Discoveries in Safety™

2024

Engaging the Future of Safety Science

How UL Research Institutes' **Xplorlabs Educator Fellows** are transforming their classrooms

UL Research Institutes | Research Experiences & Education

Xplorlabs Educator Fellowship

The Office of Research Experiences & Education believes that scientific inquiry in the context of real-world phenomena builds the foundation for a safer, more sustainable future where people are equipped with knowledge and skills to think critically about the world around them.

The Xplorlabs Educator Fellowship provides professional learning experiences with peers and leaders in education as well as UL Research Institutes safety science experts. The yearlong program includes an active cohort of secondary classroom and informal educators from across the country.

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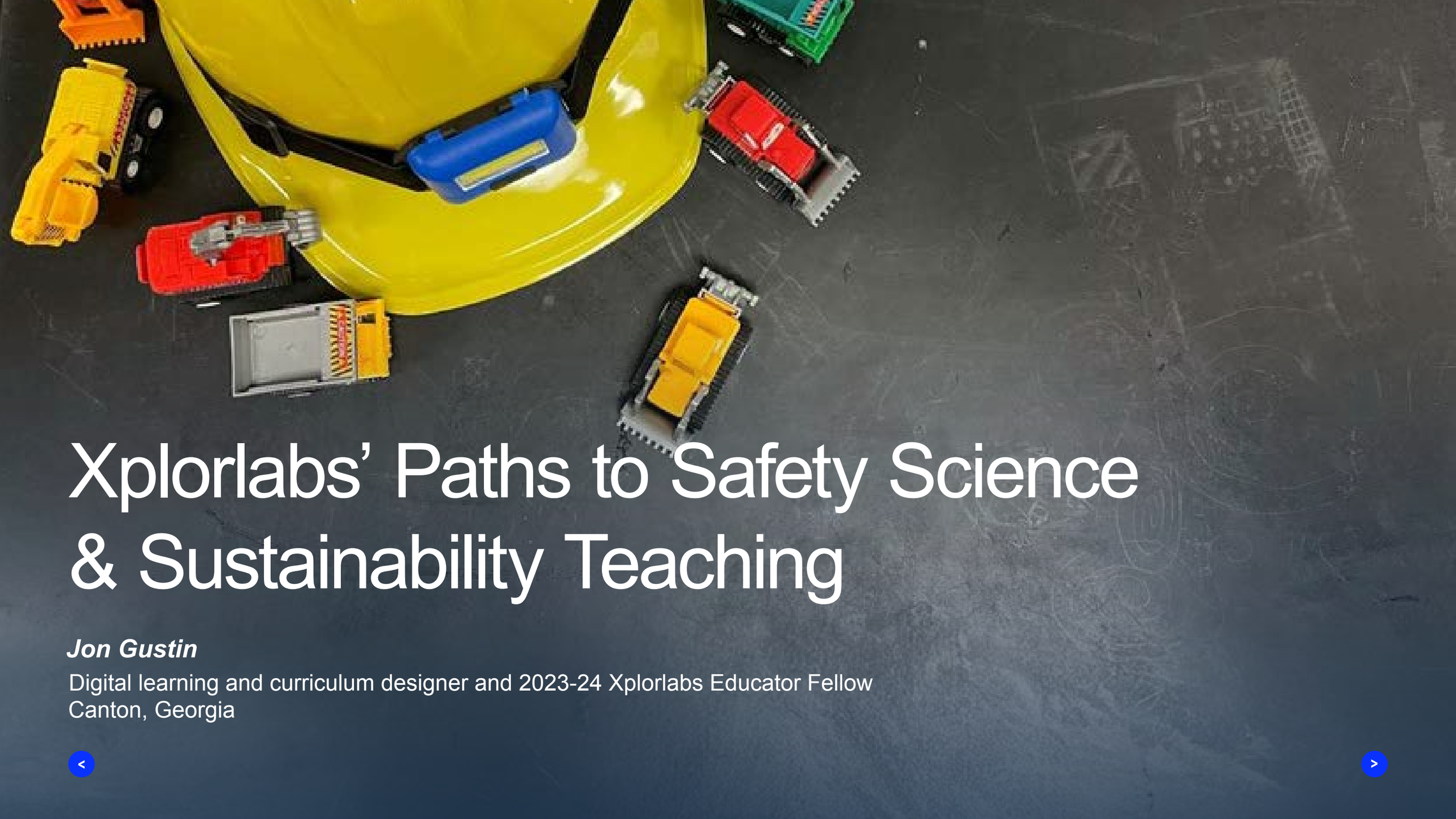

Xplorlabs' Paths to Safety Science & Sustainability Teaching

Jon Gustin

Digital learning and curriculum designer and 2023-24 Xplorlabs Educator Fellow
Canton, Georgia

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My pathway to transformative teaching

Through my lens as a digital learning curriculum designer with 17 years of hands-on experience in the science classroom, I'm deeply committed to transforming education. My journey, rooted in student-centered and inquiry-based learning, has taught me the power of blending traditional teaching with digital innovation to make learning more engaging and relevant.

