

Expanding Horizons

By Paul H. Fry

This issue of *On Common Ground* focuses on the importance of expanding the Teachers Institute model to every corner of the United States, including every state. With this focus, in behalf of the Yale National Initiative we are delighted to celebrate the inauguration of a new Institute in Tulsa, Oklahoma with a special section of comments and endorsements contributed by university, school district and teacher leaders from that city.

To begin, though, with our cover article by Rogers M. Smith, which is so important that we wish it could be required reading for every politician and school superintendent both national and local who sacrifices the integrity of public school systems to the “quick-fix dream,” as Smith calls it, of privately-funded education. With the thoroughness of the distinguished social scientist that he is, Smith shows that wherever charter models have been adopted, including even in the once-benchmark country of Sweden — still strong but now less strong — student learning results have declined; whereas in countries that have invested sufficiently in the content knowledge and job circumstances of public school teachers — both in countries already strong and in countries hitherto weak — student learning results have sharply improved. The appalling decline of the United States from leader to also-ran in secondary education, fuelled by the refusal of legislators at all levels to support public school teaching (their alternative to useful support having been an obsession with draconian test results that demoralizingly reduce teaching to rote preparation) has only been accelerated by the trend towards privatized solutions, which work once in a while and fail far more often. As we have demonstrated wherever we have had the opportunity to work, if the Teachers Institute model were everywhere present, our emphasis on content knowledge, collegiality and teacher

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empowerment — those factors that really do improve teaching, as Smith’s and Ellen Kisker’s evaluation studies have shown — could no longer be ignored in government and administrative circles. We enjoin our readers to study Rogers Smith’s article and to pass it along to all who may benefit from it.

The cover image we have chosen to accompany this article, Jasper Johns’s painting of a U. S. map, is in some ways reminiscent of those children’s jigsaw puzzles we all remember. But this painting has, as part of its deliberate technique, the purpose of blurring distinctions. Yes, we can see the states if we look hard, and we can even see their names, or parts of their names, but the brushstrokes that soften and erode boundaries are signs of independence from official identity, signs of the true individuality in each of us, making the map a unity greater than its parts. The child at work on a puzzle like this doesn’t have to ask why Texas is yellow, say, or Illinois green. In Johns’s painting all are every color, and the still-visible labels are in stencil font, black or white completely at random, as if to say, this gets stamped on the outside and doesn’t correspond to an inner reality, which is the potential for improved thinking and broader knowledge shared in common by all residents without exception when their teachers realize their own potential.

Ellen Kisker of the research firm Twin Peaks Partners has performed extensive evaluations of the seminar experience and the curriculum units written both in the Yale National Initiative and in three local Institutes: New Haven, Delaware, and Philadelphia. The two articles she has provided for this issue of *On Common Ground* distill these evaluations, the first to be made available since Rogers Smith’s study of the New Haven Institute, *To Motivate My Students* (2009). The first of Kisker’s articles updates and adds momentum to her 2011 study outlining the Institute theory of change (summarized in her article to be found in *On Common Ground* #14), fulfill-

ing the objectives identified in the Initiative’s 2007 Understandings and Procedures. Beyond the immediate and future outcomes identified in her first study, Kisker here points out — in a survey of 2014-2017 New Haven teachers — that the Institute experience caused them to focus anew on and to improve their teaching practices. She also here condenses still more her finding in the first of these two articles that curriculum unit writing and implementation can be objectively identified as sources of teacher improvement. She concludes by showing the close correlation between the Institute theory of change and the emerging field of research that has identified best practices for programs in professional development.

In our special Tulsa section, as teacher leader and Representative Krista Waldron says, the doors opened and momentum gathered for her as soon as she found a sponsor in Roger Blais. The second contribution is from Blais, recently retired Provost of The University of Tulsa and the ministering angel of the new Teachers Institute for Tulsa. A chemist in the classroom, Blais compares the state of Tulsa public schools (and we have all followed what has been happening in Oklahoma) to entropy in the Second Law of Thermodynamics, a state of decline that can only be “fixed from within.” He points out rightly that teachers already have pedagogical skills, their education training and native instincts can be given credit for that, but what they sorely need is the “content and increased determination” that the Teachers Institute model has been shown by Rogers Smith and Ellen Kisker to provide.

Tulsa Deputy Chief of Academics Danielle Neves reminds us that teachers take pride in the “craft” — a skill combining strategy, tactics, and knowledge — that the Institute can and will provide. Krista Waldron amusingly recounts the task of recruitment that teacher Representatives undertake, a task that seems at first like selling door to door, then takes on
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Smith: The Promise of America's Teachers Institutes

(continued from front cover)

neither class size nor any other factor improves school-time learning as much as the quality of teachers.³ The national education systems that are rated near the top vary in many ways. But high-performing countries like Finland, South Korea, and Singapore are all also at the top in their investments in teacher professional development, teacher salaries, and teacher recognition.⁴

In contrast, those nations that have turned to school choice initiatives in recent years have far more mixed records. In New Zealand, which adopted a countrywide school choice initiative in 1989, student achievement has not improved, while the segregation of Maori from European-descended students has increased.⁵ In Sweden, the adoption of a nationwide voucher program in 1992 has been followed by students declining from still well above average in their Program for International Student Assessment (PISA) scores in 2000, to below average in math, reading, and science by 2012.⁶

It is also worth noting that, as American elementary and secondary school performance has declined in comparative perspective and its higher education sector has also become increasingly embattled, the United States' longstanding advantage over other OECD countries in the percentage of its 25-34 year-old residents with college educations has diminished sharply, falling from a 17% edge in 2000 to a 4% advantage in 2016.⁷ Although America's higher education system remains the world's finest, it cannot prosper if the nation's K-12 schools are not performing well.

This contemporary context makes the Teachers Institute approach to improving teacher quality more essential for America today than ever before, and especially for its most high-need students. Initiated at

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Yale, which has had a successful Institute since 1978, the Teachers Institute approach of blending teachers from different grade levels in small, intensive, collaborative, long-duration seminars devoted to development of rich content knowledge and improved communication skills has all the features that educational research shows to be crucial for teacher professional development. These include:

- a focus on content, and on pedagogy linked to content;
- active teacher learning;
- teacher leadership;
- extended duration;

This contemporary context makes the Teachers Institute approach to improving teacher quality more essential for America today than ever before, and especially for its most high-need students.

