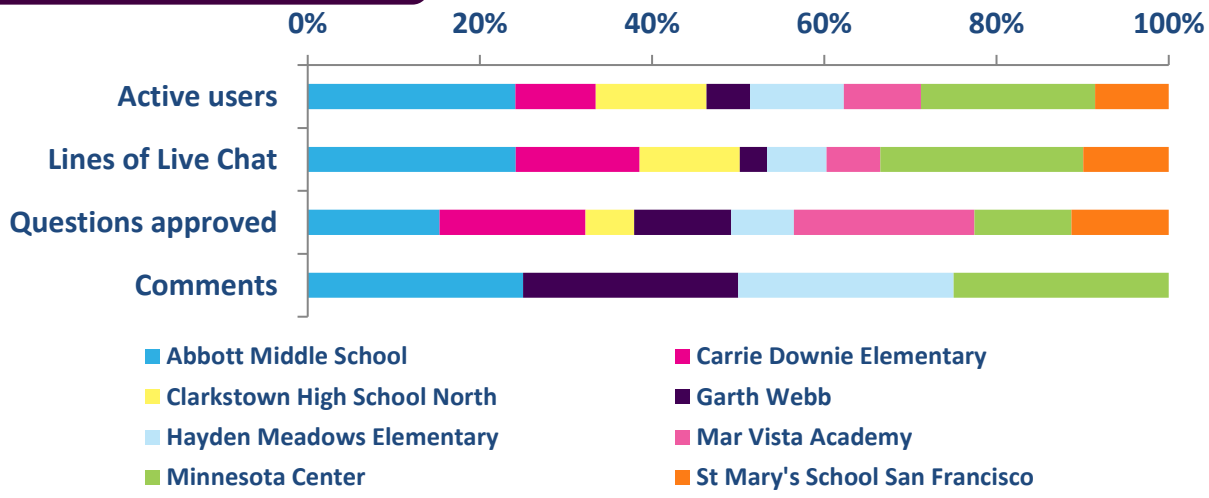
May 2016

The Soil Zone was a themed zone funded by the Agronomic Science Foundation gateway fund. The zone featured scientists working on a range of soil related topics from nodulation in roots to generation of electricity. The zone had 315 participating students from 8 schools. Some teachers had multiple classes take part in the soil zone and class sizes ranged from 13 to over 30 students across grades 4 to 12. Most of the classes had two live chats with the scientists with more live chats taking place in the second week than the first.

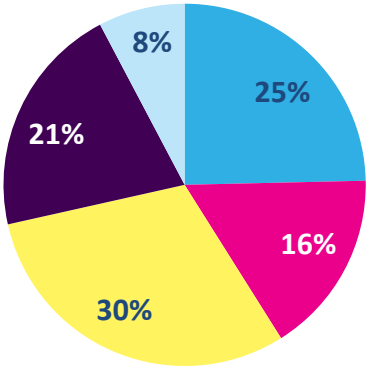
There were fewer questions submitted than other zones but 70% of those submitted were approved and over 80% of the students were actively engaged with the scientists. The live chats were well attended with Mark Ritchie even joining in from Africa and a teacher joining her class for a live chat in Minnesota while she was on a training course in Atlanta. All the scientists were very engaged and quick to reply to the students' questions with very detailed answers. They also engaged with each other, frequently commenting on the students' questions in ASK as well as conversing in CHAT.