Collaborating with Xplorlabs, created by UL Research Institutes' Office of Research Experiences & Education, has enabled me to extend this approach, integrating amazing digital resources to deepen and diversify the learning experience for students and educators alike. This collaboration has been pivotal in refining the pathways I design for educators, enabling them to explore these topics at their own pace while staying grounded in rigorous inquiry and practical application.

My goal is to inspire educators and students alike to embrace inquiry, critical thinking, and collaboration, preparing them for the challenges of tomorrow's world.

Guiding educators toward empowerment and innovation

As I navigate the rewarding role of coaching educators through the exploration of sustainability and safety science, particularly through the lens of lithium-ion batteries with Xplorlabs, I'm constantly reminded of the transformative journey we're on together. This process isn't just about expanding our students' horizons; it's about fostering growth and confidence in educators, encouraging them to step into more student-centered and inquiry-based teaching models at their own pace.

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Bridging knowledge with inquiry

For my teachers and students, diving into the world of lithium-ion batteries using Xplorlabs' Science of Thermal Runaway has been a gateway to critical thinking and active engagement with global sustainability issues. This exploration goes beyond traditional learning, empowering teachers and students to connect the dots between technological advancements and environmental stewardship. It's thrilling to see students question, explore, and contribute to complex discussions, preparing them to be the problem solvers of tomorrow.

Every activity serves as a stride toward grasping the significance of Earth's resources and our crucial shared responsibility in managing them with care. Each of the Xplorlabs pathways caters to educators at various stages of their professional journey, recognizing that some may be more accustomed to inquiry-based methods than others. However, as the activities advance, the emphasis shifts toward enhancing the educational journey for both teachers and students alike.

Supporting educators on their journey

For me, the true joy comes from supporting fellow educators as they navigate this transition. Whether it's integrating real-world issues into their curriculum or adopting new teaching strategies, I've seen firsthand how transformative this journey can be. Educators can find a comfortable pace for incorporating student-centered learning into their classrooms by starting with structured activities and gradually introducing more open-ended inquiries.

A pathway for everyone

Understanding that not all teachers are ready to dive headfirst into student-centered and inquiry-based models, I've embraced the challenge of developing diverse pathways to support teachers who are at different levels of experience and comfort. These options allow educators to gradually expand their teaching practices, incorporating more student-led investigations and discussions as they grow more comfortable.

Each pathway is thoughtfully designed to meet teachers and students where they are, providing avenues for growth, exploration, and deepened understanding. By offering varied levels of inquiry and engagement, these pathways ensure that learning becomes a shared journey of discovery, sparking lasting interest and motivation across the educational spectrum.

Embracing professional growth

Educators have found Xplorlabs to be a valuable resource for professional development. One teacher said that this was the best professional development they had all year. Through Xplorlabs' rich content and interactive nature, we've been able to refine our teaching methods, share insights with peers, and collectively push toward a more inquiry-driven approach to education.

The dual benefits of Xplorlabs — enriching student learning while advancing teacher expertise — highlight the platform's role as a catalyst for educational innovation and collaborative growth. Together, we're not just navigating new educational territories; we're reshaping the future of teaching and learning.

