



Kaleidoscope

Educator Voices and Perspectives



ABOUT KALEIDOSCOPE: EDUCATOR VOICES AND PERSPECTIVES

In December 2014, the Knowles Teacher Initiative published the inaugural issue of its new journal—*Kaleidoscope: Educator Voices and Perspectives*. Through *Kaleidoscope*, Knowles shares stories from teachers about teaching, leading and learning.

Kaleidoscope strives to provide readers and writers a public space for discourse and dialogue about the knowledge and expertise of teachers and the complexity of our profession. We believe that teachers are well-positioned to improve education in their classrooms and beyond, and we know the power that storytelling and knowledge sharing can hold in the process of transforming educational outcomes for students.

Two issues of *Kaleidoscope: Educator Voices and Perspectives* are published each academic year (Spring and Fall).

ABOUT THE KNOWLES TEACHER INITIATIVE

The Knowles Teacher Initiative is a nonprofit organization that supports a national network of mathematics and science teachers who are collaborative, innovative leaders improving education for all students in the United States. We strive to create an educational system that is led by teachers who are equipped to solve difficult problems and respond to local challenges in order to serve all of our nation's students. For more information, visit www.knowledgeteachers.org.

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KALEIDOSCOPE

EDUCATOR VOICES AND PERSPECTIVES

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The *Kaleidoscope* editorial staff accepts submissions on a rolling basis. We publish in a variety of formats, including print, podcast and video.

If you are interested in writing, or already have a piece in mind, contact **kaleidoscope@knowlesteachers.org** at any time for feedback, information, or guidance. Every submission, from idea to fully-developed piece, is assigned a peer advisor to help develop, build, and edit the piece before submission.

On our webpage, **www.knowlesteachers.org/kaleidoscope**, you can find other resources to help you develop your ideas, including

- a non-exhaustive list of the genres of stories we publish, including examples of pieces from *Kaleidoscope* and elsewhere;
- the rubric used for the final review of submissions; and
- past issues of *Kaleidoscope* to see what others have shared.

We look forward to learning your story!

Subscriptions

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The opinions and beliefs expressed in the journal reflect authors' perspectives and may not represent those of the *Kaleidoscope* editorial staff or the Knowles Teacher Initiative.



From the Editors' Desk:

A Conversation

A conversation about how the virus affected our practice and how we contextualized this issue's stories.

The most unsettling thing is the silence. I've been teaching science to young people for 10 years, and silence has never been such a pervasive concern. I wonder if students are listening. I wonder if they're reading my messages and comments. I wonder if they have questions. I wonder if they're actually laughing at my weak jokes or rolling their eyes at me. I wonder if they have the brain space to really engage with any of this beautiful content. Because truthfully, there are days I'm not sure I have the brain space to teach it. What are we even doing, I wonder, many times a day. What are we even doing, creating assignments and holding class and awarding grades amidst a once-in-a-generation, global collective trauma.

I am used to teaching under great stress and through bouts of internal turmoil and emotion. Most teachers are—this work is delicate, demanding, and barely sustainable when school is business as usual. The stress of fall 2020 is wildly different. If I look too closely at our reality, my productivity plummets. My students have lost so much. My students are carrying heavy burdens. My students' behavior oscillates between shockingly adult, demonstrating great maturity and self-awareness, and endearingly young, making silly jokes in our chat and ignoring assignment directions as usual. My colleagues and family are weary.

It's lonely here in my home workspace. I miss spontaneous small talk and banter, those daily micro-interactions that establish humanity and build

relationships. I know my colleagues are lonely. I think many of my students are lonely. Schools aspire to provide community and safe space for young people to learn and grow. How do we keep making progress toward this ideal from behind our individual computer screens, at a distance? The internet connects us, but how do we authentically come together?

Perhaps this unique historical moment can offer us an opportunity to take stock, reflect, and grow. There are so many stories people could tell about this moment. There have been new technologies and the fatigue that comes with them. There are different routines to follow and the new normal that guides our lives.

Many of the stories in this issue were written before the pandemic or before we knew how long we would be here. But the deeper meaning of the stories is still relevant to our current situation.

Exploring and appreciating nature takes on a whole new significance as we spend more of our lives online. If you'd like to get your students learning outside, you

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may find inspiration in Beth Keskey's story about her success with helping students connect with nature through technology and the observation of changes over a period of time. Perhaps now more than ever, you want to help students see themselves as participants in a learning community. In "A Good Year," Ben Buehler describes building his students' confidence to connect with the course as scientists. Maybe you are thinking about what stories your students hear about your course content. In her audio piece "On Harry Potter and Whose Stories are Told," Jamie Melton speaks to the stories within the stories that make up teaching.



