Soil Zone Evaluation

I'm a Scientist USA – March - April 2016

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I'm a Scientist, USA
Soil Zone External Evaluation Report

Waldron Educational Consulting
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Teacher

"My lower-level students were engaged by the chat and enthusiastic about talking to real scientists. That alone made it worthwhile."

Scientist

"I did like that I reached a lot more students than in other types of communication."

Teacher

What was the single most important outcome for you as a teacher?

"That my students learned what Soil Scientist were all about and such a variety of directions within the field!"

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1. Summary

The purpose of this report is to provide an external perspective on the utility of the *I'm a Scientist USA* Soil Zone. Evaluators analyzed data for a Soil Zone event that took place from April 25, 2016 to May 6, 2016. Sources of data for the evaluation included online analytics gathered by the project team; pre/post survey data for scientists, teachers and students; participant demographic data; and a preliminary report of the event prepared by the project team. This evaluation documents outcomes for scientists, teachers, and students who were involved in the project.

This evaluation was commissioned by *Keep on Questioning* and funded by the Agronomic Science Foundation (ASF).

2. Methods

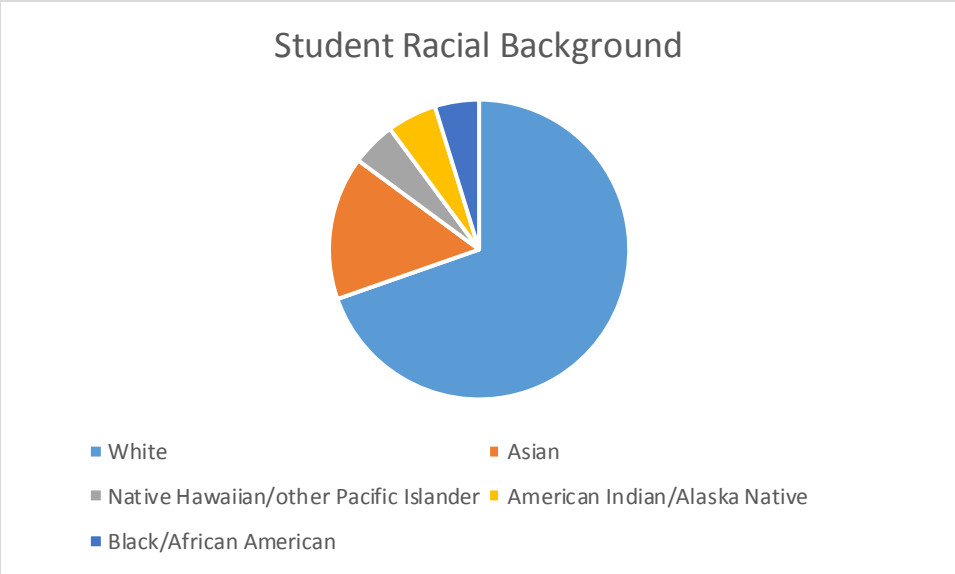
Evaluators co-developed pre/post surveys with the project team that were implemented during the event. Evaluators also logged into the Soil Zone site to determine fidelity of implementation. Online analytics data were gathered by the project team as were participant demographics and pre/post survey data for scientists, teachers, and students. All data was shared with the evaluators to allow for secondary analysis and reporting.

3. Results

Participant Demographics

For the Soil Zone *I'm a Scientist* event, five scientists, eight teachers, and 315 students participated. Eight schools participated and included all levels: elementary, middle, and high schools. Of the 315 students, 215 responded to surveys. There were 93 male and 122 female students at the participating schools. One hundred thirty students indicated that they were Non-Hispanic/Latino, and 60 students identified as Hispanic/Latino. One hundred seventeen students identified as White, 26 as Asian, 8 as Native Hawaiian/other Pacific Islander, 9 as American Indian/Alaska Native, 8 as Black/African American (See Chart 1, below).

Chart 1. Student Racial Background



Surveys

Each participant was invited to participate in a pre-survey and a post-survey of the event. Scientist and teacher surveys were designed to gather perspectives on the benefits of their participation, while the student surveys gauged both student perspectives[1] and content acquisition. All responses were collected by the project team, de-identified and shared with the evaluator for analysis and reporting.