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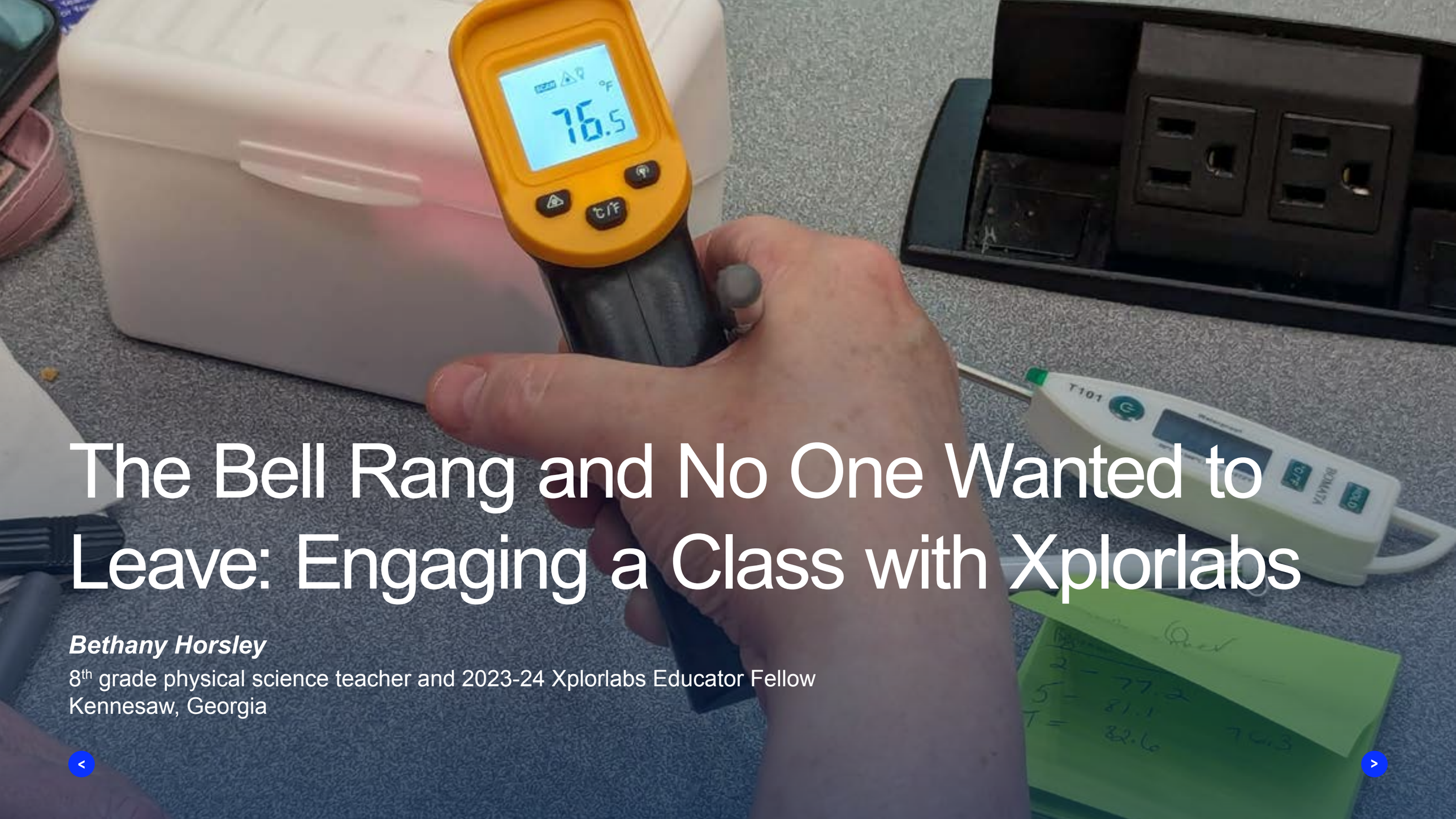

The Bell Rang and No One Wanted to Leave: Engaging a Class with Xplorlabs

Bethany Horsley
8th grade physical science teacher and 2023-24 Xplorlabs Educator Fellow
Kennesaw, Georgia

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Engaging students in eighth grade STEM standards can be a challenge. To combat the lack of interest I so often saw, I decided to teach heat transfer by popping popcorn in different ways. This seemed like the ideal way to engage my students and allow them to see all the different types of heat firsthand.

This was going well until the popcorn on the stove started to burn the pan. Smoke was everywhere, and my principal was less than thrilled. However, she loved the fact that I was enthusiastic about trying to give my students an authentic experience with heat transfer. A couple weeks later she came and asked me if I would like to attend a professional development workshop about fire forensics. This is where I first learned about UL Research Institutes' Office of Research Experiences & Education and Xplorlabs.

During my training, I quickly realized how much Xplorlabs had to offer in my classroom, and I could teach heat transformations in a whole new way. My students talked about the fire forensics experience the entire year. Not only were they engaged, but they remembered how heat transfers.

My love of Xplorlabs continued to grow as more pathways were added to the website. In 2023, I was asked to apply for the Xplorlabs Educator Fellowship. I knew this experience would allow me new opportunities to teach my standards in a way that provides my students with a real-world problem and the challenge to solve it. This would also be a way for me to grow as an educator.

How Xplorlabs connects to real-world phenomena

Lithium-ion batteries have become a hot topic. This started when hoverboards became a popular gift for kids, but we saw headlines of some bursting into flames. To help students understand the importance of battery safety and the potential fire risk surrounding lithium-ion battery devices, Xplorlabs created a pathway called the Science of Thermal Runaway. I dug a little deeper, attended training, and decided it was the next Xplorlabs pathway I would implement in my classroom.