School data at a glance

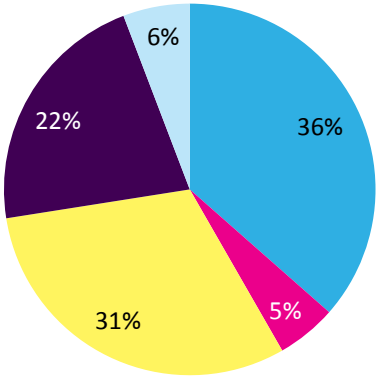


Scientists' activity

Answers



Lines of live chat



Scientist	Profile views	Position
Alex	470	Winner
Keegan	482	2nd
Clay	404	3rd
Mark	423	4th
Ana	341	5th

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PAGE VIEWS	SOIL ZONE	USA ZONES AVERAGE
Total zone	14,704	19,836
ASK page	874	1,537
CHAT page	1,993	2,417
VOTE page	1,809	2,326

	SOIL ZONE	USA ZONE AVERAGE
Students	315	292
% of students active in ASK, CHAT or VOTE	82%	82%
Questions asked	179	366
Questions approved	124	227
Answers given	207	434
Comments	39	61
Votes	378	427
Lines of live chat	2,994	3,967
Live chats	13	16
Average lines of live chat	230	245
Schools	9	13

Key figures from the Soil Zone,

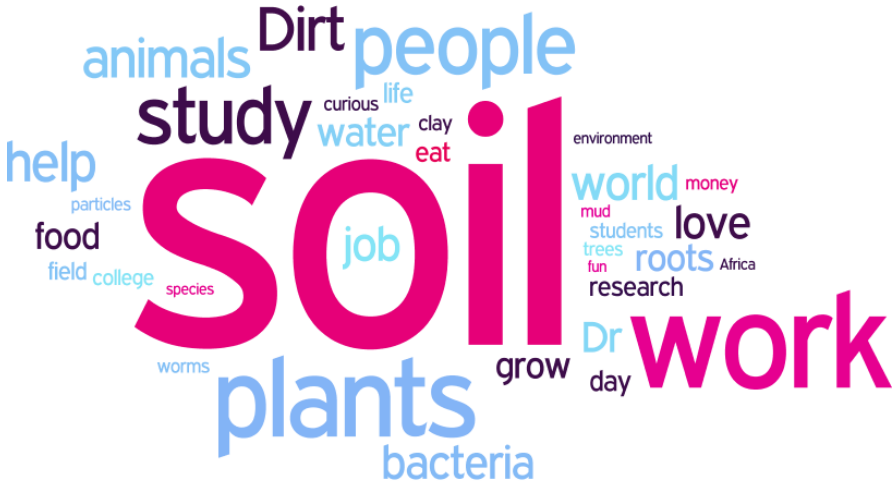
and the average of the USA zones

Popular topics

The Soil Zone featured a range of conversations and questions on the topic of soil and plant science, as well as the scientists themselves. Students did focus their interest on soil, plants, bacteria and related areas of science. With so many related topics the scientists often found themselves discussing all manner of subjects, from the presence of soil on Mars to Genetically Modified crops. There was plenty of evidence in the conversations that took place, that the students had read the scientists profiles in advance and wanted to know more about their work. They were also interested in finding out more about what it is like to be a scientist. Conversations during chats covered similar subject matter as the questions submitted to ASK, namely soil, plants and bacteria, though the actual questions were quite varied. Clay, Alex and Keegan often co-operated to answer the students' questions in both chats and the ASK section, commenting on the questions and developing further interactions. Many students asked the scientists how they got interested in their area of work and what they found most interesting about it. The students also demonstrated concern for animals and the environment and wanted to know how the scientists work helped the planet. The preponderance of excellent live chat interactions is evidenced by the many examples of good engagement listed in this report.