- collective participation by teachers from the same school, grade, or subject;
- alignment with state and local standards; and
- ongoing evaluation.⁸

It is important to note that in the latter regard, each Teachers Institute always has its program evaluated every year by all its participants. In multiple cities over several decades, teachers have consistently rated their Institute experiences as especially valuable in terms of the factors that educational researchers find to be the most important ingredients of teacher quality:

- teachers who really know their subjects;
- teachers with good basic writing, math, and oral presentation skills;
- teachers with high expectations of their students;

- teachers who are enthusiastic about teaching; and
- teachers who can motivate all students to learn.

Participation in Teachers Institute seminars has also been shown to be associated with higher retention rates for teachers in their jobs, a hallmark of outstanding educational systems like Finland's.⁹ And as described by Ellen Kisker elsewhere in this issue of *On Common Ground*, the Yale National Initiative of the League of Teachers Institutes is developing new means for more comprehensive evaluations of Teachers Institutes, including assessments of the curriculum units teachers write in Institute seminars, and systems for tracking and analyzing their uses and their impacts in classrooms.

But skeptics may reasonably ask: if the Teachers Institute approach has been around for roughly forty years, during the same era in which the performances of America's K-12 public schools, and American confidence in their schools, have declined along many dimensions, how can it be a significant part of the solution to the nation's education problems today? Shouldn't we look, as American often do, for some radical quick-fix to cure our woes — like, perhaps, dramatically privatizing education further?

The sobering yet compelling answer is that the quest for a quick-fix is in fact a main reason why the Teachers Institute approach and related educational initiatives have had real but limited positive impacts on the nation's educational challenges thus far. Strengthening teaching to strengthen learning, and thereby strengthen the nation, is an endeavor that, as international experience demonstrates, requires significant investment in programs that are both broad and deep over extended periods of time. Impatient for rapid progress, Americans have been reluctant to make those investments, and have become only more so as a variety of quick-fixes (small high schools, mandatory yearly improve-

(continued on back cover)

Updating the Theory of Change

By Ellen Eliason Kisker

A theory of change is a succinct description of a program or approach and the mechanisms through which it is expected to improve its targeted outcomes. It is a useful tool for stakeholders to communicate with others about the program and its expected benefits. An explicit theory of change also provides a foundation for evaluating the program.

The Teachers Institute Theory of Change Maps Pathways to Teacher and Student Outcomes

The Teachers Institute theory of change (Figure 1; Kisker 2011) describes how program founders designed the Teachers Institutes to improve teaching and student learning. The Understandings and Procedures of the Yale National Initiative (2007) provide a clear description of the essential features of the Teachers Institute approach. The theory of change identifies the immediate products, intermediate outcomes, and longer-term outcomes that are expected when the Teachers Institute program is implemented as intended.

The theory of change has a longitudinal dimension that is difficult to illustrate but crucial for understanding the potential impact of Teachers Institutes. Over time a significant proportion of district teachers will participate, and some teachers will participate in multiple years. In New Haven, for example, during the period from 1992 to 2017, 527 teachers participated. Half participated more than once, one quarter participated more than twice, and nearly one tenth participated at least five times (Kisker 2018a).

Higher teacher retention compounds the benefits for students over time. Teachers who stay continue to use Institute-developed curriculum units and apply their enhanced knowledge and classroom practices in teaching future cohorts of students. They provide leadership and continue to

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foster collaboration and higher morale and collegiality among teachers.

Curriculum units are available for use by other teachers, further extending the potential effects of the Teachers Institute seminars. While the extent of unit use by other teachers remains uncertain, a recent survey of New Haven teachers estimated that 11% of other teachers had used Institute units. A pop-up survey of Web site users over 17 months identified thousands of teachers across the country and around the world who had used or planned to use Institute curriculum units they found online (Kisker 2018b).

Research and Best Practices Support the Teachers Institute Theory of Change

The Teachers Institute theory of change is grounded in the founders' vision for the program, affirmed by participating teachers' reports about their experiences and the benefits of participating, and backed by research and experts' current understanding of best practices.

What Participating Teachers and Program-Sponsored Research Say

Outcomes research conducted by the Yale-New Haven Teachers Institute and Yale National Initiative shows that participating teachers consistently rate their Institute experience as valuable. From 1992 to 2017, three quarters of all New Haven teachers who participated reported at the end of the program that the program was useful to them to a great extent, and the others indicated that the program was useful to a moderate extent (Kisker 2018a). Annual surveys conducted in four Institutes that asked participating teachers to compare their Institute experience with other professional development programs rated the Institute programs higher than other programs in developing knowledge, skills, enthusiasm, high expectations of students, and capacities to motivate students (Smith 2004).

End-of-program surveys of Institute Fellows in New Haven support many of the pathways identified in the theory of change. After participating in the Institute,

almost all of the 1992-2017 Fellows agreed (many strongly) that their seminar helped them grow professionally and intellectually and that they gained knowledge of their subject and confidence in their ability to teach it. Most agreed that they have higher expectations of their students' ability to learn about the seminar subject, and two thirds agreed that they learned new teaching strategies from other participants in their seminar and that their seminar provided useful feedback about teaching. The majority of 2014-2017 Fellows agreed that the seminar gave them opportunities to work on their teaching, led them to seek information from others, led them to think about teaching in a new way, and made them pay closer attention to their teaching (Kisker 2018a).