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Implementing a pathway in your classroom

Together with the Xplorlabs Educator Fellows, I designed lessons to teach my students about thermal runaway. Our daily classes looked like this:

Day 1: The pathway starts with an interactive video that looks at an electric scooter as it charges. Using a “See, Think, Wonder” graphic organizer I created, I had students write down observations and questions about the video.

Day 2: My students were challenged to create a container that would prevent the temperature from increasing. In collaborative groups, the students designed, built, tested, and re-built containers. They each had a set job, and they took that job seriously. They love a challenge and truly enjoyed attempting to build a container that would work.

Day 3: The last part of the assignment involved writing about their experience and defending their build. The beauty of this was seeing the vocabulary I wanted them to learn being used correctly throughout their writing.

“Students didn’t want to leave”

It didn’t take long after starting the thermal runaway pathway to see that my students were extremely interested in the lesson. It was one of the lessons where the bell rang and the students didn’t want to leave. At the end, it was so encouraging to see how dedicated these students were to their work and their learning.

A new professional challenge after 20 years of teaching

The fellowship has challenged me to continue to pursue new things and to be a better teacher. This is my 20th year of teaching. I would lie if I said that some things haven’t become routine. I could easily use the things I used 10 years ago, but my students are not the same as the students I had back then. I hope that as you read this, you will be inspired to step out and try something new.

All students should have the opportunity to learn science practically. The more that we teach our students how to solve problems and that it’s ok to fail because you are going to rebuild it and give them authentic experiences, the more it deepens their understanding.

Xplorlabs and Future City: Two Programs, One Goal

Travis Koupal
Science 8/STEAM Program Lead, Future City Coach, and 2023-24 Xplorlabs Educator Fellow
Minneapolis, Minnesota

What a long, not-so-strange trip it’s been

September 2010: I’ve just started at a new school, and I need to create a “flex” class to be taught every day. I pilot a few ideas, but none really stick with students or myself. Then, the moment that changed everything — a little postcard in my mailbox addressed to “Science Teacher” for a program called Future City, a worldwide engineering and city planning competition. Nothing has been the same since.

Fast forward eight years later. My involvement with Future City has not only grown, but I am now in regular communication with Future City’s national office. They tell me about a partnership they have established with UL Research Institutes’ Xplorlabs, which features interactive and immersive safety science lessons and resources. I found out Xplorlabs was seeking Future City educators to act as ambassadors to try these free resources and share their findings with other educators.

Excited by what I see in this free safety science education resource, I immediately begin using Xplorlabs in my classroom.

Then COVID happened in 2020. COVID essentially ended the Ambassador Program but not my interest in Xplorlabs. I continue to teach Future City and Xplorlabs during and after the pandemic.

Now we arrive in 2023. An email inquiring about the old Ambassador Program leads me to ULRI’s Office of Research Experiences & Education launching the Xplorlabs Educator Fellowship. I am just beginning to integrate Future City with Xplorlabs for the first time, and the yearlong fellowship seems like a fabulous way to make that connection more explicit, concrete, and meaningful. I apply, find myself accepted, and I am ready to get to work in April 2023.

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A fellowship in three words

1. Engagement

The engagement of middle school students in any topic revolves around one thing: themselves. They need to see how what is being taught benefits and relates to them personally.

That connection to their own lives is easy with Xplorlabs and Future City. One example of this: a battery storage facility being constructed an hour from my students' home city of Minneapolis. Students saw and understood the need for electrified cities of the future to not only generate power via renewable sources, but to also store that power safely for later use via massive battery arrays. The connection was so apparent that they added a similar facility to their Future City design.

My students also made many connections between the safety science phenomena in Xplorlabs and their day-to-day lives, ranging from the phones in their pockets to the AirPod in their ear (usually only one) to the laptops on their tables. Xplorlabs' learning topics like the importance of battery safety and responsibly sourced minerals for batteries were also incorporated into their Future City design solutions. In other words, they applied learning to a new situation. This is the gold standard to assess student learning and understanding of content, and they nailed it.

2. Enrichment

When students incorporated learnings from Xplorlabs into their Future City project, they were able to make connections to their own lives. Students were motivated to question and understand the relationship to their home, neighborhood, and community experiences such as mining operations in northern Minnesota and the Thacker Pass Lithium Mine in Nevada. Through Xplorlabs, students gained greater understanding that there are risks and trade-offs to nearly everything and were also able to understand and articulate lithium-ion power and storage using technical vocabulary from the Xplorlabs pathways.