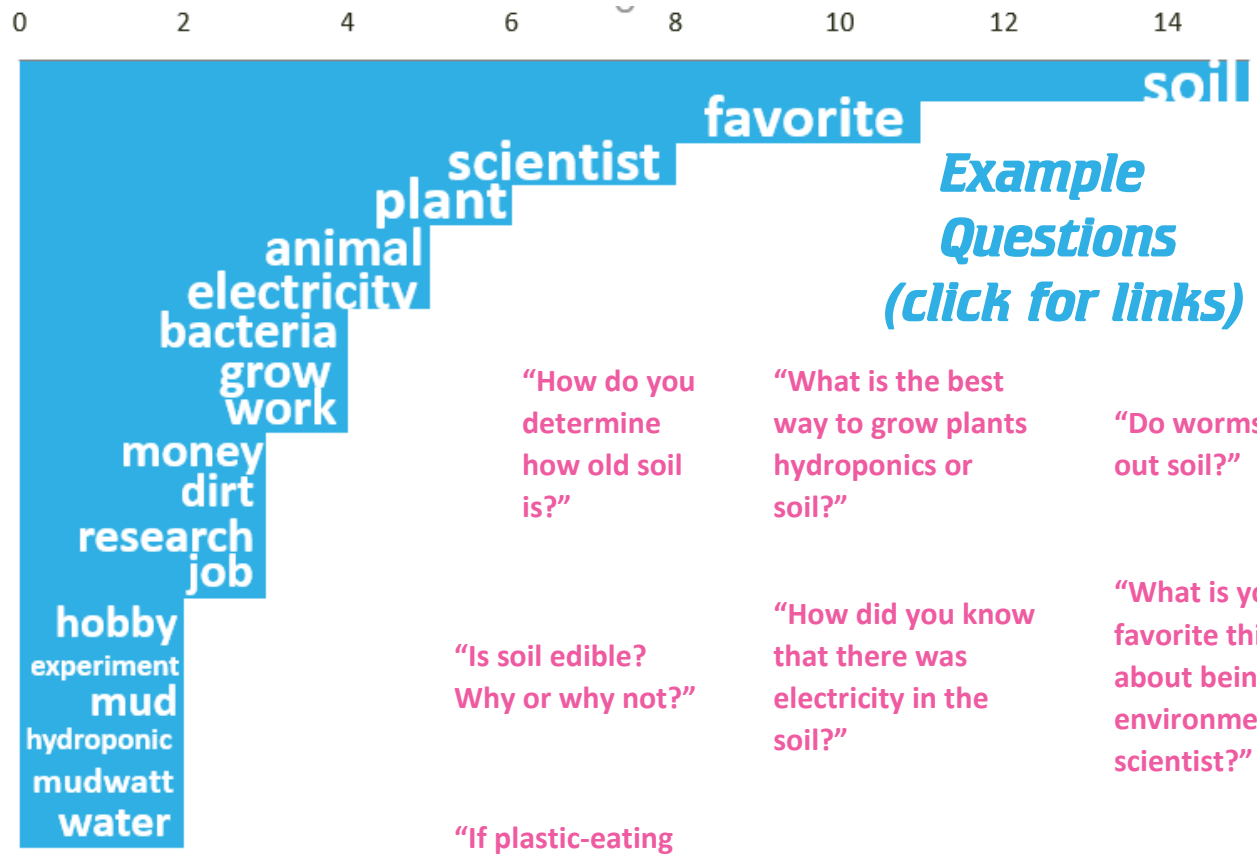
Chat

Keywords from live chats in the zone, size of the word represents its popularity



Ask ?

Keywords of questions asked in the zone, length of bar represents frequency of use



Example Questions (click for links)

"How do you determine how old soil is?"

"What is the best way to grow plants hydroponics or soil?"

"Do worms poo out soil?"

"Is soil edible? Why or why not?"

"How did you know that there was electricity in the soil?"

"What is your favorite thing about being an environmental scientist?"

"If plastic-eating bacteria were released, how drastic do you think the effect would be"

"How do you make electricity out of dirt bacteria?"

"Why do you use bacteria to infect plants?"

"Is lava important? And if it is what can it be used for?"

"How has science impacted your life?"

"What are the pros and cons of your profession?"

"Have you tested out if different organisms affect different types of dirt?"

"Are there different types of soil? If so, what type has the most nutrition and is the most fascinating?"

"Does our world need soil? Can't we just make soil with chemicals?"

"How did life begin?"

"How was the earth made?"

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Examples of good engagement

Alex, Clay and Keegan were particularly good at engaging students in the live chats. The soil zone chats featured lots of science questions and students focused on environmental science and conversations revolving around soil and plants. The students also asked about the scientists' careers, personal lives and interests.