[1] Kier, M. W., Blanchard, M. R., Osborne, J. W., & Albert, J. L. (2014). The development of the STEM career interest survey (STEM-CIS). *Research in Science Education*, *44*(3), 461-481.

Scientists

Five scientists responded to a pre-survey that focused on their motivations and interest in the *I'm a Scientist* program. Key questions and responses appear in Table 1, below.

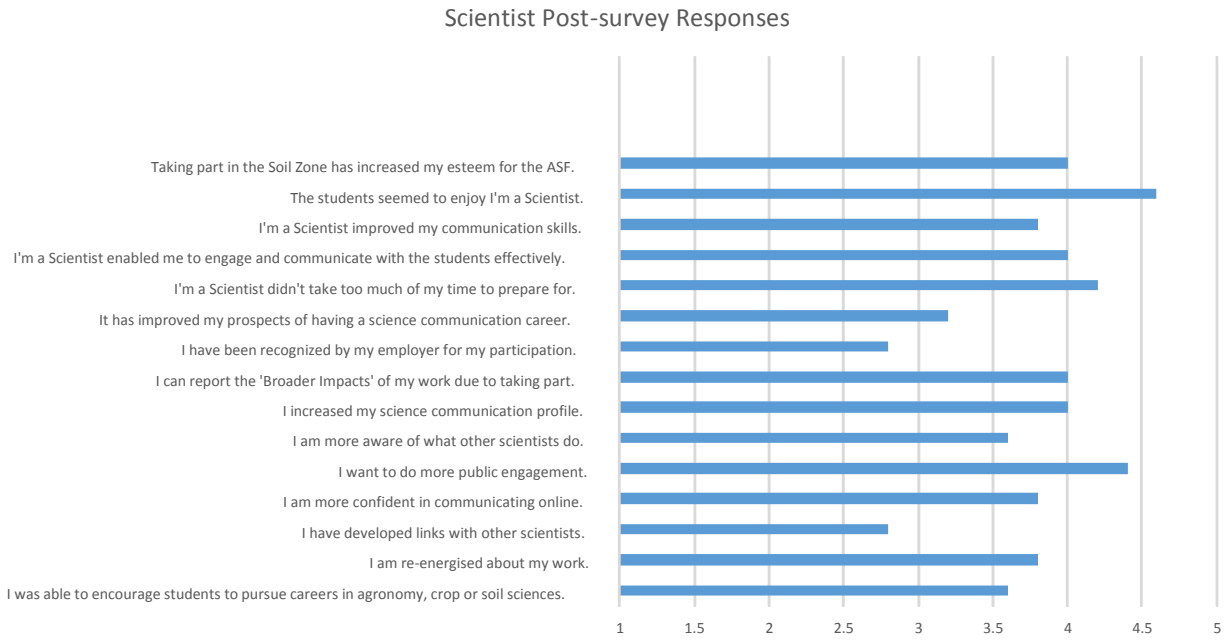
Table 1. What scientists found appealing about *I'm a Scientist*

What appeals to you most about *I'm a Scientist*?
Hearing young people's views about science in general, and my work specifically.
The chance to share what I've learned in 30 years of tramping through forests, grasslands and deserts with curious young minds. The chance to have knowledge about how the world works with curious minds.
Sharing the wonder of soils with students to get them excited about science and caring for the environment in which they live. Sharing my passion for knowledge and science with a new generation in order to inspire them to be curious about the world about them and develop a passion for learning.
The possibility to interact with students and the challenge to explain my work to them in English, that is not my mother language.
The chance to hear first-hand from young people what they find engaging and valuable about my research and what they are curious about.

The most important outcome sought by scientists was getting students more excited about science. All scientists felt confident in their ability to communicate with the public about their work.

On the post-survey, scientists rated all aspects of the event on average 3.9 out of 5 points on a 5-point Likert scale for statements to which they agreed or disagreed (see chart below).

Chart 2. Scientist Post-survey Responses



A specific question about how *I'm a Scientist* differed from other forms of science engagement, communication or education they had been involved with elicited the following responses.