3. Enlightenment

This one is about me. Safety science casts a wide net in relation to STEAM content and disciplines. STEAM creates the built world around us, and without safety science, that world becomes infinitely more dangerous. It is one thing for me to see those connections, it is another for students to see them. I did not need to make all those connections explicit — students were even better at making those connections themselves. This superpower of middle school students — to see the world in such a unique way as compared to adults. My work integrating Future City and Xplorlabs was a powerful and enlightening reminder of that superpower. I don't know why I didn't use Xplorlabs and Future City in combination long ago. These "a-ha" moments were always there, and I missed them for too long.

Cool stories, bro. What do you expect me to do with all of this?

I know it can be hard to take on something new. After 18 years, trust me I know the game and what it takes to not only survive in the classroom, but also be successful. It took me years of work to find these successes, but that timeline is in no small part because I had to figure it all out myself. You don't.

Future City and Xplorlabs both contain scaffolds and resources to help guide you on your journey. You can take on as much or as little as you are willing and able to manage, and there is so much room to grow. Don't just take my word for it: visit FutureCity.org to discover more about Future City, or check out one of the Xplorlabs pathways at Xplorlabs.org to see for yourself.

I guarantee if you incorporate Future City and Xplorlabs into your middle or high school classroom, your class will not only be the "cool, fun class," but more importantly, a class where your students will be engaged and enriched, and you will be enlightened to what they can do and "show what they know." I dare you to prove me wrong.

Safety Science Engineering: A Catalyst for Reducing Lithium-Ion Battery Risks

Charles Sabatier
High school engineering pathways teacher and 2023-24 Xplorlabs Educator Fellow
Oxford, Mississippi

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In 2023, I learned about safety science by participating in the first cohort of UL Research Institutes' Xplorlabs Educator Fellowship. I always had a focus on safety in my classroom, but during this yearlong fellowship I learned about the science of safety and how to get my students involved in learning about this exciting area of research.

The big electric vehicle project grant

In the fall of 2022, I was awarded a $5,000 grant through the Tennessee Valley Authority to modify a two-seat pedal cart into an electric vehicle powered by a large, 52-volt lithium-ion battery and recharged with a 200-watt solar panel. My second-year engineering students identified a variety of engineering challenges that had to be solved to complete this project. One of the first things we focused on was safety, specifically ensuring we didn't burn our building down as my students explored content on potential thermal runaway and fire risks in malfunctioning hoverboards. Much of this content was even new to me as I had not worked with batteries and solar panels this large before.

The Xplorlabs solution

It’s funny how learning works sometimes. As I began losing sleep about thermal runaway risks, a friend told me about a new fellowship opportunity for teachers sponsored by UL Research Institutes’ Office of Research Experiences & Education that helps bring safety science learning into the classroom through an interactive learning resource called Xplorlabs. While I had heard of both UL Research Institutes and Xplorlabs, I didn’t know much more than that before becoming a ULRI Xplorlabs Educator Fellow.

The first activity of the fellowship was to explore the Xplorlabs pathways on thermal runaway, extraction to e-waste, and fire forensics. While this did not solve my lithium-ion battery anxiety, it did provide me with a wealth of information and resources to help my students learn about the primary concern surrounding lithium-ion batteries — thermal runaway.

As part of the fellowship, I got to attend the 2023 ULRI Research Symposium at Northwestern University to learn about cutting-edge safety science research being conducted at UL Research Institutes. This also included a tour of a UL Solutions lab where they test the same lithium-ion batteries we were using in our electric vehicle. I returned to school jazzed to start planning the electric vehicle project, which would now include teaching students about new-to-me potential careers in safety science as well as helping them develop a plan to safely work with our lithium-ion battery. You know, to not burn down the building.

Putting it all together

The final EV project for my second-year engineering students allowed them to identify a variety of problems in converting our pedal cart into an electric vehicle. Most relevant to my work in the fellowship was the science of safely using, charging, and storing a large lithium-ion battery. Students used the engineering design process to attach a 1,000-watt electric motor to our pedal cart; 3D print parts to connect the throttle, digital display, and speed sensor to the cart; and create a safety manual for both operating the vehicle and working with the lithium-ion battery and solar panel. Students recommended the location for mounting the battery to best protect it and learned to adjust the parameters of the solar panel to safely charge the battery.

To learn more about lithium-ion battery storage, charging, and safe use, I encourage you to use and teach Xplorlabs in your classroom — the Science of Thermal Runaway pathway is a great way to get started!

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Yes, Your Students Can Explore the Science of Fire — *Safely*

Ethan Schubert
Chemistry teacher and 2023-24 Xplorlabs Educator Fellow
Chattanooga, Tennessee

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“Stop planning, we have everything we need for our class right here.”