We hope these stories give you a moment to reflect, take a deep breath, and start connecting again.

Even before the COVID-19 crisis, connection was not always easy. Many of us experience doubt and confusion as we search for ways to impact our community. In "The Unanswered Question," Rohan Prakash reflects honestly on his journey to understand how he might use his professional connections to participate in broader change beyond his classroom. Continually reaching out to others can be demanding and draining; the emotional labor required to earnestly create caring communities is not equitably distributed. Faven Habte describes the specific, personal cost of connection for Black teachers in "I'm Tired."

While all of our contexts look different right now and the uncertainty about the future can be overwhelming, the fact still remains: we need to stay connected. It is through our connections that we can care for others, ourselves, and our communities during this difficult time. We hope these stories give you a moment to reflect, take a deep breath, and start connecting again.

Citation

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I'm Tired.

Faven Habte

Living with the invisible tax of being a Black educator.

I've taught for five years, experiencing . . .
Three states, three schools, three subjects, three levels
Urban and suburban contexts
Homogenous and diverse student bodies and staffs
Laughing with colleagues
Crying with students
Mourning students and colleagues
Wanting to quit
Being more energized about teaching than I can put
into words

I've formed strong, lasting relationships in each setting,
but . . .

I'm tired.

I had prepared a whole story to tell. About the struggles
of feeling like I'm not doing enough. A story about my
personal failures that aren't really mine to own. About
a system that over-extends teachers while under-
supporting them. The story described how I'm asked to
be everything to everyone. A teacher, counselor, social
worker, and confidant all while lesson planning, grading,
attending meetings, and conferencing with parents
regularly. It was a good story . . . a true story . . . but
ultimately the easy, incomplete story.

Don't get me wrong, the system is unjust and draining

and unsustainable. But that's not why I'm tired today.
Today, amidst a worldwide pandemic and international
protests, I'm tired because as a Black educator, I'm
always overcompensating and yet it's rarely enough
to protect my kids. I'm exhausted by whiteness and a
system that asks me to do more and care for hundreds
of students while it fails to care for me.

Being a **Black** teacher: Is. Not. The. Same as being A
teacher. It's NEVER the same. The job is different, harder,
and more consuming than anyone, including white
teachers, can ever understand.

When I build relationships with students, especially those
who display challenging behaviors, the takeaway for my
colleagues is "it's a blessing that they have someone."
Somehow the system and my white colleagues miss the
piece of me that leaves with each student. And I don't tell
them about it either.

Every time a student reaches out for support and shares
their trauma, there's an overarching gratefulness for
how they were able to process in a safe space. No one
considers the secondary trauma it burns into my spirit
or the personal demons it could awaken. There isn't care
for how their stories of oppression and abuse bring mine
to the surface. Rarely is there mention of how their pain,
anger, and desperation enhances my own, not by my
white colleagues or my school's administration.

They don't see my teacher-hood when they
Declare it's a **calling** without mentioning the **suffering**,
Describe it as the ultimate civil **service** with no mention
of the **burden**.
Tout it as an act of **love** separated from the immense
loss.

I'm tired and invisible.

Most Black educators can share tens of stories about the Black tax (King, 2016) and all the ways we carry more. These stories desperately need to be sought out, heard, and shared. So, in that effort, here's one of mine.

One afternoon at school, a student made a false report and a SWAT team was called into the building. The entire school was on lock down for hours, and officers burst into classrooms with their guns up. Once they realized there was no real threat, police forced all students out of the building in single file lines while yelling at anyone who disobeyed. No one was allowed to retrieve belongings and students were forced into a downpour of rain without jackets, house keys, backpacks, and for some wallets and public transportation cards.

I vividly remember students looking at me with fear and frustration in their eyes. They needed my support and protection. They needed my advocacy because they knew I loved them. They trusted me to navigate the situation for them. They wanted me to provide safety.

I wonder how many of them knew we were both looking for the same thing.

Take a second and position yourself as a Black educator watching your students process the:
Fear of staring at a gun in their face **at school**
Uncertainty in not knowing what's happening
Stress of leaving school hours late when they have to pick up a sibling
Cold freezing raindrops on their skin
Anxiety of not knowing how they'll get home or even inside their house.