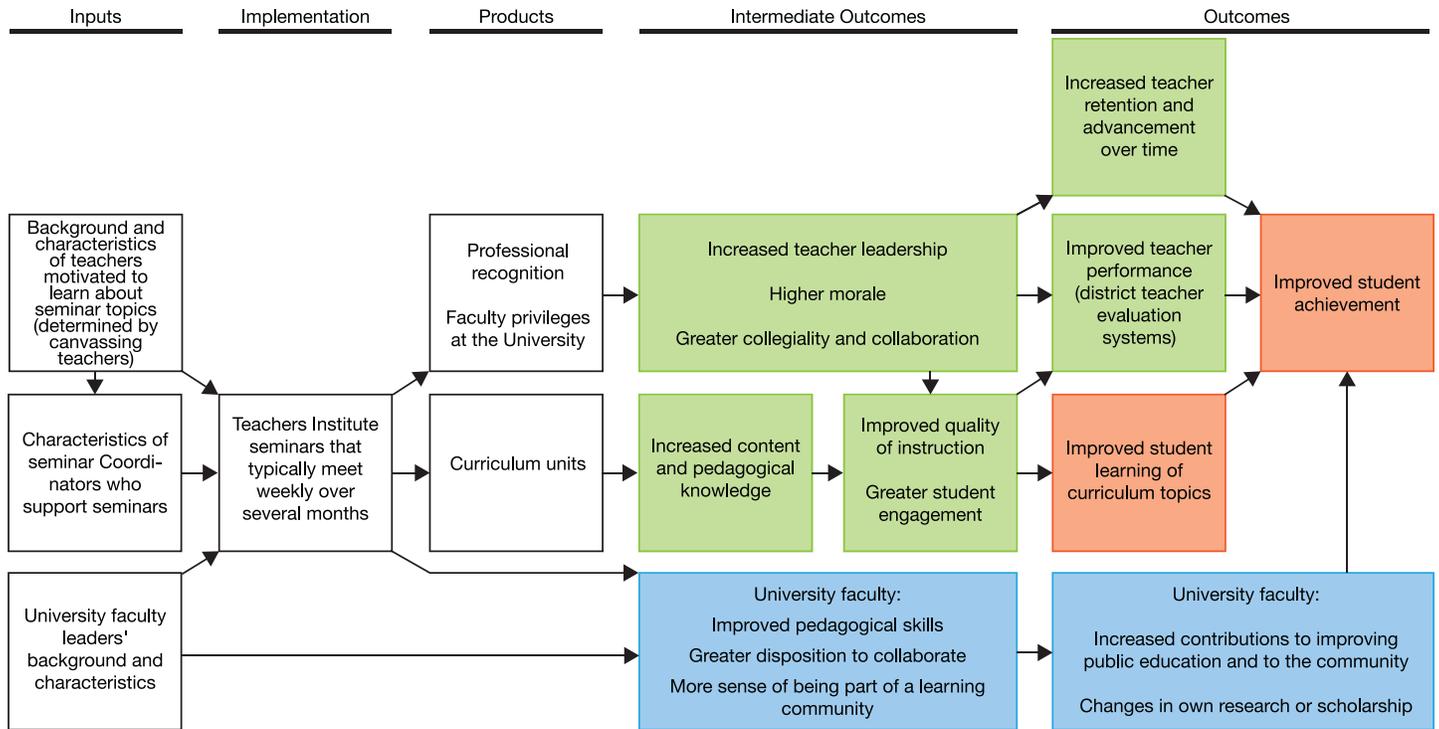
Curriculum units forge a strong link between Institute seminars and teachers' classrooms. Nearly all Fellows use the units they write, sharing some aspect of what they learned in their seminar with their students. Institute curriculum units, which focus on subject matter and teaching strategies but do not include complete lesson plans, can be used in a variety of ways. New Haven Fellows who responded to an online survey in 2016 or 2017 were most likely to implement their own units as written or with adaptations. Many Fellows also used the teaching strategies or subject matter from the unit to prepare for teaching other materials (Kisker, 2018b).

When using Institute units, other New Haven teachers and teachers who found Institute units online were most likely to read the teaching strategies or subject matter in the units to get ideas or prepare for teaching their own curriculum. Many reported that they read the bibliography to identify other resources or shared the unit with another teacher who might be interested (Kisker, 2018b).

Institute curriculum units are well-regarded. In New Haven, nearly all teachers who responded to the online survey were satisfied with the units they had used and planned to implement again the unit

Kisker: Updating the Theory of Change

Figure 1. Theory of Change for Teachers Institutes



they had used most recently. Fellows and other teachers in New Haven who had used Institute curriculum units as written or with adaptations reported that they compared favorably to commercial curriculum materials they had used (Kisker, 2018b).

Smith (2009) reported that Teachers Institutes are influential in retaining existing teachers because participating teachers find the seminars stimulating and feel “respected and acknowledged as creative, caring educated colleagues.” Quantitative analyses of data in New Haven confirm this. Of those teachers who had been Institute Fellows by the end of the 2000-2001 school year, nearly two thirds were still teaching in New Haven in 2004-2005, compared with fewer than half of other teachers. Fellows were almost twice as likely as non-Fellows to remain teaching in the district five years later, controlling for differences in race, sex, and years of teaching experience (Smith, 2009, p. 24).

The majority of participating teachers rate student attention, motivation, interest, and content mastery as higher during Institute-

prepared curriculum units compared with other curriculum units (Smith 2009). A retrospective analysis of student achievement outcomes during the 2000-2001 to 2004-2005 school years, however, did not find significant effects of the Teachers Institutes on student achievement test scores or course grades. This was not unexpected, because the curriculum units were not designed to align with achievement tests. Smith (2009) concluded that student outcomes data more closely tied to the goals of the Institute-prepared curriculum units, or more extensive and reliable data on student outcomes more generally, is required to demonstrate Institute impacts on students.

What Other Research Says

Strong causal research on the effectiveness of teacher professional development (PD) is still limited but growing. Not all rigorous studies have found positive effects on student achievement, but many well-designed studies have (Darling-Hammond et al. 2017). These studies show that teacher PD can improve the intermediate and longer-term outcomes that the Teachers Institutes

are designed to influence.

A number of studies suggest that PD can increase teacher content knowledge and pedagogical content knowledge. Of the 25 evaluation studies reviewed in Blank, de las Alas, and Smith (2008), for example, 10 reported evidence of measurable effects on teacher content knowledge. More recently, Heller et al. (2012) evaluated three PD interventions that all focused on building teachers’ content knowledge and pedagogical content knowledge in science, taking three different approaches. All three increased teachers’ content knowledge and student test scores significantly, and analyses showed that the effects on students were achieved in part through the programs’ effects on teacher content knowledge.

Research has also demonstrated that increased content knowledge can influence classroom practices. For example, Hill et al. (2008) examined associations between mathematical knowledge for teaching and the quality of mathematical instruction and found a significant, strong association between them.

Studies have also shown that teacher PD can have a positive impact on classroom practices. Scher and O'Reilly (2009) conducted a meta-analysis of strong causal studies and found that the pooled effect size of math and/or science PD on teacher practice was .63 and highly significant.