That was the call I made to my co-teacher after learning about Xplorlabs for the first time in 2022. I heard about UL Research Institutes’ Xplorlabs through a contact at the Chattanooga Fire Department in Tennessee who wanted to collaborate on a training at my school with firefighters and my co-teachers. I was surprised at how much of the Xplorlabs content directly related to the standardized content of my chemistry class. In the call I made to my chemistry co-teacher, I explained how this new tool had everything we needed to plan our first unit.

Since that day, I have been using Xplorlabs to engage students in culturally relevant scientific phenomena, connecting with their community, and leading the inquiry process.

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Students blossomed once we started using Xplorlabs

In our first year implementing Xplorlabs at Brainerd High School, we continued our partnership with the Chattanooga Fire Department, allowing students to conduct experiments alongside firefighter mentors. Students in our target group blossomed. Class attendance skyrocketed, personal connections with community members began to form, and students who participated in the intervention group performed at the same level as the honors chemistry sections. This is why Xplorlabs continues to be a highlight of many students' experiences.

In the Chattanooga science teaching community, we have been wrestling with the problem of phenomena not engaging students in the same way it has in the past. In our curriculum planning, we have carefully selected engaging moments of science that students could interact with meaningfully, provided students with a common entry point, and be explained as they learned. Since 2020, we have seen that the phenomena doesn't "slap" the way it did before; students are no longer dropping their jaws when they observe chemical compounds as solids, liquids, and gas all at once.

To begin tackling this issue, we expanded the use of Xplorlabs and added to our fire forensic mentorship by exploring the safety hazards facing lithium-ion batteries, such as overheating, also known as "thermal runaway," in our science classrooms. The phenomenon of thermal runaway is when a lithium-ion battery cell has been damaged in a way that leads to a malfunction of the battery management system. The battery then overheats to a point that other battery cells can also overheat and start a fire, potentially leading to an explosion. We also saw an opportunity to give students a chance to explore new careers by partnering with The University of Tennessee at Chattanooga's College of Engineering and Computer Science. With UTC professors on-site, we watched real lab footage of a hoverboard catching fire to launch Xplorlabs' Science of Thermal Runaway pathway, and my students could not contain themselves and even shared personal experiences of their own hoverboards, their friend's e-scooter, or a similar video they saw on social media.

Students then asked questions and generated their own wonderings before we could even get to the driving question board. After this first connection, the professors were impressed at how complex the student-prepared explanations were and the kinds of questions they asked. Students then got to work exploring and connecting classroom content to the hoverboard video. Eventually, students began an engineering design challenge to create a safe protection device for a lithium-ion battery.

> This type of teaching is the kind that I feel changes the lives of our students for the better.

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The level of confidence students began to show in their own abilities was inspiring, and many expressed their excitement to connect with the UTC professors and share their designs.

