

David Walker's Arctic adventure



David Walker, a TCTA member since 2012, works in a permafrost pit on Alaska's North Slope in June 2019 to collect samples for researchers studying carbon in the Arctic. Photos courtesy of David Walker and PolarTREC

TCTA member gets hands-on experience through PolarTREC research during a month in Alaska, applies lessons to enrich his classes in Austin

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David Walker, a longtime member of TCTA, embraces project-based learning. As a science teacher at Austin ISD's Liberal Arts and Science Academy for the past 10 years, he encourages his students to engage in the world around them, organizing field trips and year-long field research projects at area parks. The experiences help him teach organism identification, geologic and topographic mapping, field geology and biology, along with the geobiological history of Central Texas. The rigorous academic expectations at LASA, a magnet high school, give Walker an incentive to enrich the classroom experience for students in his geobiology and organic chemistry classes.

"I love the challenge of learning subject matter in the comprehensive, detail-oriented manner required to teach it well," Walker says. "It's also exciting to realize that my own learning is constantly driven by the great questions my students ask."

"Every year I teach represents a clean slate. I am free to experiment with new teaching methods, classroom management strategies and techniques to explain concepts. I can change the pacing of my course, remap the order of my units, even restructure the units themselves," Walker adds.

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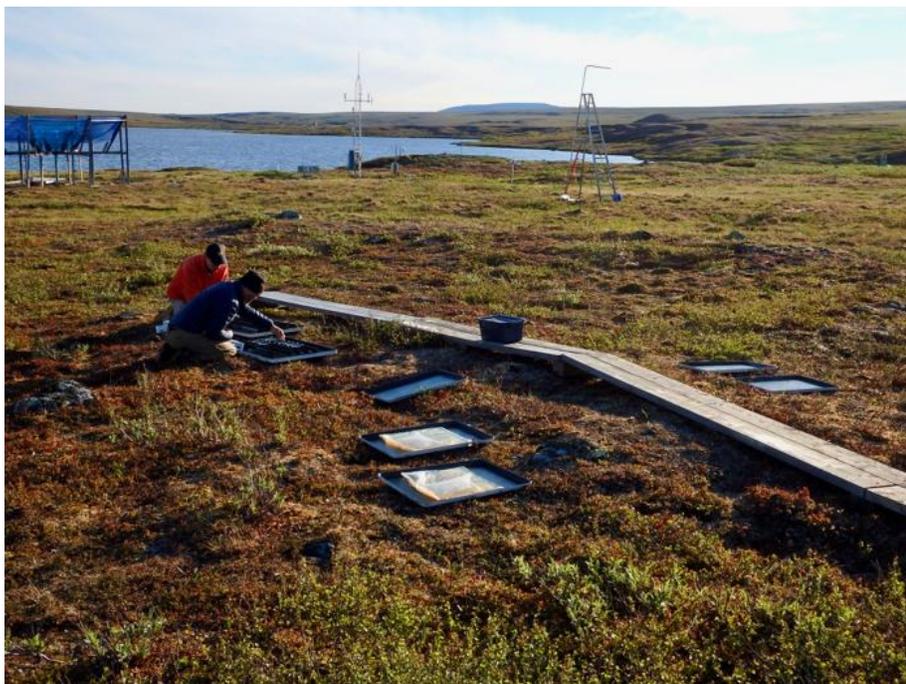
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Researchers prepare trays that will be used to expose soil samples to sunlight.

Carbon and climate science

He gains experience and refines his teaching methods through his own hands-on learning. In June 2019, Walker spent a month at Toolik Field Station in Alaska's North Slope, helping scientists with their research studying carbon in the Arctic.

Researchers led by Dr. Rose Cory of the University of Michigan are working to understand how microbes and sunlight interact. As permafrost soils thaw, large amounts of carbon are released from land to water, and they are studying the impact this has on the global carbon cycle and the warming of the planet. Walker helped collect soil samples, which were studied to see how exposure to sunlight affects the rate at which the dissolved organic carbon in microbes converts into carbon dioxide.

The PolarTREC project directly aligned with Walker's research interests and the content of the courses he teaches. "Permafrost science is rooted in geology, and the process by which organic compounds from thawed permafrost are converted into carbon dioxide by microbes and sunlight directly concerns biology and organic chemistry," he says. The experience helped Walker improve his understanding of climate science and the effects of climate change.