Several studies point to the value of PD that supports teachers in developing their own curriculum. Carpenter et al. (1989) evaluated a PD program that made teachers aware of research findings, then supported them in developing curriculum units. The evaluation documented positive effects on teacher knowledge, improvements in observed teacher practices, and higher student achievement. McCutchen et al. (2002) provided an instructional institute for teachers focused on increasing teacher knowledge and supporting teachers in developing their own curriculum around what they learned. The evaluation documented positive effects on teacher knowledge and improvements in observed teaching practices.

Teacher PD also can have a positive impact on student attitudes and student perceptions. Scher and O'Reilly (2009) found significant pooled effect sizes of math and/or science PD on student attitudes (.42) and student perceptions (.57).

The ultimate goal of teacher PD is to increase student learning and achievement. Yoon et al. (2007) identified nine studies of PD that met What Works Clearinghouse evidence standards. All nine studies employed workshops or summer institutes for elementary school teachers and focused on a range of content areas. Most reported effects on student achievement were positive; 8 were statistically significant, and 9 of the remaining 12 were substantively important, with effect sizes of at least .25. The average effect size was .54.

The meta-analysis conducted by Scher and O'Reilly (2009) also found positive effects on student math and science achievement, with pooled effect sizes ranging from .12 to .38. Blank, de las Alas, and Smith (2008) found that one third of the evaluation

studies they reviewed reported measurable effects of teacher PD in math and science. Darling-Hammond et al. (2017) identified 35 studies with strong evaluation research designs (experimental or quasi-experimental design) or analyses with appropriate statistical modeling and controls for context and student characteristics that demonstrate positive effects on students.

What Experts Say

To help states and school districts making decisions about teacher learning and development, organizations providing technical assistance have synthesized research results and advice of experts to identify features and practices that make it more likely that a teacher PD program will be effective. The National Comprehensive Center for Teacher Quality, for example, identified five features of high-quality PD: (1) alignment with school goals, district standards and assessments, and other professional learning activities; (2) focus on core content and modeling of teaching strategies for the content; (3) inclusion of opportunities for active learning of new teaching strategies; (4) provision of opportunities for collaboration among teachers; and (5) inclusion of embedded follow-up and continuous feedback (Archibald et al. 2011).

More recently, Darling-Hammond et al. (2017) examined rigorous studies of PD programs that demonstrated positive effects on teaching practices or student outcomes to identify common features of these programs. They found that effective teacher professional learning includes most or all of seven widely shared program features: (1) a focus on teaching strategies associated with specific curriculum content; (2) active learning to engage teachers directly in designing and trying out teaching strategies; (3) support for teachers to share ideas and collaborate in their learning; (4) use of curricular models and modeling of instruction to show teachers what best practices look like; (5) sharing of expertise about content and evidence-based practices, focused directly on indi-

vidual teacher needs; (6) built-in time for teachers to think about, receive input on, and make changes to their practice by facilitating reflection and soliciting feedback; (7) sustained duration.

The Teachers Institute approach encompasses many of these recommended best practices: (1) each Teachers Institute is aligned with school reform goals and is designed to support a district's strategic plan, and the curriculum unit each teacher develops is aligned with state and local standards; (2) Institute seminars deepen teachers' knowledge of core subjects and assist them in developing strategies to teach their own students what they have learned; (3) teachers are active learners in Institute seminars, receiving feedback from their peers and often trying out the units with their students as they prepare them; (4) the collegial exchange of ideas and sharing of expertise among school teachers and university faculty members lies at the very center of Institute seminars and is a tenet of the Institute approach; and (5) Institute seminars are of substantial duration, involving a minimum of 26 hours in session plus substantially more time for meeting with seminar leaders, researching seminar topics, and writing curriculum units. Teachers Institutes are planned, implemented, and sustained by teachers. Each Institute seminar topic is suggested by teachers based on what they think will enrich their classroom instruction. Teachers recruit their colleagues to participate, and one teacher in each seminar plays a coordinating role to handle administrative details, help establish collegiality, and act as a resource for other teachers.

The Theory of Change Needs to Be Tested Using a Strong Evaluation Design

The Teachers Institute theory of change has a solid foundation in experience and research, but it is still a theory that needs more testing with research designed to assess the causal relationships in the theory. Evaluation of the Teachers Institute approach employing a strong causal

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An Institute for Tulsa

Editor's Note:

This Tulsa section is headed by an image of progress chosen from one of the ten murals called America Today: Changing the West by the regional artist Thomas Hart Benton. Superimposed on the traditional landscape of the West, with its cowboy and old-fashioned ranch windmill, are images of progress and futurity: the planes, the skyscrapers, all foreseen by a surveyor who stands in for the visionary artist. Down below, alongside the welding that goes on close to a propane tank, you have glimpses of the daily and after-dark life everywhere that never changes, though inflected by local patterns. We illustrate the article below by teacher Thomas Teague — who remarks that getting involved with the Institute is like jumping onto a moving train — with another of Benton's murals, its train hurtling into the future with impressive purpose, though with the curious image above it of a then-futuristic plane wing: futures on futures, perhaps in rivalry like the train chasing the rabbit in Turner's Rain, Steam and Speed.



THOMAS HART BENTON, *CHANGING WEST*, 1930-31

Teacher Leadership in Tulsa's New Institute

By Krista B. Waldron

Two years into my time as a Fellow, and my first year serving as the Tulsa City Representative, I found myself sitting outside at the bagel café making cold calls to TU faculty. I desperately wanted two or three of them to accompany me for the start of the Intensive Session that summer, though I was still learning the ropes myself. Imagine the celebrated chemistry professor answering a phone call from a high school English teacher: “Uh, wanna spend five days at Yale with a bunch of public school teach-

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ers?” I’m not sure my actual plea sounded much better than that.

I finally stopped to think about whom I really knew on campus. How could they help me? Provost Roger Blais took the time to listen to my enthusiastic accounts of my times at Yale. He understood the concept immediately, and helped me seek out faculty who would be not only qualified seminar leaders down the road but who would also be respected leaders and spokespeople on our behalf. One by one, faculty members came on board as they heard the teachers’ stories or traveled with us to New Haven.

