the soil in both the field and in the laboratory. Of course, a shovel is very handy to collect soil in the field. Soil scientist may also use sophisticated equipment like a LI-COR® multiplex system to measure soil respiration or a hydrometer to measure the moisture content in the field.

### Most Exciting Discovery

The decline of red spruce trees in the northeastern U.S. is a result of changing land history.

### When did you know you wanted to be a scientist?

As a child, I was curious about how the natural world really worked. My grandfather was a farmer, and he exposed me to the wonder world of soil, at an early age. I had ambitions of being an architect, lawyer or a medical doctor. After doing a book report on Benjamin Banneker, the first African-American man of science, I realized that I wanted to pursue science as a career.



# Meet the Scientist!



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Soil scientists study how soils influence the cycling of water, nutrients, carbon, pollutants, and other materials. We also study similarities and differences among different soil types.

## Dr. Randy Kolka

### Research Soil Scientist

Ph.D., University of Minnesota  
USDA Forest Service scientist

### Important Scientist Characteristics

To be a good scientist you need to have creativity and solid critical thinking skills. You also need skills related to statistical analysis, experimental design, and understanding the limitations of your research. Excellent organizational skills are also critical.

**Example of a simple research question I have tried to answer:** How can we reduce soil erosion and nutrient loss? Erosion and nutrient loss can create dead zones in oceans. The dead zones have only a small amount of oxygen left for living things to use. In our research studies, we use strips of native prairie plants in corn and soybean fields to slow erosion and nutrient losses.

### Technology or equipment used in research:

Our climate change research, with the Spruce and Peatlands Under Climatic and Environmental Change (SPRUCE) experiment, monitors artificial heating of soil and air and elevated carbon dioxide. This experiment helps us assess the impacts of climate change on wetlands.

### Most Exciting Discovery

A graduate student and I analyzed data on mercury pollution during forest fires and where this pollution was deposited. After a number of attempts, we were able to understand that the amount of time which has passed after a fire is an important variable for determining the amount of mercury that was deposited.

### When did you know you wanted to be a scientist?

At the University of Wisconsin-Stevens Point, all natural resource students are required to take a six-week summer camp between their sophomore and junior years. It was during the soils section of camp, where we practiced the discipline in the field, that I discovered a passion for soil science.

<http://www.nrs.fs.fed.us/people/Kolka>



# Meet the Scientist!



A soil microbiologist studies the diverse group of organisms in soil, their functions, and their effect on soil structure, soil properties, and plant growth.

## Dr. Sharon Parker

Soil Microbiologist/Program Leader  
for Science Synthesis

Ph.D., Cornell University  
USDA Forest Service scientist



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### Important Scientist Characteristics

Good record-keeping contributed most to my research. Record-keeping is central in the scientific process for managing and planning research, for reproducing results, and for publishing and peer review.

### Example of a simple research question I have tried to answer:

What happens to bacterial populations when simple carbon compounds are limited? I was able to show that populations of bacteria decline in soil because of a limited supply of usable simple carbon compounds. The simple carbon compounds are used by fungi which are more efficient at adjusting and storing nutrients than bacteria.

### Technology or equipment used in research:

Currently, I use computers to communicate science information. When I was working as a soil microbiologist, I used traditional laboratory methods and equipment to isolate and identify bacteria from soil samples and diseased tree rings.

### Most Exciting Discovery

In my current position as Program Leader for Science Synthesis, I am most excited about helping to communicate the wonder of science to different audiences. My job includes ensuring that Forest Service science meets standards of excellence and reaches the people who can benefit from the knowledge.

### When did you know you wanted to be a scientist?

I was eight years old when I knew I wanted to become a scientist. I was a freshman in college when I decided I wanted to become a microbiologist. Bacteria intrigued me when I viewed them through the microscope, especially the differences between good and bad bacteria. Their shapes, sizes, and colors were fascinating!

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# Meet the Scientist!



A soil scientist studies soil properties and processes, how they change in response to management actions, and how they influence other parts of the forest.

**Dr. Andy Scott**  
Research Soil Scientist  
Ph.D., Virginia Tech  
USDA Forest Service scientist



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## Important Scientist Characteristics

I think my most important talent is in communicating science to a wide variety of people. Too often, scientists focus on discovery but don't communicate it well. I enjoy speaking about my science to everyone, from the experts to local elementary schools.

## Example of a simple research question I have tried to answer:

Do forest management practices, such as tree harvesting, alter the soil's ability to function in a number of ways?

## Technology or equipment used in research:

I frequently use a custom-made soil coring tool. It's about 50 cm long, 8 cm wide, and it is hammered into the soil to remove an intact soil core 30 cm long. From this sample, I can calculate all sorts of chemical and physical properties important to understanding how the soil functions.