"As a science teacher, I was aware of positive feedback loops in the Arctic prior to this experience. I was not aware of how severe these feedback loops are, nor was I aware of the role of sunlight in the Arctic in exacerbating them," Walker says. "The summer months in the Arctic are of huge importance when it comes to climate change. Arctic permafrost is melting at an unprecedented rate, unlocking large amounts of organic carbon. As Dr. Rose Cory and her team discovered, microbes and sunlight work together to break down the organic compounds released by thawing permafrost into carbon dioxide. This contributes directly to global warming."

Walker says current climate models don't account for the rate of this large-scale thawing that takes place during Arctic summers. He hopes Cory's research and the work of other scientists in the area will help change these models.



David Walker spent June 2019 at Toolik Field Station in Alaska.

Engaging experiences

Spending part of last summer in Alaska was not Walker's first hands-on learning experience. He actively seeks out summer field study and professional development opportunities for science teachers.

In 2015, he participated in a program through the National Oceanic and Atmospheric Administration called Teacher at Sea. "I was able to assist with a SEAMAP groundfish, plankton and hypoxia survey in the Gulf of Mexico," Walker says.

In 2016, he traveled to Antarctica with National Geographic and Lindblad Expeditions through their Grosvenor Fellowship for teachers.

In 2017, he participated in research in Baja California with Ecology Project International as part of a fellowship for teachers.

"These experiences have helped me learn a lot more about what I teach, and each of them has led to new ideas, more creative lesson plans and projects, and meaningful connections in the scientific community," Walker says.

During his Arctic adventure last summer, Walker kept in contact with many of his students, posting journal entries and field notes with questions for them to answer and sharing insights from the professional scientists he was working alongside through livestreams and videos. Since returning to Austin, he's continued to share that experience in his classroom.

"The knowledge I obtained through PolarTREC has made it much easier to educate students about the anthropogenic climate crisis. This is a large part of the first unit of my Planet Earth course, and I have been able to incorporate so much of the media I collected from the Alaskan Arctic to further engage my students," Walker says.

Students in his organic chemistry course conduct experiments drawn directly from the research at Toolik. In one activity, students are exposed to photooxidation, one of the main pathways by which organic molecules in Arctic streams are exposed to sunlight and oxidized into carbon dioxide. The amount of photooxidation results in photobleaching, in which streams slowly lose their color, Walker says. "To mimic this process, students expose brewed tea to sunlight and analyze for photobleaching using a spectrophotometer."

In a second activity, students are introduced to Van Krevelen diagrams, which Walker says are used to interpret results of high-resolution mass spectrometry and characterize the compound classes seen in complex organic structures. His students create Van Krevelen diagrams to analyze a sample of stream water in Central Texas. Their experiences this year and the questions they pose as they learn will help Walker refine how he teaches his next group of students.

"This is what teaching is for me: constantly evolving, never perfect, but never stagnant. I relish this process, which is why I plan to remain an educator for the rest of my career. Every year that I teach, I will make a concerted effort to continue to develop, learn from feedback, incorporate new professional development experiences, and make my courses more interesting and meaningful for my students."



PolarTREC connected David Walker, at left, with researchers at Toolik Field Station in Alaska.

Field Notes

David Walker's summer in the Arctic Circle was filled with adventure. Walker is an avid bird watcher, and the trip gave him an opportunity to see several species for the first time. He also had opportunities to help with other research being conducted in the area, spending one day helping build green houses and another trapping ground squirrels. In a place where the sun never sets, it's very easy to lose track of time, and he says he had to remember to sleep.

"Toolik over the summer gets a bit cold at times, but no worse than winter in Austin," he says. "It's beautiful and green. The weather can change quite rapidly, though; when preparing for a day in the field, I would bring most everything I had in my closet in a large backpack. On one day on the tundra, we experienced hot sun, followed by rain, followed by sleet, followed by snow, and then sun again. Lots of critical costume changes were required."

Walker kept a journal of his PolarTREC experience, sharing videos and lessons with students. The entries are archived at <https://www.polartrec.com/expeditions/carbon-in-the-arctic>. He encourages other science teachers to explore his resources and integrate them into their classrooms.

The researchers he worked with at Toolik Field Station continue to provide feedback on the lessons and projects he developed, and Walker says he plans to submit one of his lessons for publication to reach a wider audience.

PolarTREC connects educators from across the U.S. with scientists conducting research projects in the Arctic or Antarctica. Educators in all science, technology, engineering and math disciplines can apply for the STEM at the Poles program. 2020 project deadlines have passed, but interested teachers can learn more about opportunities in 2021 as well as explore entries and resources from previous trips at polartrec.com.

Walker encourages other STEM teachers to apply. "PolarTREC challenged me to learn much more about the subjects I teach, facilitated the development of career relationships with research scientists, and invigorated my teaching practice with new skills and ideas."



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