Unexpectedly, one great challenge was recruiting Tulsa teachers who would be around long enough to share in and benefit

from the work we were doing. Oklahoma, including Tulsa, has been experiencing an unprecedented loss of teachers to states with higher salaries and more respect from their legislators. Teacher after teacher was ready to engage but could not commit to the next few years. We slowly but diligently built our teacher family. Now, nearing the end of our first Institute year, I value the equally unexpected relationships I’ve cultivated with teachers across the district, in all grades and in all disciplines. We are buoyed by our shared hard work and love for it, both in our seminars and in growing our local Institute. On Monday nights, teachers roll into seminars exhausted and overwhelmed. They leave feeling inspired, rejuvenated, and connected.

Against Social Entropy

By Roger Blais

The Second Law of Thermo-dynamics teaches us that a closed system naturally tends toward increasing entropy that can only be overcome by work on the system. For children, parents and teachers are the primary influences fighting social entropy or disorder through education. There is no higher calling than the development of the next generation in intellect and character to foster a vision of hope and self-sufficiency for the future.

When we learned in Tulsa about the Yale National Initiative it seemed an ideal program to support and encourage teachers who endure low salaries, long hours, bureaucratic hurdles, and disrespect from politicians. The Initiative recognizes, as the

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late classicist Gilbert Highet said, that “A good teacher is a determined person.” Most teachers are deeply determined and eager to do the work necessary to combat social entropy. Already skilled in pedagogy, they yearn for the time and opportunity to master their disciplines more fully so they may better engage their students. The Yale Initiative recognizes and respects teachers as professionals who need the freedom, mentoring, and resources to explore new depths in their subject fields. Through their own exploration they discover innovative ways to spark student interest and resonate with the natural curiosity and creativity of youth. Participating teachers inspire one another while developing and sharing new lesson material. This inspiration helps to retain determined, hardworking teachers in the profession.

Establishing the order needed to form an Institute between Tulsa Public Schools and The University of Tulsa required six years

of work. We were supported by local philanthropists, particularly the Charles and Lynn Schusterman Family Foundation. By the time we offered our first four local seminars in November 2017, we had leadership from a dedicated and bonded cadre of school teachers and university professors who had experienced the seminars at Yale and were eager to provide the same opportunity for other teachers in our community. University faculty seminar leaders also learned much about pedagogy from the teacher-Fellows in their seminars. Fellows are currently developing units around understanding DNA, tracing the evolving concept of self in great literature, teaching chemistry through cooking, and exploring original materials in the Bob Dylan archive housed in Tulsa.

By supporting the teachers who affect all children so profoundly, the Yale National Initiative is a unique and effective actor in the struggle to reduce social entropy.

Community Investment in Tulsa Teachers

By Danielle Neves

The Tulsa Public Schools’ strategic plan, *Destination Excellence*, calls for our district to be the destination for extraordinary educators who work with our communities and families to ignite the joy of learning and prepare every student for the greatest success in college, careers and life. We recognize that developing and retaining empowered educators who create powerful learning experiences for all students is paramount to accomplishing our ambitious goals.

The hard truth is that we have students in our classrooms who do not always receive high-quality, robust and relevant learning experiences each day. One of the reasons for this reality is that our teachers are

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stretched so thin, and they are battling daily — whether it’s the endless budget and teacher salary woes in Oklahoma or a negative public narrative about our schools, students, families and teachers.

Even with these challenges, our teachers remain deeply committed to their professional craft and seek opportunities to continually deepen and refine their practice. Such opportunities reinforce the professionalism of teachers by allowing them to think deeply, engage in rigorous academic study, be challenged and stretched by colleagues, and develop powerful learning experiences for their students. The Yale National Initiative provides these rigorous learning opportunities for teachers. Unfortunately, these experiences are too few and far between.

Teachers Institutes give us an opportunity to invest in our teachers as they create

powerful learning experiences for students. It allows us to practice the types of adult learning that produce transformative benefits for our students. Local Teachers Institutes are not limited to the work that occurs in New Haven. The approach calls for local communities to design, found, and implement a Teachers Institute in their own cities. Accordingly, in fall of 2017, we launched the first local Teachers Institute for Tulsa in partnership with The University of Tulsa, more than doubling the number of Tulsa Fellows engaging in this rigorous academic discourse. Through our local Institute we will be able to exponentially impact our system as more teachers engage in these joint conversations and deepen their content knowledge through robust transdisciplinary opportunities that will prepare our students for their futures.

TiFT Testimonial

By Robert Sheaff

The Teachers Institute for Tulsa (TiFT), a collaboration between Tulsa Public Schools (TPS) and The University of Tulsa (TU), is finally a reality after the hard work and dedication of many individuals. My name is Robert Sheaff and I am an associate professor of biochemistry at TU. I served as one of the first seminar leaders, leading a discussion on the “Scientific and Societal Impact of DNA, the Blueprint of Life,” which attracted an eclectic group of Fellows interested in this hereditary molecule and how it could enhance their curriculums.

Robert Sheaff is Associate Professor of Chemistry and Biochemistry at The University of Tulsa.

Completed units covered a diverse range of topics from genetically modified foods and forensics to dog genomes and egg yolk tempera painting. My involvement in TiFT actually started much earlier during the planning stages, when I attended an Intensive Session of the Yale National Initiative to learn about program particulars. There I was introduced to an enthusiastic and dedicated group of teachers at TPS, which like many public educational systems is going through tough times. I came away from that visit impressed with what the Yale National Initiative offered in terms of structuring a collaboration between university faculty and local teachers, and saw firsthand the positive impact the program could have on teacher morale, retention, and professional development.

After my seminar I was surprised to discover that the program impact goes both ways, for I had gained new perspectives on my own areas of interest, as well as pedagogical pointers from experts. For these reasons I have agreed to continue serving locally (as a TiFT advisory board member) and nationally (as a member of the National University Advisory Council). Our next round of seminar topics has already been selected by area teachers, and we envision a significant increase in participation as word gets out about the Institute and its impact. I am excited about the establishment of the Teachers Institute for Tulsa at TU, and envision a long and fruitful collaboration with TPS that benefits not only teachers from both institutions, but most importantly the students they instruct.