## Most Exciting Discovery

I calculated the potential biomass energy lost from harvesting trees on nutrient-poor sites and the energy it would require to restore the nutrients to the soil. I showed that the energy gain of having fertile soil is much greater than the energy needed to fertilize the soil.

## When did you know you wanted to be a scientist?

I grew up exploring the forests around my house, and entered forestry upon the advice of a local forester. I got a job working for a forest soils scientist the first summer I was in college, and I found that I loved forestry, soils, and science.



# Meet the Scientist!



A soil ecologist studies how soils interact with the organisms that live in and on them.

## Melanie K. Taylor

Soil Ecologist

M.S., University of Georgia

USDA Forest Service scientist



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### Important Scientist Characteristics

A willingness to get dirty certainly helps in the field of soil ecology! Additionally, creativity in asking and answering scientific questions, and having great mentors, have been extremely helpful.

### Example of a simple research question I have tried to answer:

How do symbiotic fungi affect the amount of carbon stored in soils? Symbiotic organisms, such as the fungi in our research question, live closely with other organisms. One or more organisms can benefit from the symbiotic relationship.

### Technology or equipment used in research:

An infrared gas analyzer (IRGA) detects the amount of carbon dioxide in a gas sample. I use an IRGA to determine the amount of carbon dioxide being released from soils.

### Most Exciting Discovery

The type of symbiotic fungi sometimes found with tree roots helps explain the amount of carbon which is stored in the soils around the trees. Soil stores a huge amount of carbon, so this finding helps us account for all of the carbon!

### When did you know you wanted to be a scientist?

I knew I wanted to study science since I was a teenager. I grew up near an abandoned farm. Seeing part of the land change from farm to forest left me with many questions.

<http://www.srs.fs.usda.gov/forestdisturbance/>



# Meet the Scientist!



Environmental economists study the way people interact with nature. This research includes how people value nature, how they respond to changes in the environment, and what policies can be used to protect the environment.

## Dr. Travis Warziniack

Environmental Economist

Ph.D., University of Wyoming

USDA Forest Service scientist



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### Important Scientist Characteristics

My research is a bit like story telling. I create a model to explain something that I observe in real life or just to see if something is possible. The only requirement is that the people in the “worlds” I create have to follow the basic rules of economics and math.

### Example of a simple research question I have tried to answer:

How will climate change affect the way people in the United States use freshwater? A lot of places are already running out of freshwater for human use. It is important to know how climate change will affect the amount of available freshwater, and how to find ways we can conserve that freshwater.

### Technology or equipment used in research:

When I start looking at a question or problem, I use a pencil and a lot of paper to create models of peoples’ behavior and the effect of those behaviors on the environment. The models are really a bunch of math equations. After I have solved the math, I turn that math into computer models to study large scale problems like climate change and drought.

### Most Exciting Discovery

My research focuses on the value of ecosystem services. Ecosystem services are the benefits humans get from ecosystems, like clean air or clean water. In 2015, President Obama asked the USDA Forest Service to think about ecosystem services when they manage public land. To help meet the President’s request, I have traveled to National Forests throughout the country. I have also gone to Washington, D.C. to talk about my research.

**When did you know you wanted to be a scientist?** I have always wanted a job with environmental policy. It was not until college that I discovered economics. It is one of the few fields that combine policy and math. I was lucky to work with professors in college, and I fell in love with research.

<http://www.fs.fed.us/rmrs/people/twwarziniack>



# Meet the Scientist!



As a forest and soil ecologist, I am interested in how forest management practices impact soils.

## Dr. Dexter Strother

Forest/Soil Ecologist

Ph.D., University of Georgia  
USDA Forest Service scientist



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### Important Scientist Characteristics

Curiosity contributes most to my scientific research. It is the reason I became a scientist. I am always questioning things, and these questions lead me down many different paths.

### Example of a simple research question I have tried to answer:

What are the effects of black carbon on labile carbon? Black carbon is a product created naturally during wildland fires. Labile carbon is the portion of carbon in soils that can be easily decomposed by soil organisms.

### Technology or equipment used in research:

I often use a PP Systems EGM-4 Environmental Gas Monitor. It is not very big, weighing about 4 pounds. This equipment allows me to measure how much carbon dioxide is in a soil sample that I am using for research.

### Most Exciting Discovery

I am still in the process of conducting research, so my most exciting discovery is still to come.