Imagine yourself feeling it alongside them because you know them. **Because parts of you are them.**

Do you know the most disturbing part of that memory for me? The Black teachers who gave up our jackets, emptied all our cash for student bus/train fare, coordinated Uber and Lyft rides, and stayed well into the evening hours waiting for parents to pick up their children. We made the devastating yet routine decision to push aside our own trauma to make sure our Black students were cared for. Our trauma was secondary. Concealed. Something to be dealt with on our own time. Something to be sacrificed and ignored.

And that might've been a systemic failure . . . if only a single white teacher had showed up in the same capacity. I remember looking around in the chaos to see at least 10 Black staff and only two white teachers. The white teachers stayed for a moment and within an hour, they were gone. The Black staff stayed for hours. We saw the



Don't get me wrong, the system is unjust and draining and unsustainable. But that's not why I'm tired today.

anguish and tension in each other's faces. We heard the disappointment and sadness in each other's voices as they apologized for leaving because they had to go care for their own loved ones. We felt the concern when we asked each other if we were okay and encouraged taking the night off instead of doing any work.

I'm not here to judge or qualify individual responses to traumatic events; I needed healing too. I needed to go home, eat, cry, hug someone, and let it out. But in that moment my students needed me and, like always, I neglected myself for them. It's a choice I repeatedly make because I'd rather deal with the mental and emotional toll on myself than risk another outcome.

I'm tired and invisible and angry.

My reality is that I have to show up and provide more than non-Black colleagues daily. And while that's problematic enough, I'm also pressured to negotiate language to placate white fragility and guilt. I couldn't process this with them. I couldn't ask them to analyze how race influenced the sequence of events. This creates an immense tension between maintaining safe spaces for a largely white teaching workforce while simultaneously pushing for change that cares for Black bodies, including my own.

So, excuse me if I've had enough of individual-level solutions like work-life balance, self-care, and mindfulness. These solutions are as short-sighted as the people who see me as an effective educator without once considering how I've been disproportionately depleted in that effort. They are "solutions" that come with a tremendous cost that only some of us bear.

I'm tired and invisible and angry and discouraged.

I don't know how long I can do it for or how long I'll even want to. I don't know what I'll look like on the other side of teaching (whether it's in three years or 30) or how



We made the devastating yet routine decision to push aside our own trauma to make sure our Black students were cared for.

much guilt I'll carry for all the times I couldn't be enough.

All I know is that I'll continue for as long as I can and **deal with the impacts later . . . I've had a lot of practice in that.**

Suggested Resource

King, J. (2016, May 15). *The invisible tax on teachers of color*. Washington Post. https://www.washingtonpost.com/opinions/the-invisible-tax-on-black-teachers/2016/05/15/6b7bea06-16f7-11e6-aa55-670cabef46e0_story.html

Citation

Habte, F. (2021). I'm tired. *Kaleidoscope: Educator Voices and Perspectives*, 7(2), 3–5.



Faven Habte,

a Knowles Senior Fellow, teaches high school science in Washington, D.C. Throughout her career, she's taught chemistry, biology, and environmental science and loves finding connections between the content and social issues,

especially those centered around identity, race, and equity. Faven is passionate about teaching students of color, including English language learners, a group that is close to her heart as a first-generation Eritrean-American. In her spare time, Faven enjoys traveling, cooking, and reading. Reach Faven at faven.habte@knowlesteachers.org.

A Good Year

Ben Buehler



In his 17th year in the classroom, a teacher learns a new lesson from his students about what makes a successful science course.

What makes for entertaining teaching isn't always the best teaching. In this talk, given at the Knowles Teacher Initiative's 20th Anniversary Gala, Ben Buehler reflects on how he's often robbed students of the "doing" of science in his physics course.

Ben helps us see that the role of an entertaining teacher, while often celebrated, pales in comparison to the role of a teacher who opens opportunities for students as people to learn with and from. He also explains how support from a robust professional community, like the one he's found at the Knowles Teacher Initiative, can make all the difference in transforming teaching and learning.

"He said, 'Mr. Buehler, I hear what you're saying, but it makes absolutely no sense, and I think you're wrong.' Right then, I knew it was going to be a very, very good year."

Watch Ben tell his story on the *Kaleidoscope* website: knowlesteachers.org/kaleidoscope.

Citation

Buehler, B. (2021). A good year. *Kaleidoscope: Educator Voices and Perspectives*, 7(2), 6.



Ben Buehler, a Knowles Senior Fellow, is currently teaching physics, chemistry, and computer science at Yorktown High School in central Indiana. Inside school, he enjoys perusing student whiteboards and asking lots of questions. Ben is particularly interested in helping students learn how to talk about science in meaningful ways. Reach Ben at ben.buehler@knowlesteachers.org.