Everybody Must Get Stoned: Dylan in the Tulsa Institute

By Sean Latham

In the hilarious opening track of his revolutionary 1966 album *Blonde on Blonde*, Bob Dylan and his band famously proclaim that “they’ll stone you when you’re trying to be so good.” The song broke into the top ten in the United States and got heavy radio play thanks to its clever pun that intermixes a still nascent drug culture with Biblical references. Dylan won his Nobel Prize, in part, because he has the poet’s distinctive ability to do just this kind of thing — move into what seems like simple language only to twist and transform it in ways both rollicking and revelatory. That same shock of discovery captures my own experience as a teacher and student of language during the seminar sessions I’m now leading as part of the Teachers Institute for Tulsa.

Sean Latham is Professor of English and Pauline Walter Professor of Comparative Literature at The University of Tulsa; and Director of the Oklahoma Center for the Humanities.



GAI TERRELL, NEWPORT FOLK FESTIVAL, 1964

When my provost first invited me to visit the Yale National Initiative, I figured “what the hell.” We were passing through New Haven that summer anyway and it would be a good excuse to visit the Beinecke. I never actually made it to the library that week and returned to Tulsa excited to recreate the creativity and deep sense of public engagement I saw at Yale. The George Kaiser Family Foundation had just acquired the Bob Dylan Archive and I was helping to lead the University of Tulsa’s research efforts around

these exciting new materials. I thus proposed a seminar called “From Woody Guthrie to Bob Dylan and Beyond: Art and Politics in American Popular Music.” It would draw heavily on archives here in Tulsa and I was convinced that I could help local teachers learn how to engage these materials and bring them into their classrooms.

That top-down plan, however, fell apart as soon as the Fellows began to develop their projects. In each of our sessions, I learn more and more from these talented teachers about the craft of pedagogy and about how vital a role popular music already plays in their diverse and chronically underfunded classrooms. I was so impressed by their developing units, in fact, that I invited two of the Fellows to share their work as featured speakers at a major symposium organized around the Bob Dylan Archive. These teachers are transforming my own teaching practices and working with them has knocked down my own professional pretensions while opening up new ways of seeing the classroom. Put simply, “they stoned me.”

Jumping on a Moving Train

By Thomas Teague

Getting involved with the Yale National Initiative with my fellow Tulsa teachers two years ago felt like jumping on a moving train. When a fellow teacher recruited me, I didn't realize that Tulsa was a projected location for a local Teachers Institute. The esteemed University of Tulsa faculty who joined us on my inaugural trip to Yale are all now leading their own seminars. I made connections and embraced my role as a classroom teacher during a time when teaching in Oklahoma was precarious and other careers were more financially lucrative. I fell in love with learning all over again and found at Yale a peer group of professional learners and educators. More importantly, I saw the

up its cultural and scientific resources. For example, Tulsa famously houses the Woodie Guthrie archives, which prompted Bob Dylan, whose "Okie Face" emulated Guthrie, to house his archives in Tulsa as well. Our teacher Fellows have had unique access to some of these materials while exploring social and political progress through music.

Other teacher Fellows have had access to scientific equipment on The University of Tulsa campus, used it, and even learned how to extract DNA in the classroom with the simplest and most available of tools. Still others are learning how we invent ourselves with the modern selfie, drawing comparisons between Velázquez and Montaigne and the Instagram artists who help our students invent themselves



THOMAS HART BENTON, *INSTRUMENTS OF POWER*, 1930

hard work people were doing to improve professional development nationwide. I wanted that for Tulsa. Staying in the classroom was a must for me once I saw how much I could grow professionally.

The Teachers Institute for Tulsa is going to help restore Tulsa, through teachers and students, to its former status as a world class city. An Institute for teachers can open

Thomas Teague is a Science Teacher at Central Junior High School in Tulsa, Oklahoma.

Fry: Expanding Horizons

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meaning as interest develops and word spreads. At the start of the Tulsa section, I mention teacher Thomas Teague's contribution in describing the two murals by Thomas Hart Benton. Tulsa Professor Sean Latham, entrusted with the university's important Bob Dylan and Woody Guthrie archive, has been teaching one of the inaugural seminars, on Dylan, and writes inspiringly that the teachers in his seminar showed him, with their independence and originality of insight, that collegiality in Institute seminars isn't just scripted, it's the necessary consequence of mutual and reciprocal knowledge on everyone's part. To accompany Latham's account we show a photo of Dylan, wearing the "Okie face" of Guthrie (as Thomas Teague puts it) at the Newport Folk Festival of 1963 — where with an electric guitar Dylan defied received opinion, as the hard thinking shared by professors and teachers in our seminars tends to do also. Finally, Tulsa Professor and member of our National University Advisory Council Robert Sheaff writes about teaching his inaugural seminar on DNA, explaining his involvement with the Yale National Initiative and expressing his enthusiasm for Tulsa's new Institute and its prospects.

Next in this issue, we are proud to publish a testimonial from Victoria Oakley, the recently retired Interim Chief Academic Officer of the Richmond Public Schools, who is an activist sponsor of the planned Institute in Virginia, long the project of teacher leader Valerie Schwarz (no stranger to these pages), which moves ever closer to reality. As Oakley writes, the hope of the work now going forward is to cement ties with Virginia Commonwealth University. We accompany her remarks with a primitive artist's rendering of *Lincoln in Richmond*, a fitting image of the People's President who reunited the country after the civil strife with the Confederacy of which Richmond had been a part, modeling the possibility of restored

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Our Current Journey towards a Richmond Teachers Institute



MALCAH ZELDIS, LINCOLN IN RICHMOND, 1983

By Victoria Oakley

Richmond Public Schools in Richmond, Virginia truly values our partnership with the Yale National Initiative. Since 2005, fifty-five Richmond Public School teachers have participated in the Yale National Initiative, exposing them to the Teachers Institute

Victoria Oakley recently retired as Interim Chief Academic Officer of Richmond Public Schools in Richmond, Virginia.

model with the hope of bringing this model to Richmond.