Questions about soil

"Is their soil on Mars?" - **student**
"Geologists would say there is soil on Mars because their definition only involves the loose material on the surface of a planet. Soil scientists and agronomists (scientists who help grow plants and crops) say that soil has life in it. By that definition, there is no soil on Mars because there is no life in it; no organisms, and it has not been influenced by life such as grass and trees." – **Clay, scientist**

"What is clay made of the soil component?" - **student**
"There are many types of soil minerals. Most clays belong to a special class of minerals that have special combinations of alternating layers of super thin aluminum and hydroxyls (oxygen and hydrogen) and silicon and oxygen." – **Clay, scientist**

"@Alex Are there any plants that don't grow in soil?" - **student**
Sure! there's a whole group of plants called "epiphytes" like orchids and bromeliads, that grow on tree trunks." – **Alex, scientist**

"That is cool what are some of the bacteria in the dirt?" - **student**
"There are millions of different bacteria in a teaspoon of dirt. The ones I'm most interested in are called Rhizobia and Frankia. Frankia makes one part of that smell of the soil after it rains, which is called "petrichor!" – **Alex, scientist**
"There are all kinds but I like nitrogen fixers and those that eat methane!" – **Mark, scientist**

"Is soil just from worms Mark and Ana??" - **student**
"@Robloxian Soil is not just from worms. Worms are good at taking big chunks of organic matter and breaking them into smaller chunks and binding them more tightly to soil mineral particles." – **Mark, scientist**
"@RobloxianSoil, worms live in the soil, but there are many many other animal, vegetal and microbiotics species living there. You would be surprised if you take a look of a piece of soil under the microscope!!!" - **Ana, scientist**

"@mark why is worm poop so good for plants?" – **Lance, student**
"@Lance - worm poop is good because the tough material left behind when leaves of plants die is converted in soil particles that bacteria like, which then provide nutrients plants like." – **Mark, scientist**

"Is there something like the yeast fermentation in dirt?" - **student**
"There are many different species of yeast, and many live in the soil. Yeast is the word we use for a fungus that only has one cell. The yeast that we use to brew beer or make bread lives in fruits in the wild." – **Alex, scientist**

"We have a prairie plant project coming up what are the best soils for prairie plants do you know?" – **Lance, student**
"Deep organic soils like those in the corn belt - it is no accident that in fact prairies and their animals made many of those soils." – **Mark, scientist**

Questions about other plant and environmental science topics

"@alex how have carnivorous plants evolved?" - **student**

“That's a great question! Actually, like nodulation, carnivory is a trait that evolved several times independently. In most cases, it evolved from plant defenses against insects and fungi (which have the same compound in their defensive walls), into the ability to eat insects!” – **Alex, scientist**

“Hey @Dr.Dirt how does photosynthesis work?” – **David, student**
“Photosynthesis is a process that goes on in chlorophyll (green part) in plant leaves. The chlorophyll uses carbon dioxide from the air and water the plant gets from the soil and transports through the xylem to the plant leaves. The chlorophyll captures light energy in the form of an electron and stores it in a carbohydrate or simple sugar that it makes from water and carbohydrate. It then transports those sugars to other parts of the plant as food for cells, or to store in a fruit, or as a vegetable.” – **Clay, scientist**

“How does wood grow on trees? What creates wood?” **– student**
“If you weighed a tree trunk, other than the water, more than 90% of the weight would have come from carbon dioxide in the air. That carbon dioxide is “fixed” into sugars by photosynthesis, using the sun’s energy.” **– Alex, scientist**

“@Clay How do venus fly traps digest their food?” – **David, student**
“@David Venus fly traps secrete their digestive enzymes (like your saliva and the stuff in your stomach) out of the lining of their flower, and digest the insect on the outside of the flower.” – **Clay, scientist**