Table 2. How Scientists View *I'm a Scientist* Compared with Other Activities

The online format was new, as I have either done short in-person "seminars" with K-12 or been a coach for a middle school team in a science competition. I didn't like that there was no feedback from students other than what they wrote in chats, which was usually short and not informative. I did like that I reached a lot more students than in other types of communication.
Favorably - it did allow reaching a greater number of schools and students in a one-time event. The online environment facilitated those connections.
It was definitely nice to engage with students from home.
Most communication and outreach I've been involved in to date has been writing articles for adult non-scientists on my blog and visiting classrooms and zoos to talk about my science. *I'm a Scientist* was a completely different format, and I really appreciated how it allowed a little delay time to consider and formulate an answer, and instant feedback in the form of follow-up questions. *I'm a Scientist* is a powerful new tool for getting students excited about science!

Overall, scientist hopes for their involvement were high at the beginning, and their expectations were met through their experience in *I'm a Scientist*. All scientists would participate again, and all would recommend the program to a colleague.

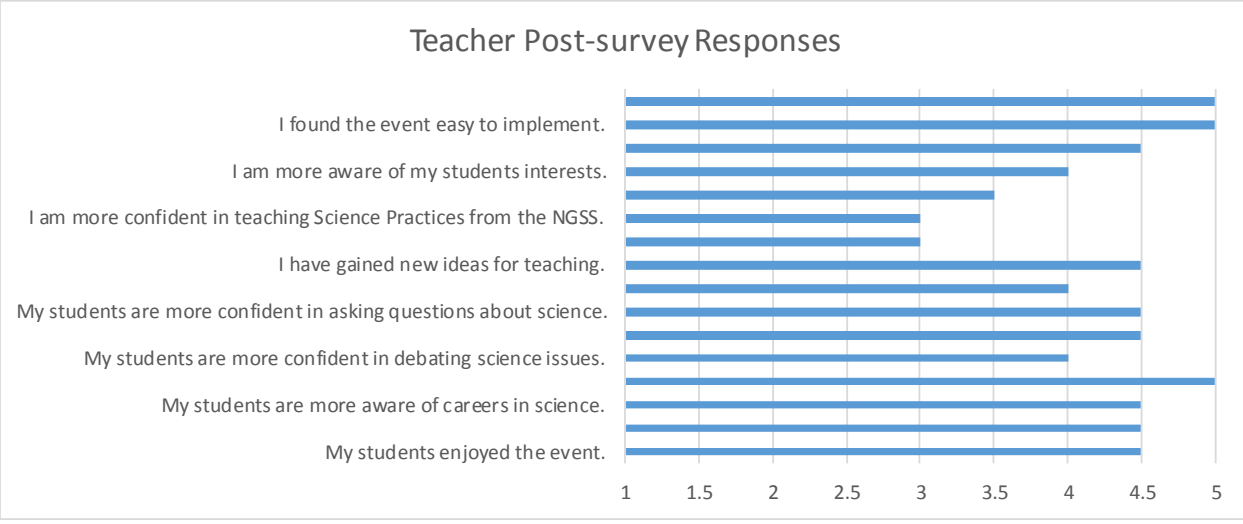
Teachers

Four teachers responded to the pre-survey and two teachers responded to the post-survey. Summary data appears below.

The top four outcomes from participating in the Soil Zone were anticipated to be: 1. Students have a more nuanced view of science 2. Students are more aware of careers in science 3. Students are more excited about science 4. Students have a more positive view of science. Two of the teachers planned to use the Soil Zone as enrichment, and two as part of outside lessons as part of a themed day/week. Other types of enrichment classes have participated in are the Amplify pilot curriculum from Lawrence Hall of Science, a visit to the California Academy of Science, a visit to a landfill and a water treatment plant, and Google Expeditions. Teachers planned to spend between 1 and 5 lesson periods on the Soil Zone.

Teachers were asked how much they agreed with several statements about the program's usefulness post-event on a 5-point Likert scale. The general trend was to agree or strongly agree with the statements, with the overall rating 4.5 out of 5.0.