The Unanswered Question: Coping with How Much You Can Do As a Teacher

Rohan Prakash

Adjusting my expectations and understanding of what counts as success.

It was a rainy, cold fall weekend where I sat alone in my room and just cried. Then another weekend when I called up my best friend late at night and vented about everything. And then one day, as I was driving to work, I just pulled over into a parking lot I saw on the side of the road, slumped over my steering wheel for a few minutes and thought to myself, “Do I actually care about this anymore? Do I want to do this job?”

The answer has always—eventually—been yes. Of course I want to teach. I’ve known I wanted to teach since my junior year of high school. Scratch that. My parents would say I’ve known I wanted to teach since I was five and my favorite make-believe game was “School School.” (The repetition is important!) Occasionally, I wonder what it would be like to do something else, but at the end of the day, I’ve always come back to teaching.

Teaching is difficult. I know that.

Everyone says the first year of teaching is supposed to be the most difficult—that it’s okay to not be great the first year. It takes practice to get it right. Even after student teaching, which is its own process of learning and developing, the first year solo teaching can be rough for everybody. I knew about the first-year challenge, and I was prepared for that.

But I realized the second year can be just as rough. I had just gone through a few Knowles Teaching Fellowship meetings where I was asked to think deeply about how the Common Core math practices were being used in my classroom and what it meant for a student to do math in my classroom. I did a year-long inquiry into what group work looked like in my classroom for students and how they collaborate. These ideas made me think deeper about my role in the classroom and about the purpose of what my students were learning. I was still learning.

I told myself that once I cleared my state credential and achieved “permanent employee” status at the end of that year, I would feel more at ease with my teaching prowess. I knew I’d still be learning (and I am excited for that; I hope to still be learning even in my 25th year of teaching), but I thought maybe the day-to-day stresses would decrease. I thought I would feel more confident in my ability.

My third year of teaching came, and I thought I was ready. I was teaching two courses that I had taught before, and I was more comfortable changing things in my teaching practice to reflect what I had learned from the last two years. I was implementing new learning from my credential program, in-district professional development, and from my Knowles Teaching Fellowship work. I was experimenting with grading math on a standards-based system. I was trying to incorporate retake systems and new homework policies into my classes that better reflected my ideals around learning. I had fully bought into the professional learning community (PLC) model after going to a conference and thinking through it more with others at my school, and both of my PLC teams nominated me as their lead

teacher.

In this third year of teaching, I thought, I was prepared to focus on these experiments with my practice. I thought I was ready to continue questioning my practice and continue improving.

I was not ready.

How do I know if I'm succeeding even a little bit?

To my surprise, my third year of teaching was the most stressful and made me feel the most like a failure.

I had the day-to-day stuff mostly down. My lesson plans were ready in time, my copies were made in advance, and my grading was (mostly) finished in a reasonable time frame. I still worked on inquiry in my classroom and continued thinking about how I could serve my students better. These were the challenges I expected to face, and I was comfortable dealing with them.

But some larger questions crept in and started troubling me—what was even the point of being a math teacher? How do I know if I'm successful?

My district provides PLC leads with coaches to help with leadership skills and implementing PLC processes. When I was feeling completely hopeless and exasperated with what I saw as my failure, my coach asked me a question that made me continue thinking about the purpose of math education. She asked me where my ideas about what math education could look like came from. My credential program? Knowles? Jo Boaler? Dan Meyer? The Freakonomics podcast about the state of American math education (Dubner, 2019)?

It was difficult to articulate an answer to her question. I kept doubting myself on what I believed was an ideal outcome for a math class. Every time I thought I had an answer like "I want students to problem-solve because it's useful in life" or "I want there to be more equity for student learning by detracking math at my school," I immediately went down an endless spiral thinking about what the underlying purpose was.

Who was I, as a 24-year-old, third-year teacher, to make big changes in my school when I couldn't articulate my ideals properly? Who was I to question the decisions of far more experienced teachers in my department and try something different from them? Why did I want to do this job and what change was I hoping to create?

Fragments of an answer

The trouble is, I do not think I have a complete answer to that question yet, nor do I think I will find a satisfying



Who was I, as a 24-year-old, third-year teacher, to make big changes in my school when I couldn't articulate my ideals properly?

one. There are pieces of my answer that I know can go together. For instance, I know I want to help my students grow as mathematicians and I want them to see something interesting in the math I teach them. I also understand that teaching doesn't exist in a vacuum, and if I want there to be a lasting effect on students, the solution cannot only come from what I do in my classroom. Developing my students' mathematical knowledge and interest in the field also depends on their previous math classes, their future math classes, and the messages they hear about math from their friends, parents, and society at large! Even when I got to this conclusion for what my solution could be, it felt ridiculously overwhelming.