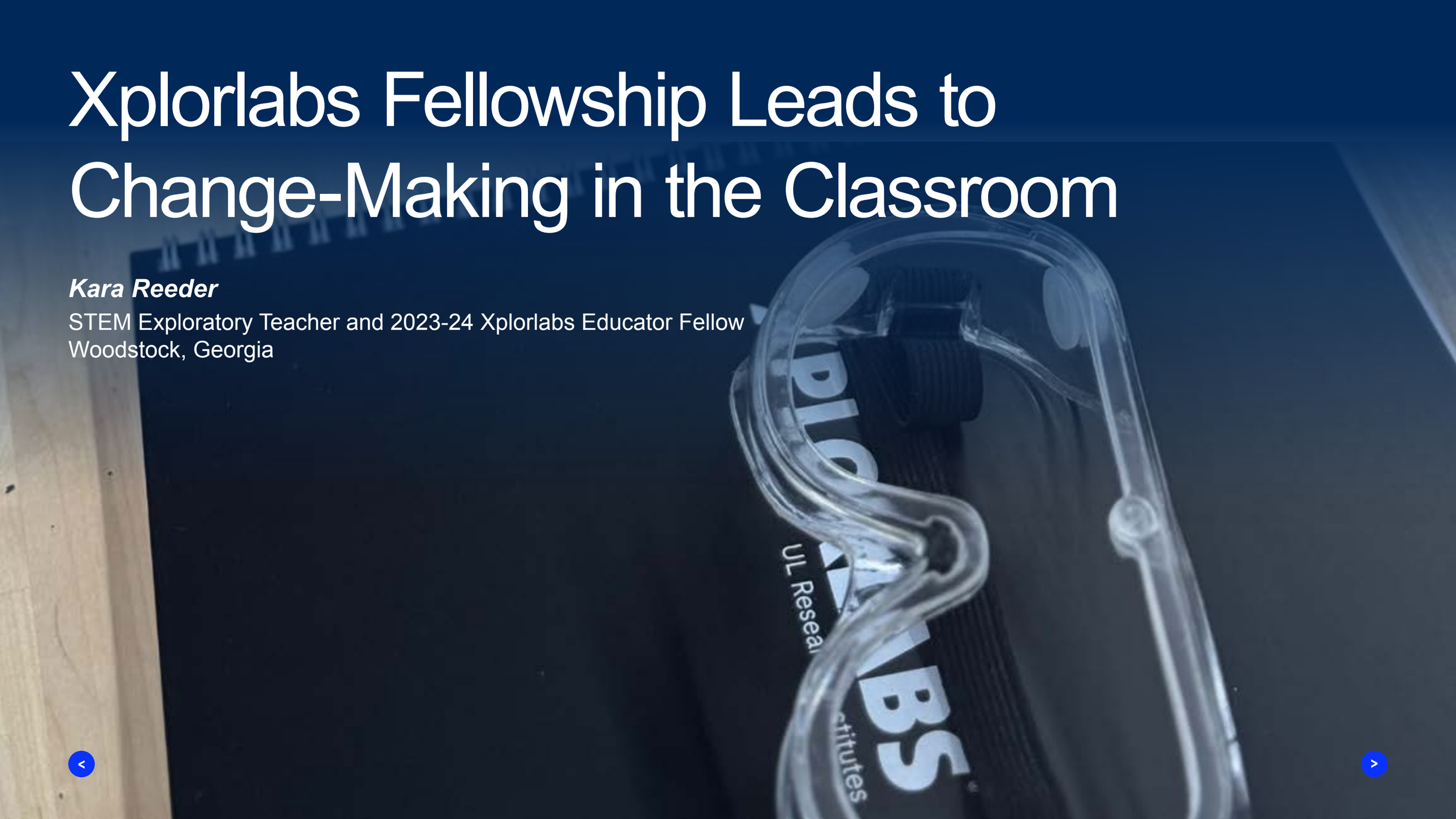
When implementing both the fire forensics and thermal runaway pathways, students began feeling a sense of belonging and connection to these career professionals that has turned some students toward careers they never saw themselves in before. Some students switched declared majors to engineering, other students switched from no college to applying to our local schools, and a third group applied for jobs at our local Volkswagen plant to work in the new electric vehicle lines.

I also stumbled across a surprising social phenomenon as we used Xplorlabs. The students' understanding and learning of the content was demonstrated outside of the lessons as well. I observed one of my students who asked to borrow her friend's laptop charger. When she got the charger, she noticed it wasn't the correct wattage and off-brand, and proceeded to inform her friend why her charger was not safe to use. She used evidence from Xplorlabs' thermal runaway pathway to explain how an off-brand charger with a different battery management system can cause abusive overcharge of her device and damage the laptop's battery, potentially leading to fires.

I believe student application of learning to their daily lives is the strongest aspect of safety science. Students can make choices and educate others. This type of teaching is the kind that I feel changes the lives of our students for the better. I am encouraged by how much each student is engaging with their community and using their learning to improve that community.

Xplorlabs Fellowship Leads to Change-Making in the Classroom

Kara Reeder
STEM Exploratory Teacher and 2023-24 Xplorlabs Educator Fellow
Woodstock, Georgia



As a STEM educator, my role is to make learning meaningful through real-world, authentic, and engaging lessons. However, finding topics of interest that hook the attention of a middle schooler is not easy. Xplorlabs is an online resource created specifically to educate students on safety science and engage them in real-world investigations while identifying some of today's most relevant topics. I began using the Xplorlabs Fire Forensics module a few years ago in partnership with our local Cherokee County Fire & Emergency Services and, more recently, expanded to other pathways including battery supply chains and thermal runaway.

Xplorlabs is funded through UL Research Institutes, an organization dedicated to safety science and creating a sustainable society. Recognizing the importance of K-12 education to its mission, UL Research Institutes' Office of Research Experiences & Education introduced an educator fellowship in May 2023. The inaugural fellowship included travel to national conferences, a stipend, and an opportunity to collaborate with educators and ULRI's researchers to continue developing innovative safety science resources for sixth- through eighth-grade classrooms.

Sparking student curiosity through real-world safety science

My experience throughout the fellowship has been relevant, connected, and empowered. As one of the few STEM educators in my district, I find it challenging to find engaging middle school resources that introduce students to real-world problem-solving while promoting positive impact. The safety science research being conducted at ULRI is extremely relevant to middle school students because it connects their classroom learning to real-world events. This sparks students' curiosity and increases their sense of purpose by taking ownership of their work.