“Do you think that GMO's Can harm humans because of all the modified genes?” – **Tyler, student**
“@Tyler no, there's no evidence for that at all, and there have been thousands of studies.” - **Alex, scientist**

“What do you think about GMOs ? @allscientists” – **Kaila, student**
“That's a very interesting and controversial question. I think you'd find many scientists with different viewpoints. My personal view is that there's nothing wrong with GMOs in themselves - they're no more "unnatural" than a chihuahua. However, many GMOs are designed specifically to deal with pesticides like RoundUp that might be harmful. So I don't have a problem with GMO technology, but I'm not a huge fan of how GMOs are used right now.” - **Alex, scientist**
“Chihuahua, hm very nice comparison. @alex” – **Kaila, student**

Questions about the scientists’ work

“What happens if food does not have nodulation would the food have the same color and taste?” - **Student**
“Many crops don't nodulate, but yes the partnership affects what compounds are in the food. Nodulating crops tend to be higher in protein.” – **Alex, scientist**

“How powerful is the electricity in the mud, (watts and amps,) does it not work like that?” - **student**
“Thanks! For the little mud batteries that we produce, people typically see about 100 microWatts or 300 microAmps coming out of them. This is a lot less than your phone or laptop consumes, but it is still enough electricity to power some small electronics, like LEDs, Clocks, and sensors for example.” - **Keegan**

“Do you ever focus on one plant or soil?” - **student**
“Yes I do focus on specific plants, currently I'm studying "Elaeagnus umbellata," or "autumn olive" which is a plant from Russia that grows around Michigan (and Minnesota too!). It's what we call "invasive" meaning it's from another place and disturbs the ecosystem where it grows. I'm interested in it because it forms the nodulation partnership with bacteria but is not related to most plants that do.” – **Alex, scientist**
“Could you answer this question if you didn't study roots what other part of the plant would you study?” - **student**

“If I didn't study roots I would probably study flowers, because I'm interested in how plants interact with other organisms and flowers are one of the other most important parts for that, since they attract pollinators like bees and bats.” – **Alex, scientist**

“MARK What is your favorite plant to study?” - **student**
“My favorite plant is the grass called Themeda that fixes nitrogen.” – **Mark, scientist**

“Would your work help animals?” - **student**
“My work helps animals because if we help the ecosystem resources upon which they depend (soil, water, and plants), we help them.” – **Clay, scientist**

“Mark what might you think in your work would help humans and environment today?” **- student**
“My work directly helps people in Africa because we have programs to help them manage their livestock to allow grass to come back, build soil and soil carbon. This makes their land more productive and they potentially can get paid for removing greeenhouse gases from the atmosphere.” – **Mark, scientist**

“Do you think your study on the plant roots can affect climate change and the greenhouse gases in the atmosphere?” - **student**
“For sure studying roots can have an impact in climate change. Every management practices, even in agriculture, can change a lot. For example, if the plants have more efficient root system and they can explore the soil better, we'll need to provide less fertilizers to them, what can help in avoiding water contamination, for example.” – **Ana, scientist**

Conversations like the following one were common and showed that the students had studied the scientists’ profiles and were then asking relevant questions with the scientists’ responses further informing and engaging the students through their knowledge and anecdotes.

“@Alex We saw in your profile that you study roots. What was the longest root you have found, and what was the plant? @Doreen” – **Victoria, student**
“The longest root in the world, I believe, is the Mesquite tree, which can have roots going down over 200 feet.” – Alex, scientist
“200 feet is a lot. Have you ever dug the tree up?” – **Victoria, student**
“@Alex really that is really deep.” – **Doreen, student**
“@Doreen sure is! Mesquite lives in dry places like the American southwest, and needs those deep roots to reach water. @Victoria, no I've never dug them up! The deepest I've ever dug was to pull a maple tree out of my friend's yard ☺.” – **Alex, scientist**
“Thats funny if you have dug the tree up I would have to give you a lot of credit because 200 feet is a lot.” – **Victoria, student**