Spending some time thinking about my reasons for being a math teacher and what I hoped to accomplish, even if it is still unclear, made me more confident to talk about what I believe in. I could trace back to how my previous experiences as a math student affect my desire to teach math, how other teachers I've observed have inspired me to implement certain strategies in my classroom, and how different books I've read have factored into my view around the purpose of math education.

Yet I was still frustrated by not being able to have the clearest of answers. Even now, I can only talk about my vision for math education in vague broad statements rather than specific, narrow ones. The systems and policies that I think will support improved and equitable student outcomes are not definitive solutions.

And, even if I achieve some small amount of success in my classroom, there are still so many other students on whom I do not have an effect. This was what was driving me into bouts of hopelessness around the purpose of teaching. It was severely affecting my mental health and on a few occasions brought me close to quitting.



I do not control the big systems, but I am in control of how I interact with students, and that's where I can make the most impact.

I managed to open up to a few teachers about these struggles, and they told me that they had similar questions and struggles themselves around their third or fourth year teaching. It was then that they had time to think about the bigger picture and their role in the education system. While I wasn't alone facing this issue, the other teachers I spoke with seemed to have reconciled it for themselves and figured out how to work in the system by compromising and changing.

I, too, had to learn to cope.

The big picture and coping

The most frustrating thing has been narrowing down my locus of control. I am one teacher. I can make some changes, but I cannot change the entirety of the American education system. While still unsatisfying to me, it is a way to cope with the bigger problems I am not able to affect. I do not control the big systems, but I am in control of how I interact with students, and that's where I can make the most impact.

Somewhat contradictorily, I've also found it helpful to zoom out to look at the big picture sometimes. Change is slow, especially when there are so many moving parts. I teach in the same district where I went to high school. Even in the seven years since I graduated, so much has changed. Change might be happening right now too, but it is not easy to see when I am right in the middle of the situation and unable to see it from a distance.

In the end, it seems like the best way to cope with the uneasiness and lack of control is by leaning into the uncertainty and lack of clarity in this work. Seeing that uncertainty as an opportunity for more growth, more inquiry, and more work to be done can be exciting. I cannot imagine what teaching would look like if I could just box it up, wrap it with a nice bow, and say, "This is

done." And frankly, I think it would be boring if I could.

Every year brings new challenges and new perspectives. In order to keep finding joy in teaching, I need to be willing to continually refine and reevaluate not only my practices, but my beliefs—and be open to change. At first, this idea made me feel a bit discouraged; after all, this means I will never feel completely comfortable with my teaching. More importantly, however, it makes me feel excited and energized—I'll never feel stalled or stagnated, and also, I'll never feel alone.

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Citation

Prakash, R. (2021). The unanswered question: Coping with how much you can do as a teacher. *Kaleidoscope: Educator Voices and Perspectives*, 7(2), 7–9.



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Finding the Pulse of Nature through Guided Inquiry in Nature-Based Citizen Science

Beth Keskey



After my middle schoolers completed a year-long series of nature observations using technology tools, one of my students epiphanized, “I never knew the trees could tell us things. It’s like they’re talking in their own way.”

Advancements in technology have transformed the methods students use to learn about the natural world; answers are often at our fingertips with a simple Google search. As a result, young people need to develop the skills to navigate an information-rich society alongside their scientific practices as described in the Next Generation Science Standards (NGSS). Our students’ technology-based culture, methods of communication and recreation, and ways of knowing are changing as well. The ways in which society engages with nature and technology will have profound impacts on our future. Taking time to slow down to find the pulse of our planet through observations in nature requires both technological literacy and a curious mind, both essential for the future of scientific practice and discovery. In order to challenge the ways my students critically think about information, I created a year-long citizen science learning experience for students to collect authentic data from nature observations. This turned into a powerful tool for marrying technology and nature in the classroom setting.

Citizen science is the collection and recording of data by the general public and includes a variety of projects and visualization tools that are accessible through various websites or apps. This data is often used for the benefit

of researchers, other educators, resource managers, and important decision makers in conservation. These platforms also provide students at increasingly younger ages the opportunity to work with large quantities of data. In my classroom, our year-spanning guided inquiry connected students to nature, empowered them as scientists, provided new perspectives on environmental indicators of climate change, and developed skills that would reach beyond the classroom.