Chart 3. Teacher Post-survey Responses



Teachers were asked a range of questions on the post-survey about the utility of *I'm a Scientist* for their teaching. Results were overwhelmingly positive. The most important outcome for the teachers included, "That my students learned what Soil Scientist were all about and such a variety of directions within the field!" and "My lower-level students were engaged by the chat and enthusiastic about talking to real scientists. That alone made it worthwhile." When asked what the best part was, teacher responses included, "The LiveChat was the best part!" and "Students realizing that scientists are real people."

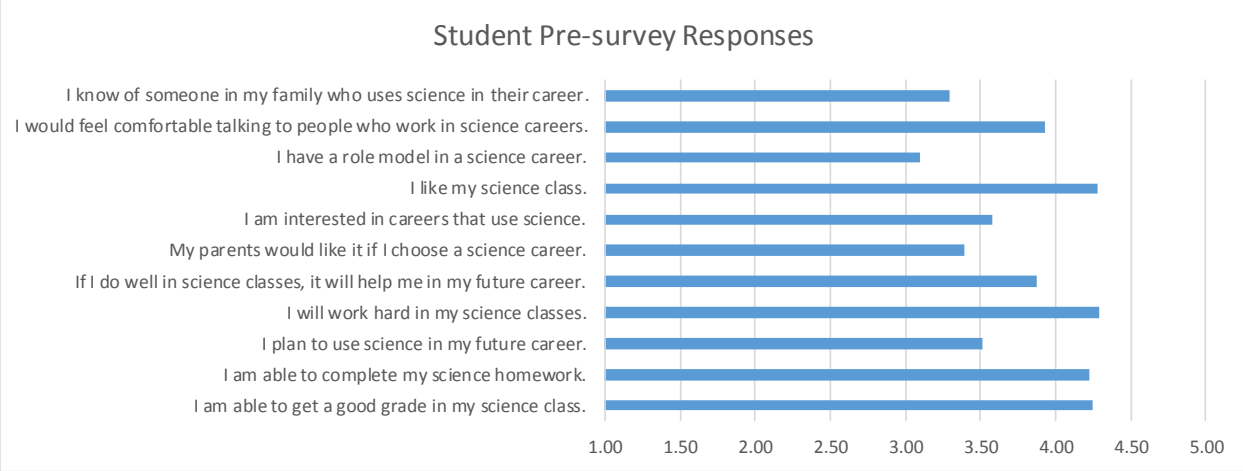
Students

Although 215 students completed the pre-survey, only 73 completed the post-survey. Therefore, matched comparison was not feasible. Rather, aggregate data was analyzed for the pre-survey and also for the post-survey. Results for each survey follow below.

PRE-SURVEY

Seven girls and 208 boys responded to the pre-survey. Students were asked to rate their agreement or disagreement on a 5-point Likert scale to the statements in the following chart. Overall, ratings were 3.8 out of 5 points.

Chart 4. Student Pre-survey Responses



Students were also asked subject knowledge questions related to the Soil Zone learning materials and content. These questions drew on educational research about student understanding of soil and plants[2][3][4]. The first question, "Choose the statement you agree with most" related to plant growth and included 23 responses of, "Plants gain most of their weight from materials in the air." The remaining 192 respondents indicated, "Plants gain most of their weight from materials that come from nutrients in the soil."

When asked, "Where does the matter in a pound of wood come from when a tree grows?", 13% of students indicated that the matter comes from the soil. Another 10% said that it comes from nutrients. Students were also asked about their understanding of soil by indicating which statement in the following table they agreed with most. The majority responded with, "Soil has living and nonliving parts."

[2] Keeley, P., (March 2015). Soil and Dirt: The same or different? Formative Assessment probes. *Science and Children*, 29-31.

[3] Ozay, E. ad Oztas, H., (2003). Secondary students' interpretations of photosynthesis and plant nutrition. *Journal of Biological Education*, 37 68-70.

[4] Dauer, J., M., et al., (2014). Connections between Student Explanations and Arguments from Evidence about Plant Growth. *CBE—Life Sciences Education*, Vol. 13, 397–409.