We are very proud of our Yale Fellows. They have worked diligently to promote our own Richmond Teachers Institute. This school year they met with all the school board members to share the strengths and advantages of developing a Richmond Teachers Institute. The Fellows lobbied the school board for funding in the 2018-19 budget. A successful meet and greet was held with Richmond Public School principals to

share the concept of developing our own Richmond Teachers Institute. A steering committee comprised of teachers, administrators, university faculty and community members has been formed to promote and support the implementation of a Richmond Teachers Institute. Steering Committee members have met with the Provost from Virginia Commonwealth University to reaffirm their commitment. Our next steps are to reconfirm the commitments of Virginia Commonwealth University and Richmond Public Schools and hire a Planning Director. Our goal is to begin local seminars in 2019.

Our Richmond Teachers Institute will annually serve up to forty-eight K-12 teachers from throughout the district in core subject areas and support an interdisciplinary approach to learning, inspiring higher-level thinking skills for teachers and thus for students. The local Institute will encourage collaboration through the sharing of curriculum units aligned to the Virginia Standards of Learning and foster collegiality among teachers throughout the district. Our desire in forming a partnership with Virginia Commonwealth University is to build teacher leadership and ownership in professional development, increase teacher morale and retention, and attract highly qualified educators who seek continual professional growth.

Ultimately, establishing a Richmond Teachers Institute will provide a long-term investment in student achievement and in our city.

Study of Teachers Institute Curriculum Units

By Ellen Eliason Kisker

In Teachers Institute seminars the faculty seminar leader guides participating teachers (Fellows) in learning about the seminar topic, and the Fellows

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develop curriculum units on some aspect of the topic. Writing a unit is intended to solidify teacher learning and help Fellows work out, with support from their seminar leader and other Fellows, how to take some part of what they learned in the seminar into their classroom to share with students.

Unlike most commercial curriculum

materials, Teachers Institute Curriculum Unit Guidelines require units to emphasize subject matter and teaching approaches, and the program expects Fellows not to provide complete lesson plans. Nearly all unit authors leave their seminar planning to do more work on their units before implementing them, and other teachers using the

units should expect to adapt the units to meet their own needs.

Institute Curriculum Units Are Written for Diverse Students

A systematic review of Institute units showed that, across seminars and locations, Teachers Institute curriculum units are written in all core subject areas and target students in all grades from kindergarten through 12th grade. Units are usually written for both the least and most advanced students.

The diversity of their students led some unit authors to discuss differentiation (35 percent of units), how to create a positive learning environment (23 percent of units), or how to address anticipated challenges, such as frequent student absences, in teaching the unit (23 percent of units).

Most Institute Curriculum Units are Clearly Written, Accurate, and Usable by Another Teacher

Teachers Institute curriculum units are written with an audience of other teachers in mind. A systematic review by teacher reviewers determined that 81 percent of the units are written clearly, and the subject matter and teaching strategies could be understood by other teachers.

Faculty reviewers indicated that the content of the subsample of units they reviewed was accurate in all cases, but the depth of understanding demonstrated varied from superficial understanding (10 percent of units) to in-depth understanding (55 percent of units).

Teacher reviewers found most curriculum units (87 percent) to be usable by another teacher. The small proportion of units found to be unclear or not easily usable is notable, given that teachers are not selected for the program based on prior preparation or skill in writing.

Both Authors and Other Teachers Use Institute Curriculum Units

Curriculum units forge a strong link between Institute seminars and teachers' classrooms. Nearly all Fellows use the units they write, and it is common for them to use units written by other Fellows also.

Other teachers use Institute curriculum units, too. While the extent of use by other teachers is uncertain, the study found that 11 percent of other teachers in New Haven had used Institute units. A Web pop-up survey also identified thousands of teachers across the country and around the world who had used or planned to use the Institute curriculum units they found online.

Teachers Use Institute Curriculum Units in Multiple Ways

New Haven Fellows who responded to an online survey were most likely to implement their own units as written (49 percent of Fellows) or with adaptations (49 percent of Fellows), such as rearranging the unit to fit the curriculum, implementing parts of the unit at various times, adapting the unit to a different grade or to differentiate instruction, supplementing the unit to fit the needs of particular classes, and adjusting pacing or activities based on experience teaching the unit or in response to student interest while teaching the unit. Many Fellows also used the teaching strategies (57 percent of Fellows) or subject matter (41 percent of Fellows) from the unit to prepare for teaching other materials.

When using Institute units written by other teachers, New Haven teachers were most likely to read the teaching strategies (66 percent of teachers) or subject matter (62 percent of teachers) in the units to get ideas or prepare for teaching their own curriculum. Many reported that they implemented the most recent unit they had used with adaptations (43 percent of teachers) or

read the bibliography to identify other resources (31 percent of teachers).

Teachers Compare Institute Units Favorably to Commercial Curriculum

Institute curriculum units are well-regarded. In New Haven, nearly all teachers who responded to the online survey were satisfied with the units they had used and planned to implement again the unit they had used most recently.

Most teachers reported that, compared with commercial curriculum they have used, Institute units elicit the same or greater student attention, interest, and motivation, and lead to the same or higher student mastery. More than half reported that Institute units were superior overall to commercial curriculum materials they have used.

Publication of Institute Units Online Extends Their Use

Publication of Teachers Institute curriculum units online leads to their use by thousands of other teachers, many of them public school teachers, across the country and around the world. A Web pop-up survey, even with a low response rate, documented use by more than two thousand teachers over a 17-month period. These teachers were most likely to read the subject matter or teaching strategies to prepare for teaching other materials or to implement the unit with adaptations.

I found that the units contained rigor and caused students to think and reflect in ways that they are unaccustomed to with the current curriculum.

— New Haven teacher

Teachers Institute Curriculum Unit Study

The study focused on curriculum units completed in 2014 and 2015 in three Teachers Institutes (Yale-New Haven Teachers Institute, Delaware Teachers Institute, and Teachers Institute of Philadelphia) and the Yale National Initiative.

The study drew on multiple data sources, reflecting different perspectives on curriculum units:

1. online questionnaires completed by Fellows at the end of the program;
2. a systematic review of curriculum units;
3. a Web pop-up survey (Yale National Initiative and Yale-New Haven Teachers Institute Web sites only);
4. online teacher survey (New Haven, CT school district only); and
5. focus groups (Yale-New Haven Teachers Institute only).