Planning to Connect Students to Nature Through Inquiry and Technology

When I asked my rural, Midwestern seventh-grade students about their sunshine-filled weekends, I was surprised that many would explain they spent their time indoors playing video games, watching Netflix, or engaging with other technology. My students seemed to be missing out on those vivid nature-based experiences I reflect on so fondly as an adult. This could have consequences for the conservation of our planet, as many environmental studies suggest that nature connection is a fundamental building block for creating future environmental stewards (Louv, 2005). I wanted to help my students develop an appreciation for the outdoors.

To develop this appreciation, my students needed to learn how to take their time noticing elements of nature. Facilitating nature connection would be more powerful if students could integrate the key NGSS science inquiry practices, such as: asking questions and defining problems; analyzing and interpreting data; and obtaining, evaluating, and communicating information. Through these considerations, I developed

a lesson that can be modified to meet both middle- and high-school NGSS standards (see Table 1).

Table 1

NGSS Standards Emphasized in this Lesson Series

NGSS Standard	Science Practices
MS-LS2-1—Analyze and interpret data to provide evidence for the effects of resource availability on organisms and populations of organisms in a population.	Cause and effect
HS-LS2-6—Evaluate claims, evidence and reasoning that the complex interactions in ecosystems maintain relatively consistent numbers and types of organisms in stable conditions, but changing conditions may result in a new ecosystem.	Stability and change

participating in this nature-based citizen science data collection was a great way for them to think more deeply about evidence and the earth as an interacting system of cause and effect.

To support these goals and connect students to nature using technology, I chose Nature's Notebook (USA National Phenology Network, n.d.-a). Created by the USA National Phenology Network, Nature's Notebook is a free website and application that specializes in tracking phenophases in plants and animals. The opportunity to evaluate large phenology datasets through a visualization tool, while learning to understand the data collection process, helps my students draw conclusions about seasonal trends over time.

I hunted my school grounds and chose a green ash tree (*Fraxinus pennsylvanica*) on campus for its easy accessibility for ongoing student observations. After creating an observation deck on Nature's Notebook, I downloaded a species profile on the green ash tree which provided general background, phenophase definitions, and a data collection sheet (USA National Phenology Network, n.d.-b) (see Figure 1). Starting in the fall season and extending into spring, some of the specific phenophases observed and recorded by my students on the data collection sheet were colored leaves, falling leaves, breaking leaf buds, and pollen release.

Finally, I saw an opportunity to connect this experience to our real-world understanding of climate change. Phenology, the study of repeating yearly events observed in living things, is an excellent context for teaching climate change. This is due to the students' ability to observe and make data contributions, just as professional and citizen scientists do, to databases that help us track environmental impacts of global climate change. As temperate forest trees have dealt with changing seasons for millenia, tree species have evolved their cued seasonal responses differently. Responses include temperature, sunlight exposure or a combination of both. These responses are especially important with the onset of rapidly shifting carbon dioxide levels and resulting temperature change. As temperature changes occur, the specific observable seasonal events or phenophases, such as autumn leaf color change or spring budding, will respond by adjusting their timing. Many of my students struggled to fully comprehend climate change prior to this lesson, and

Figure 1

Green Ash Tree Data Collection Sheet Developed by the USA National Phenology Network

Trees and Shrubs *Deciduous (with pollen)*

nature's notebook

Species: *Fraxinus pennsylvanica*
 Common Name: green ash
 Nickname: _____
 Site: _____
 Year: _____
 Observer: _____

Directions: Fill in the date and time in the top rows and circle the appropriate letter in the column below.
 y (phenophase is occurring); n (phenophase is not occurring); ? (not certain if the phenophase is occurring).
 Do not circle anything if you did not check for the phenophase. In the adjacent blank, write in the appropriate measure of intensity or abundance for this phenophase.