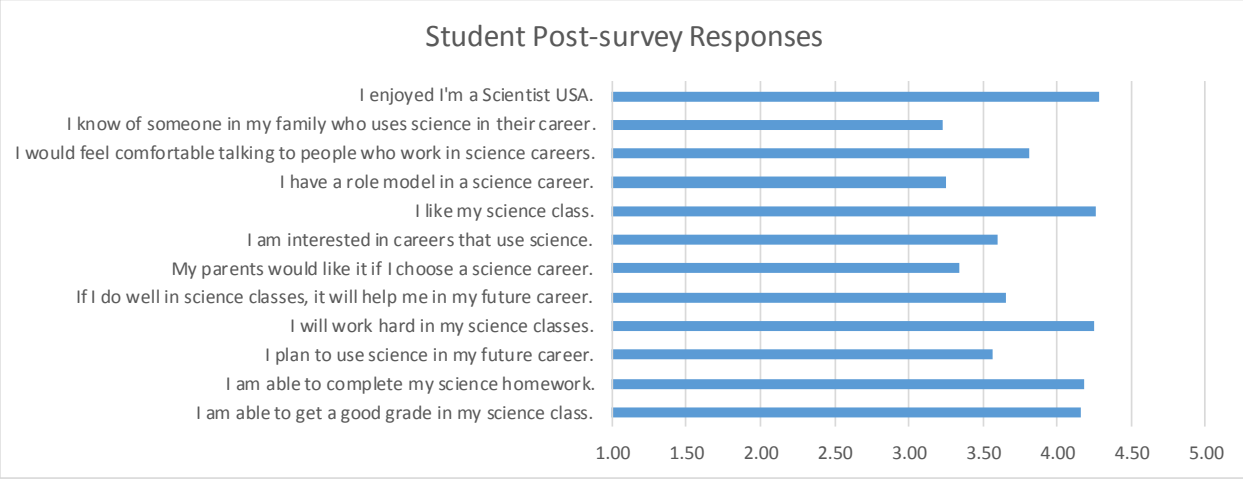
Table 3. Student Responses to Statement Pre-event

Statement	Number of responses
Soil has living and nonliving parts.	116
Soil is another name for dirt.	91
Soil is tiny pieces of rock.	8

POST-SURVEY

There were 73 student post-survey responses. The students rated the event as 3.9 out of 5.0 on a 5-point Likert scale as seen in the chart below.

Chart 5. Student Post-survey Responses



Students showed that they knew where plants gain their mass, as 60 students agreed with the statement: "Plants gain most of their weight from materials that come from nutrients in the soil." Only 13 students selected, "Plants gain most of their weight from materials in the air" as the best choice.

The students showed more sophistication and knowledge of soil in their answers to the question, "Where does the matter in a pound of wood come from when a tree grows?" 7.5% of students said the matter comes from the soil, while 7.5% said it comes from nutrients. Other answers included carbon (4.6%) and photosynthesis (4.0%).

Compared to the pre-survey, fewer students chose "soil is another name for dirt" and "soil is tiny pieces of rock." Fifty students selected "Soil has living and nonliving parts."

Table 4. Student Responses to Statement Post-event

Statement	**Number of responses**
Soil has living and nonliving parts.	50
Soil is another name for dirt.	18
Soil is tiny pieces of rock.	5

4. Conclusion

The Soil Zone *I'm a Scientist* event was a useful tool for students to learn about soils and their role in plant productivity. Scientists involved had positive interactions with students and found the format useful given their science communication goals. Teachers found the format very useful for themselves and their students and would participate in future *I'm a Scientist* events. Overall, the event was successful as evidenced in the data collected from participants.

Appendix

Participating scientists

The scientists' profiles and CVs can be accessed at this link: https://soila16.imascientist.us/scientists/

One scientist was a member of the American Society of Agronomy (ASA) and the Soil Science Society of America (SSSA). None of the other scientists indicated membership of ASF societies.

All the participating scientists agreed that taking part in the Soil Zone had increased their esteem for the Agronomic Science Foundation.

Participating schools

Participating schools, their geographic distribution and the grade level of the students are detailed in the Soil Zone report, available at this link: https://imascientist.us/wp-content/uploads/2017/01/Soil-Zone-Report.pdf

School data

There were three elementary, two middle and three high schools.

The schools are in six different states (MN, ID, FL, CA, DE, NY) and one Canadian province (ON).

There were five urban and three suburban schools.