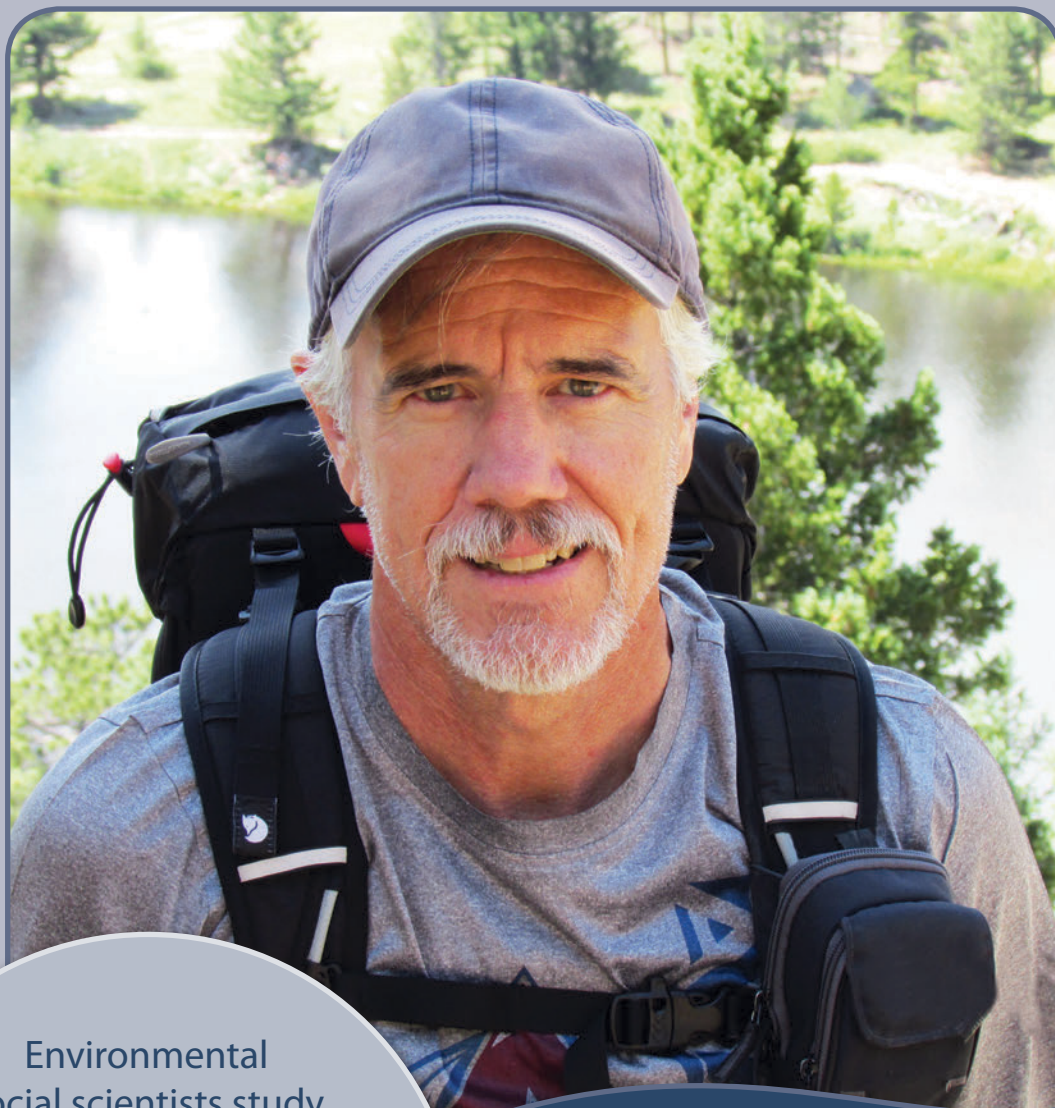
### When did you know you wanted to be a scientist?

I believe I have been studying science for a long time, even when I was little. I did not know I would become a scientist until my time in college.

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# Meet the Scientist!



Environmental social scientists study a wide variety of topics involving people, society, and their interactions with the environment. My work focuses on how people experience and value nature in their everyday lives.

**Dr. Daniel R. Williams**  
Environmental Social Scientist  
Ph.D., University of Minnesota  
USDA Forest Service scientist



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## Important Scientist Characteristics

I'm a bit of a daydreamer and "undisciplined" in my approach, which helps me remain open-minded about possible solutions. I'm curious how different fields of science try to answer similar questions. Each science brings important insights. We must recognize that understanding complex problems involves many different kinds of science.

## Example of a simple research question I have tried to answer:

Why do people feel attached to some places more than others? Can the strength of attachment be measured using a questionnaire or survey?

## Technology or equipment used in research:

In my early days, I used photography as a tool to elicit people's perceptions of natural landscapes. In recent years I have examined the use of social media, such as blog posts people make about the places they have visited, as a way to examine landscape perceptions and preferences.

## Most Exciting Discovery

Even in our highly mobile society, people still need to feel attached to one or more places as they go through their lives. They can do this by establishing a long-term connection to a place they visit frequently, such as a second home in a forest or natural landscape.

## When did you know you wanted to be a scientist?

Growing up in the mountains, I was fascinated by my geology and earth science lessons in 8th grade. Later, in college, I began to think about how I could investigate why people are attracted to natural landscapes and why they form emotional bonds with specific places.

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