	Date:							
Do you see...	Time:							
Breaking leaf buds	y n ?	y n ?	y n ?	y n ?	y n ?	y n ?	y n ?	y n ?
Leaves	y n ?	y n ?	y n ?	y n ?	y n ?	y n ?	y n ?	y n ?
Increasing leaf size	y n ?	y n ?	y n ?	y n ?	y n ?	y n ?	y n ?	y n ?
Colored leaves	y n ?	y n ?	y n ?	y n ?	y n ?	y n ?	y n ?	y n ?
Falling leaves	y n ?	y n ?	y n ?	y n ?	y n ?	y n ?	y n ?	y n ?
Flowers or flower buds	y n ?	y n ?	y n ?	y n ?	y n ?	y n ?	y n ?	y n ?
Open flowers	y n ?	y n ?	y n ?	y n ?	y n ?	y n ?	y n ?	y n ?
Pollen release	y n ?	y n ?	y n ?	y n ?	y n ?	y n ?	y n ?	y n ?
Fruits	y n ?	y n ?	y n ?	y n ?	y n ?	y n ?	y n ?	y n ?
Ripe fruits	y n ?	y n ?	y n ?	y n ?	y n ?	y n ?	y n ?	y n ?
Recent fruit or seed drop	y n ?	y n ?	y n ?	y n ?	y n ?	y n ?	y n ?	y n ?
Check when data entered online:	<input type="checkbox"/>							
Comments:								

Note. This figure shows an example of a free, downloadable phenology protocol developed by the USA National Phenology Network. This example is a free downloadable phenology green ash datasheet from Nature's Notebook (USA National Phenology Network, n.d.-b) with accompanying phenophases extending through the year.

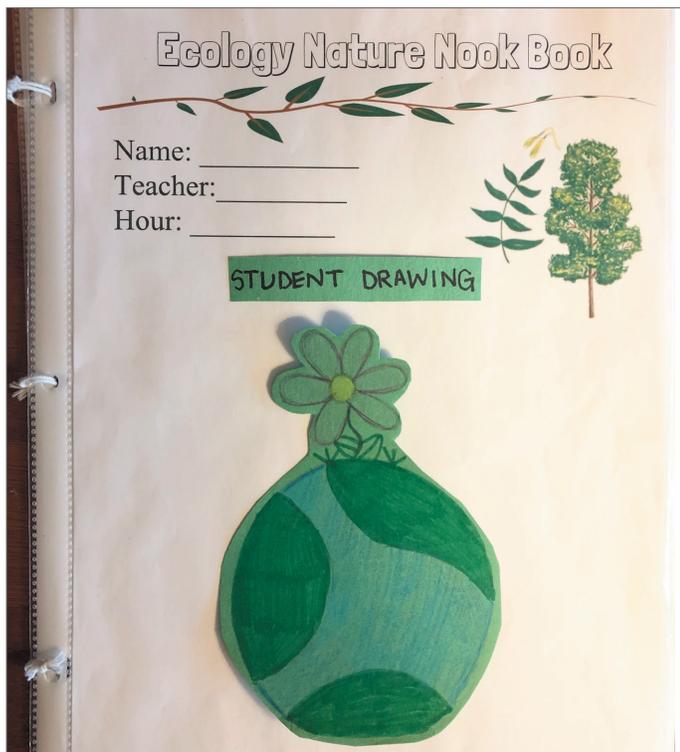
I also located a grove of trees and bushes of various species at my school. This location became the place where students would select their “nature nook” (McGowan et al., 2010), a sit spot where students would return throughout the year to deepen their exposure to natural settings and develop their observation skills.

Nature Nook Books

To kick off my yearlong, nature-based citizen science project, I started with an observation activity in the fall. I wanted to engage and introduce my students to observing aspects of nature with a nature nook book (see Figure 2).

Figure 2

Student Nature Nook Book with Student Drawing



After we arrived at the grove, I asked my students to use their nature nook book to record their questions about the plants they saw in their nature nook. We revisited their nature nooks multiple times throughout the year. For this first observation, I encouraged students to share their questions with peers, which ultimately allowed me to introduce the terms phenology and phenophase.

After students shared their initial observations, I introduced the importance of citizen science and how they would be serving as scientists. My students began up-close observations of our green ash tree, which continued throughout the year. Each time we visited the tree, we took an additional 20 minutes to visit their nature nook to hunt for other examples of phenophases.

After our time outdoors, we returned to the classroom and submitted our green ash tree data to Nature’s Notebook. Students honed in their observation skills by taking a total of eight different observations throughout the school year.