The schools were varied in terms of the socioeconomic status of the students and the ethnic diversity. One school, Mar Vista Academy, is located in a poor neighbourhood of San Diego, just one mile from the Tijuana border crossing and has an intake with over 80% of the students from socioeconomically disadvantaged backgrounds, 78% of the students are Hispanic or Latino and over 30% of the students are English Learners.

Teacher ASF awareness

Two of the teachers that responded to the survey had heard of the Soil Science Society of America (SSSA), another teacher had heard of the Soils 4 Kids website.

Evaluation survey questions

Student pre-event survey

What grade are you in at school?

Options available 2-12.

Are you a..... Boy Girl

The following eleven questions are on a Likert scale with the following choices:

Strongly Disagree (1), Disagree (2), Neither Agree nor Disagree (3), Agree (4), Strongly Agree (5)

I am able to get a good grade in my science class.

I am able to complete my science homework.

I plan to use science in my future career.

I will work hard in my science classes.

If I do well in science classes, it will help me in my future career.

My parents would like it if I choose a science career.

I am interested in careers that use science.

I like my science class.

I have a role model in a science career.

I would feel comfortable talking to people who work in science careers.

I know of someone in my family who uses science in their career.

Choose the statement you agree with most.

"Plants gain most of their weight from materials in the air."

"Plants gain most of their weight from materials that come from nutrients in the soil."

Where does the matter in a pound of wood come from when a tree grows?

Choose the statement you agree with most.

Soil is another name for dirt

Soil has living and nonliving parts

Soil is tiny pieces of rock

The following questions were optional

Which best describes you? (Choose one.)

Hispanic/Latino

Non-Hispanic/Latino

Which of these best describes your background?

(Choose one or more.)

American Indian/Alaska Native

Asian

Black/African American

Native Hawaiian/other Pacific Islander

White

Student post-event survey

What grade are you in at school?

Options available 2-12.

Are you a..... Boy Girl

The following twelve questions are on a Likert scale with the following choices:

Strongly Disagree (1), Disagree (2), Neither Agree nor Disagree (3), Agree (4), Strongly Agree (5)

I enjoyed I'm a Scientist USA.

I am able to get a good grade in my science class.

I am able to complete my science homework.

I plan to use science in my future career.

I will work hard in my science classes.

If I do well in science classes, it will help me in my future career.

My parents would like it if I choose a science career.

I am interested in careers that use science.

I like my science class.

I have a role model in a science career.

I would feel comfortable talking to people who work in science careers.

I know of someone in my family who uses science in their career.

Choose the statement you agree with most.

"Plants gain most of their weight from materials in the air."

"Plants gain most of their weight from materials that come from nutrients in the soil."

Where does the matter in a pound of wood come from when a tree grows?

Choose the statement you agree with most.

Soil is another name for dirt

Soil has living and nonliving parts

Soil is tiny pieces of rock

The following questions were optional

Which best describes you? (Choose one.)

Hispanic/Latino

Non-Hispanic/Latino

Which of these best describes your background?

(Choose one or more.)

American Indian/Alaska Native

Asian

Black/African American

Native Hawaiian/other Pacific Islander

White

Teacher pre-event survey

What appeals to you most about I'm a Scientist?

Please rank the following outcomes in terms of importance for you as a teacher (the most important at the top to least important at the bottom).

Students are more excited about science

Students have a more nuanced view of science

Students have a more positive view of science

Students are more aware of careers in science

Students are more confident in asking questions about science

Students are more confident in debating science issues

I am more aware of cutting edge science

I will gain ideas for teaching in the future

I am more aware of the insights my students have into science

I am more confident in teaching science practices

I am more confident in using online tools in lessons

Is there anything else not mentioned in the question above that you're expecting as an important outcome?

How are you planning to run I'm a Scientist?

In lessons as part of the scheme of work.

In lessons as enrichment.

Outside lessons as part of a themed day/week.

Outside lessons in a STEM club.

Visit from a scientist

What grade(s) of students are you planning to run I'm a Scientist with?

Have the class(es) you're running I'm a Scientist with taken part in any of the following science enrichment activities?

Visit from a scientist.

Visit to a local science center/museum.

Visit to a science festival.