Questions about careers

“Did your mom and dad support you wanting to be a scientist or did they want you to be something else @keegan @alex” - **student**
“That's a great question (everyone has such great questions). My parents didn't really know much about science or scientists, so they kind of just let me lead that path for myself. They weren't opposed to it though, because they saw that gave good opportunities for jobs.” – **Keegan, scientist**
“I've been lucky to have a supportive family, but I know many scientists who have families who don't understand or support what they're doing.” – **Alex, scientist**

Questions about being a scientist

"Why are you a scientist." - **student**
"Several of you asked why I am a scientist. I am curious, and that is why I became a scientist. I am curious about the natural world, why and how it works, and how all the parts work together." – **Clay, scientist**

@Ana, when did you become interested in soil" - **student**
"I became more aware of the importance of soil and the real meaning of a healthy soil since I am working in my actual position here in Oklahoma. I am now in contact with people that work in agriculture and with farmers, and I realize how important for the plants is to explore the soil in a more efficient way, and how important for Humans is to keep the soil healthy. Soil is what feed us, I mean, the plants we grow in it and the animals we feed with this crops." – **Ana, scientist**

"What is the worse possible mistake you can ever make?" – **Musa, student**
"The worst thing you can do as a scientist is be dishonest. Scientists have worked really hard to be respected for their honesty. Sometimes its hard for scientists to admit they didn't find the answer they were looking for, but you have to stick to what the data tell you." – **Mark, scientist**
"Thanks, Mark" – **Musa, student**

Questions about the scientists

"Do you know how many times you succeeded and failed before any of you?" - **student**
"I'm sure we've all failed many times before, part of being a good scientist is learning from your mistakes, picking yourself up and trying again." – **Alex, scientist**

"What did you guys do to combat high school stress?" - **student**
"I find that meditation, yoga, and exercise - anything that clears your mind - helps combat stress." – **Alex, scientist**

"What do you do on your spare time @keegan" – **Nikolas, student**
"I usually try to get some exercise, like going swimming or biking. Other than that, I try to sneak in a quick video game once in a while" – **Keegan, scientist**

Are you the only scientist in your family? @keegan" – **Sheila, student**
"Yes, I'm the only scientist in my family. My wife is a scientist too though and I suppose she is part of my family now, hehe." – **Keegan, scientist**
"What kind of scientist is ur wife? @keegan" – **Sheila, student**
"My wife works on the crazy chemistry of plants (plants have some crazy abilities). She makes them glow green, hehe." – **Keegan, scientist**

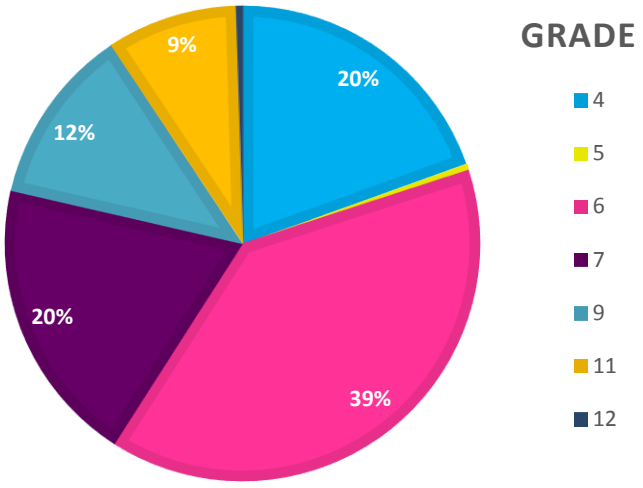
On many occasions student questions about the scientists and their personal interests led to interesting conversations about soil and science.