Throughout the fellowship, I've connected with a cohort of educators from different backgrounds and teaching experiences. Together, we've committed to inspire our students through the investigation of safety science, develop engaging instructional strategies, and culminate projects based on the Xplorlabs lessons. In addition, I've also had the opportunity to learn from today's leading safety scientists, engineers, and entrepreneurs and expanded my network of resources and contacts within ULRI.

Traveling to Chicago to participate in the 2023 ULRI Annual Research Symposium was both personally and professionally rewarding. Learning about each of the institutes and offices that make up ULRI challenged me to think globally about real-world issues and empowered me to be a changemaker in the classroom. I was treated as an equal and a valuable contributor to UL Research Institutes' initiatives.

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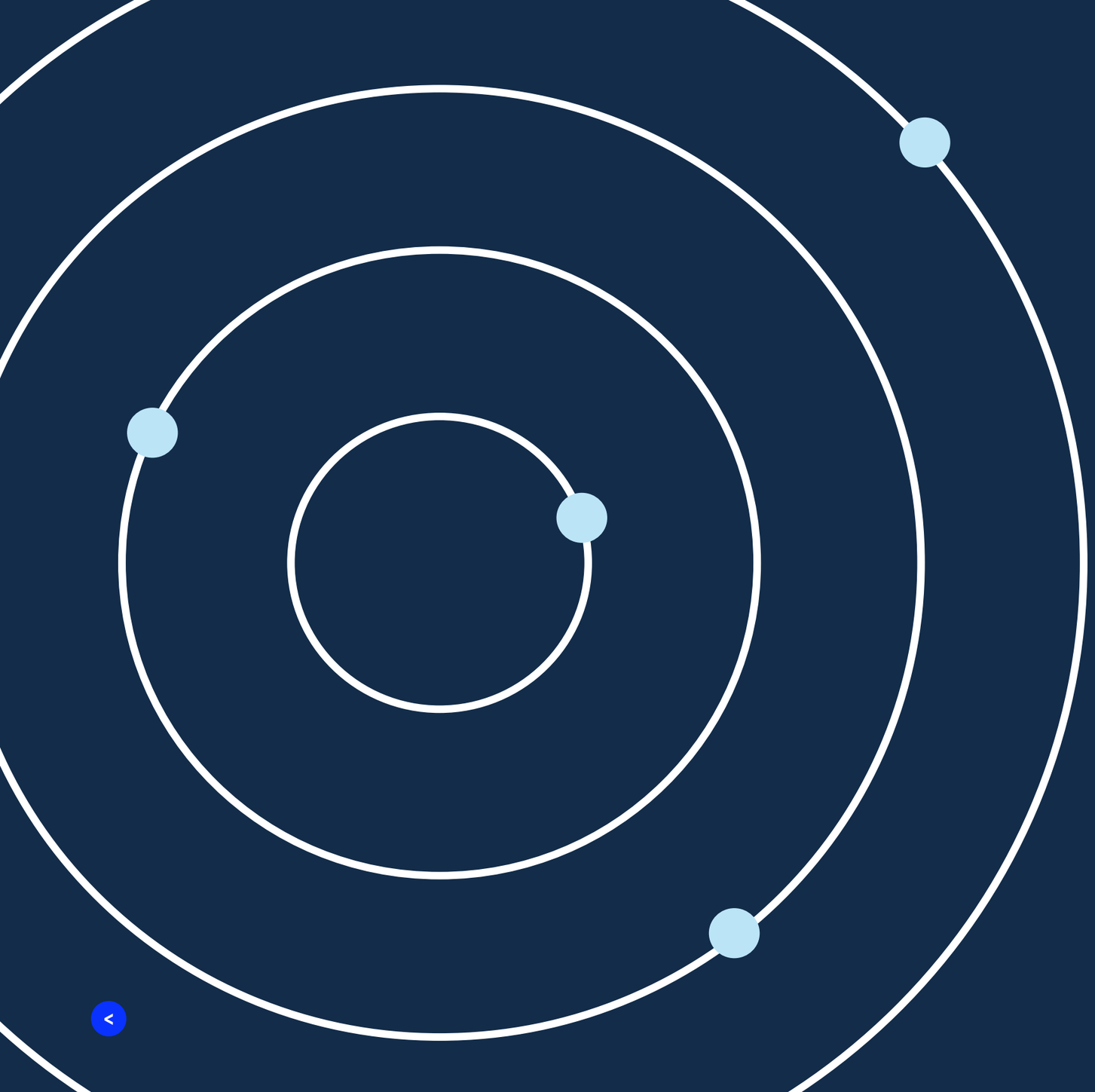

Learn more about implementing Xplorlabs in your classroom by exploring the site or reaching out to the Xplorlabs' education team at ***ULRI.Xplorlabs@ul.org***.