I'm a Scientist, previously.

Have the class(es) you're running I'm a Scientist with taken part in any other science enrichment activities?

Have you taken part in any of the following science enrichment activities with other students?

Visit from a scientist.

Visit to a local science center/museum.

Visit to a science festival.

I'm a Scientist, previously.

How many lessons do you plan to spend on I'm a Scientist?

If you are planning on running other science enrichment activities over the next few months tell us here?

Have you previously heard of any of the following organizations or websites?

Agronomic Science Foundation (ASF)

American Society of Agronomy (ASA)

Crop Science Society of America (CSSA)

Soil Science Society of America (SSSA)

Soils 4 Kids

Soils 4 Teachers

Teacher post-event survey

What grade(s) of students did you run I'm a Scientist with?

The following sixteen questions are on a Likert scale with the following choices:

Strongly Disagree (1), Disagree (2), Neither Agree nor Disagree (3), Agree (4), Strongly Agree (5)

My students enjoyed the event.

My students are more excited about science.

My students are more aware of careers in science.

My students have a better understanding of the practices of scientists.

My students are more confident in debating science issues.

My students have a more positive view of science.

My students are more confident in asking questions about science.

My students have a more nuanced view of science.

I have gained new ideas for teaching.

I am more confident in using online educational technology with my students.

I am more confident in teaching Science Practices from the NGSS.

I am more aware of cutting edge science.

I am more aware of my students' interests.

I am more aware of my students' attitudes to science.

I found the event easy to implement.

Overall I was satisfied with the event.

What was the single most important outcome for you as a teacher?

Does I'm a Scientist align with the school curriculum?

Does I'm a Scientist align with the state curriculum?

Does I'm a Scientist align with the Next Generation Science Standards?

Is I'm a Scientist an effective way to overcome geographical barriers to STEM education?

Is I'm a Scientist an effective way to overcome gender barriers to STEM education?

Is I'm a Scientist an effective way to overcome economic barriers to STEM education?

Is I'm a Scientist an effective way to overcome racial or ethnic barriers to STEM education?

Is I'm a Scientist an effective way to overcome stereotypes in STEM education?

Would you participate again?

If you would participate again, would you sign you students up for a general science zone OR a topic specific zone e.g. astronomy?

- General science zone
- Themed zone
- Different zones for different classes

Would you recommend I'm a Scientist to a colleague?

How did you run I'm a Scientist?

- In lessons as part of the scheme of work
- In lessons as enrichment
- Outside lessons as part of a themed day/week
- Outside lessons in a STEM or after school club
- Other

How many lessons did you spend on I'm a Scientist?

From a technical viewpoint, how did you find using the site?

- Difficult throughout
- Quite difficult to start but easy once I was used to it
- Quite simple and straightforward
- Very easy
- Other

The following six questions are on a Likert scale with the following choices:

Strongly Disagree (1), Disagree (2), Neither Agree nor Disagree (3), Agree (4), Strongly Agree (5)

Me and my students found ASK (students submitting questions) useful.

Me and my students found CHAT (live chat sessions) useful.

Me and my students found VOTE (student voting) useful.

Me and my students found Pupil Profiles useful.

I found the Live Chat booking form useful.

I found the staffroom useful.

How would you rate the teacher briefing notes?

- Very useful - they told me everything I needed to know
- Quite useful - they covered most points but had some gaps
- Not very useful - I had lots of questions after reading them
- Not at all useful - a waste of paper
- I didn't read the briefing notes

How did you use Lesson 1 - You're the judges?

- Used in full
- Picked bits out
- Did not use
- Plan to use later
- Other

How did you use Lesson 2 - Meet the Scientists?

- Used in full
- Picked bits out
- Did not use
- Plan to use later
- Other

How did you use Lesson 3 - Live chat? If your students didn't take part in a live chat can you tell us why?

- Used in full
- Picked bits out
- Did not use
- Plan to use later
- Other

How did you use the debate kit?

- Used in full

Picked bits out

Did not use

Plan to use later

Other

Was the VOTE part of the competition clear?

Did your students vote more than once?

Please tell us about ways it could be improved or how it worked well with your students.

What did you think of the number of emails you received in the run up to and during the event?