"where is your favorite part in the world mark?" – **student, 937sscb22**
"@937 My favorite place is Ngorongoro Crater - imagine an entire national park in the bottom of a huge volcano." - **Mark, scientist**
"Is the soil there good?" – **student, 899sscb23**
"@899 The soil varies a lot because there are a lot of recent volcanoes. Where there is recent ash deposits and lava the soil is very good. In sandier areas far from volcanoes, the soil is some of the poorest in the world." - **Mark, scientist**

Schools and students

Schools and students taking part in the Soil zone

- Minnesota Center
- Hayden Meadows Elementary
- Pasco Middle School
- Abbott Middle School
- Rockford Env Science Acade...
- Mar Vista Academy
- Carrie Downie Elementary
- Clarkstown High School North
- St Mary's School San Francis...
- Garth Webb



Percentage of students participating by grade.

(Data based on pre-event survey responses from 215 students.)

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Scientist winner: Alex Taylor

Alex's plans for the prize money: "*Build an interactive activity for museums, zoos and botanical gardens to show people how important and amazing nodulation is and write about my research on my blog "Thought and Awe."* Read Alex's thank you message.

Student winner: Ryan, Carrie Downie Elementary

For great engagement during the event, this student will receive a gift voucher and a certificate.

Feedback

Here are a few of the comments and tweets made during the event and in the post-event survey…

"Omg thank you guys sooooooooo sooo much for answering my questions, you guys are the best!!!" – **Jade, student**

"Well, we're leaving, You guys are the best! I also like your jokes in your profile! ☺" – **student**

"Sounds like you are real genuine person @alex" – **Karissma, student**

Mark : @Robloxian I entered this "competition" to learn more about how to commuicate science with students of a variety of grade levels. I want to win because I really want to start an afterschool science club at two local middle schools because the students there have relatively little exposure to science. x

Clay, aka Dr. Dirt : @Roblixian It would be cool to win, but I did not enter to win. I entered to have a chance to talk to students about soil and being a scientist. x

Mari Venturino
@MsVenturino
Following

We are having SO much fun! Students love asking real scientists questions. Thanks @MudWatt and @ATayters

Neon Monkey : Being a scientist sounds like fun

"Thank you so much! We've had a great time!" – **Liana Gertzer, High School teacher**

"The students really liked talking with the scientists. This made it more real for the students!" – **Becky Strand, Middle School teacher**

"Next time, if I could, I would schedule the chat in the first week so as to allow students to meet the scientists earlier." – **Liana Gertzer, High School teacher**

"Wow! Great Q&A!!! #proudteacher from Atlanta." – **Becky Strand, Middle School teacher**

"Thanks everybody for your questions!!! That was awesome!!!" - **Ana, scientist**

"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!" – **Alex, scientist**

Isaiah : I hate that we have to leave why can't we do this every day 😢 😢 😢 😢 😢 😢 😢 😢 😢 😢 😢 😢 😢 😢 😢 😢 x

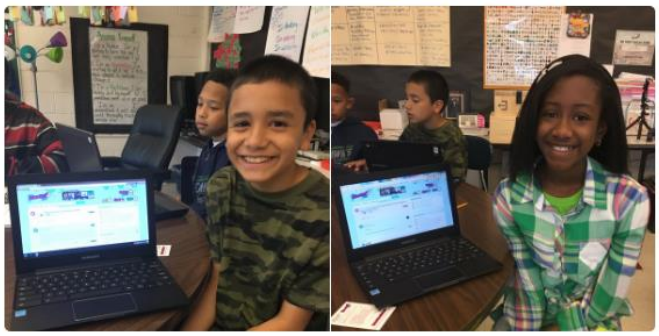
marielleventurino : Thank you @Alex and @Keegan for taking time to answer our questions! My students and I had a blast this morning! Thanks

Alex Taylor
@ATayters
Following

Fun answering students' questions for #imascientist #soil zone! Really makes me take a step back @imascientistUS

Ms. Burke's Class
@Daring_Dolphins
Following

Finding out your @imascientist question got answered by a real scientist = great start to the day! #cddolphins



We're all having a great time participating in @imascientist ! #cddolphins

Mari Venturino
@MsVenturino
Following

.@imascientistUS When's the next round? Can't wait to do this again with my students!