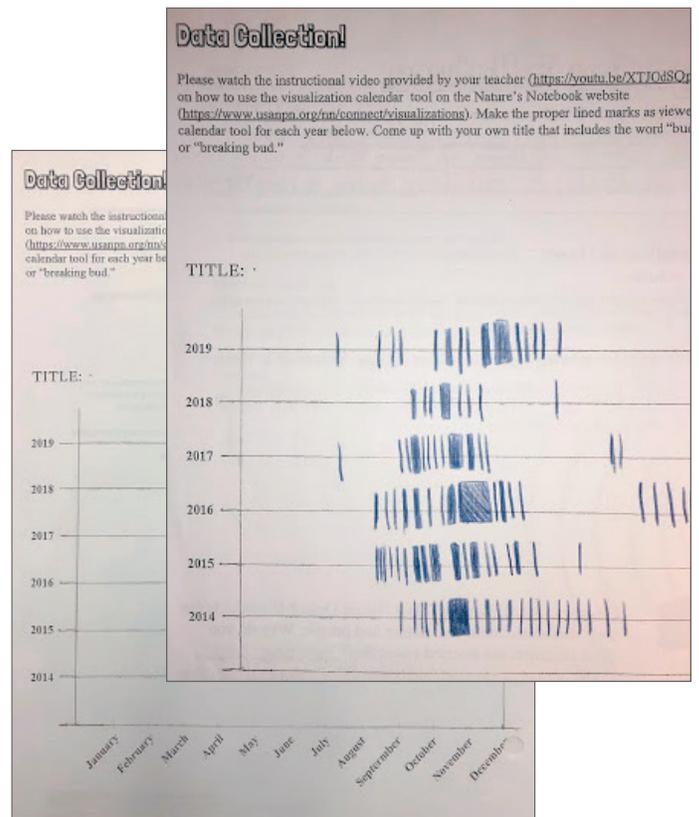
Guided Inquiry

To scaffold and model the inquiry process for my students, our guided inquiry took place after the class completed their final spring observations and focused on manipulating our green ash data, as well as green ash data from across the United States, using the online Nature’s Notebook visualization tool. Data were provided by the USA National Phenology Network and the many participants who contribute to its Nature’s Notebook program. We focused specifically on the spring phenophase “breaking leaf buds” because students had recently observed it and it is a strong indicator of spring timing and climate change.

To support students in navigating the visualization tool,

Figure 3

Nature Nook Book Data Collection Template



Note. This figure shows a sample of student work. Students viewed the online visualization tool and transferred colored hash mark data from 2014 to 2019 to their template in order to identify trends in spring phenophases.

I created a video with directions on how to generate budburst data on the green ash tree from 2014 to 2019. We discussed the fact that climate refers to an extended period of time, and that this five-year period represented a relatively small snapshot. I added a new template to my students' nature nook book that aided them in plotting data and identifying trends in the green ash's spring phenophase (see Figure 3).

After plotting the data, students analyzed, interpreted, and searched for trends in the spring phenophases from year to year. Students were asked to contemplate a series of questions:

- Are the timing of seasonal changes the same each year? Why or why not?
- What changes in phenophase timing can you identify from year to year in your data?
- How would you predict the following year's data to look, based on your current data?

During the class discussion that followed, students shared their reasoning for the observed shifts in the spring phenophases. Students concluded that the planet's driving force for many seasonal changes was based on climate and that the trees were responding to those changes. This was an exciting moment as I watched my students discover climate change and understand it in a unique way.

Concluding Thoughts

The Nature's Notebook platform served as the method for not only engaging my students in nature, but also bringing important evidence-based conversations on climate change, using real world datasets, into the classroom. What I found most rewarding, beyond the simple excitement my students had for being outdoors, was students' responses when I asked if I should repeat this lesson with future students. They responded without hesitation, explaining that I should, and they began to share what they had learned from this work. I was delighted to hear several students chime in that timing is "the Earth's way of sending messages" and describing their realization that "climate change was happening in [their] backyard." Nature's Notebook was not just a method of guiding my students through inquiry, but also set the foundation for promoting self-efficacy in full inquiry in the future. I began to understand phenology as a tool for making both seasonal and climate change tangible.

Climate is not the only thing changing that's important in education. The work of adapting Nature's Notebook tools and datasets for my students changed me as well. When teachers are allowed to pursue their passions and curiosity alongside resources for professional learning, the simplest idea can evolve to create something new and meaningful in the classroom setting.

Suggested Resource

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On Harry Potter and Whose Stories are Told

Jamie Melton

While taking a class about Harry Potter, I realized that teaching any subject—even science—is subjective.

In this audio piece, narrated by the author, Jamie Melton, we ponder the question of whose stories are being told in our teaching and why.

“I don’t teach biology in my classroom; I teach my own story of biology.”

Listen in to hear how Jamie was confronted with an alternate meaning of the beloved Harry Potter series by J.K. Rowling and how this, in turn, caused her to question the choices she makes in her teaching practice on the *Kaleidoscope* website: knowlesteachers.org/kaleidoscope.

Citation

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