How useful was the content of the emails you received?

Can you suggest any information you feel was missing from emails about the event?

Is there anything else you would like to add, such as things you particularly liked or disliked about the event, or what you would change about the event?

As a teacher, what would you do differently next time (if anything)?

What was the best thing about I'm a Scientist?

Scientist pre-event survey

How did you hear about I'm a Scientist?

I am a member of the following societies.

American Society of Agronomy (ASA)

Crop Science Society of America (CSSA)

Soil Science Society of America (SSSA)

What appeals to you most about I'm a Scientist?

Please rank the following outcomes in terms of importance for you.

Having a better understanding of how students view science

Developing links with other scientists

Getting students more engaged with science

Increasing my science communication profile

Boosting my science communication career

Winning $500 to spend on outreach

Making students more aware of careers in science

Being able to report on the Broader Impacts of my work

Becoming more confident in communicating my work

Becoming re-energized about my work

Becoming more confident in using online tools

Being more aware of what other scientists do

Being recognized by my employer for my volunteering activities

The following two questions are on a Likert scale with the following choices:

Strongly Disagree (1), Disagree (2), Neither Agree nor Disagree (3), Agree (4), Strongly Agree (5)

I feel confident communicating with young people.

I feel confident discussing social, ethical and environmental implications of my work with members of the public/people outside my field?

Have you previously taken part in any science engagement projects? (Tick all that apply)

Visit to a local school

Science festival

University/institute organized events.

Activities with a zoo or museum

A student science fair.

A popular science blog

A twitter chat, skype chat or other online communication with school students

Please describe any other types of public science communication or engagement you have taken part in.

Approximately how long do you expect to spend per day, on average, participating in the event?

What have you done to prepare for I'm a Scientist?

Please add any other comments, suggestions or descriptions in relation to science communication, education or I'm a Scientist USA.

Scientist post-event survey

The following eighteen questions are on a Likert scale with the following choices:

Strongly Disagree (1), Disagree (2), Neither Agree nor Disagree (3), Agree (4), Strongly Agree (5)

I enjoyed taking part in I'm a Scientist.

I am more confident in communicating my work.

I have a better understanding of how students view science.

I was able to encourage students to pursue careers in agronomy, crop or soil science

I am re-energized about my work.

I have developed links with other scientists.

I am more confident in communicating online.

I want to do more public engagement.

I am more aware of what other scientists do.

I increased my science communication profile.

I can report the 'Broader Impacts' of my work due to taking part.

I have been recognized by my employer for my participation.

It has improved my prospects of having a science communication career.

I'm a Scientist didn't take too much of my time to prepare for.

I'm a Scientist enabled me to engage and communicate with the students effectively.

I'm a Scientist improved my communication skills.

The students seemed to enjoy I'm a Scientist.

Taking part in the Soil Zone has increased my esteem for the Agronomic Science Foundation.

How did I'm a Scientist compare to other forms of science engagement, communication or education you have been involved with.

Would you participate again?

Would you recommend I'm a Scientist to a colleague?

The following three questions are on a Likert scale with the following choices:

Strongly Disagree (1), Disagree (2), Neither Agree nor Disagree (3), Agree (4), Strongly

Agree (5)

CHAT (live chat sessions) was useful for communicating with students.

ASK (questions and comments) was useful for communicating with students.

My scientist profile was useful for communicating with students. How did you find the scientist briefing notes?

How did you find the scientist briefing notes?

- Very useful - they told me everything I needed to know
- Quite useful - they covered most points but had some gaps
- Not very useful - I had lots of questions after reading them
- Not at all useful - a waste of paper
- I didn't read the briefing notes

From a technical point of view, how did you find using the site?

- Difficult throughout
- Quite difficult to start but easy once I was used to it

Quite simple and straightforward

Very easy

Approximately how long did you spend per day, on average, participating in the event?

What do you think about the number of emails you received in the run up to and during the event?

The content of the emails was useful.

Strongly Disagree (1), Disagree (2), Neither Agree nor Disagree (3), Agree (4), Strongly

Agree (5)

Is there anything else you would like to add, such as things you particularly liked or disliked about the event, or what you would change about the event?