Literature and Information

By Jessica C. Brantley

In 2015 I led a Yale National Initiative seminar that explored connections between “Literature and Information” — or fiction and nonfiction — in the K-12 classroom. The seminar was designed as a response to the debate surrounding Common Core standards for learning recently adopted by most states. Among many other changes, these standards newly emphasize nonfiction (“reading for information”) over more traditional kinds of literary texts (poems, plays, prose fiction). But reading is a complicated art. One reads to find the answers to questions, to enter-

Jessica C. Brantley is Professor of English at Yale University.

tain oneself, to communicate ideas, to move emotions — and the kinds of skills required to read are not divisible into neat categories. The YNI seminar surveyed many kinds of texts and a variety of ways of reading them, in order to challenge any clear relation between “literature” and “information,” and to explore the benefits of learning in both modes.

Joyce Arnosky, a member of the “Literature and Information” seminar, took up its challenge by creating a unit that innovatively teaches the events of American history through children’s eyes. Her unit for middle school students enlivens the history of the Great Depression with multiple ways into that history, from the songs and lyrics of Woody Guthrie, to the math behind the

economic crisis of the period, to the photographs of Dorothea Lange and Walker Evans, to — yes — recipes for blackberry pie. Most of all, Joyce wanted the variety of materials she gave her students to suggest to them strong connections between then and now, and especially between children’s experience in the Great Depression and today. And so she used fiction for its unique capacity to spark an imaginative leap from one person’s perspective into another’s: novels such as *Bud Not Buddy* and *Out of the Dust*, read alongside the nonfiction *Children of the Great Depression*, can provide young learners with a powerful emotional connection to other children’s stories, creating a link between the past and the present.

Teaching Children about Children in the Great Depression

By Joyce Arnosky

“Can we make blackberry pie? Please?!” This question came up repeatedly throughout the unit. My students wanted to be sure that we could make a blackberry pie described by a kind-faced, elderly woman in a documentary we had watched as we began our unit on children suffering through the Great Depression. She recounted a poignant memory from her Depression-era childhood of picking blackberries and how her mother would make them into pie — a sweet delight in their otherwise cheerless circumstances. When I think about teaching this unit, their question, oddly, is what comes to mind for me as well. Of all the work we did, and all that we learned, it was my students’ connection to blackberry pie that was the catalyst.

Reflecting on teaching my unit, I would begin by saying that though it didn’t unfold

Joyce Arnosky is a Fifth-Grade Teacher at Penn Alexander School in Philadelphia, Pennsylvania.

exactly as I had planned, changing as it did to be responsive to the students in front of me — the reality of this class, this year — it did retain its essential goals and focus. This underlying integrity depended in large part, I believe, on the breadth and depth of knowledge obtained through the process of researching, thinking about, and creating the unit. This allowed me a great deal of flexibility. I was able to support my students as they discovered and pursued ideas and images that captured their imaginations, yet still remain within the framework of the curriculum. I felt I knew my content so thoroughly that no matter how far afield we ventured, I could always point our way back.

My principal has always allowed us a great degree of autonomy in our practice. So when I shared the unit with my two grade partners and they enthusiastically suggested we make it a project for the entire fifth grade, we were able to go with it. We three have very different teaching styles and curricular passions, and it was interesting to see how each one chose

activities from the unit and how each went about teaching them. For one of us, it was Guthrie’s protest songs and their connection to Bob Dylan. For another, it was the photographs of Lange and Evans and learning to “read” them. The mathematics of the stock market was the focus for another. With no common planning time, we met hurriedly and informally, but I was able to provide resources and a measure of cohesion to our project. When we came together for a culminating event of Depression-era food and students’ shared writings, it was clear that each of us had been able to take the unit, make it our own, make it relevant to and reflective of our particular classroom’s needs, while assuring that all our students had a meaningful shared experience.

An expectation of our seminar was aligning fiction and nonfiction so that students could read each work and understand its thesis more fully. I was able to see glimmerings of this deeper understanding and felt certain that the texts and activities I had chosen met those criteria.

Fry: Expanding Horizons

For example, when the class read that many children didn't go to school and many youngsters took to the rails, their initial reaction was, "Boy were they lucky! No school!" Those sentiments were tempered as we read the gritty details. Our literary discussions were enriched because of what students read in paired fiction and nonfiction texts and a deeper, more empathetic understanding of Depression children's lives evolved.

One of the joys of creating a unit is that you acquire so much knowledge — but time is not a friend to teachers. The initial plan of four weeks was not enough — no surprise there. Though I regretted having to leave things out, I realize that the lessons learned in the seminar are now and will remain a part of my teaching repertoire, available for teaching any subject.

So how does the blackberry pie motif fit into all of this — aside from the obvious connection between ten-year-olds and sweets? At first, I was taken aback. Here was this brilliantly conceived unit and all my students could think about was making pie! But I realize it made perfect sense. Their question shows the empathy I had hoped they would experience. I wanted them to see children, much like themselves, as part of that past, yet connected to today. I wanted them to understand history as a construct of many voices and experiences to be discovered in the works they were reading. The blackberry pie connected them with a child, like themselves, who invited them along on the journey through the bad times, and they followed.

By the way, we did make that blackberry pie.

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unity that we saw too in Jasper Johns brushing over in advance the differences between red states and blue states.

Ellen Kisker's second article for us shows how teachers and their peers have made constructive use of their curriculum units, proving from widespread testimony that they are superior to curriculum materials made available commercially. Authors of the units themselves adapt both the content and teaching strategies of their units to other grade levels and circumstances when necessary, and teachers who read these units, strikingly, use the strategies and even content they find there even when teaching wholly different subject matter. What stands out most remarkably overall is the influence of these units beyond the sphere of those who have written them. While such evidence is difficult to gather, Kisker has heard from over two thousand enthusiastic teachers who have made use of units without having been involved in any seminar themselves. This shows that even without the nationwide expansion we are advocating, the Institute model can cast a far wider influence than one might suppose. Imagine the incremental extent of that influence with the presence of an Institute in every state!

It is a tradition of *On Common Ground* that we devote a substantial part of each issue to reports from teachers in past National Initiative seminars who have now taught the curriculum units they wrote in their seminars. These reports, introduced by their seminar leaders, give us a lively sense of content-based enrichment in action. Having participated in Jessica Brantley's seminar on "Literature and Information," which Brantley illustrated in a lecture to the whole of the Initiative on how to read one of President Obama's great speeches after a school shooting, Joyce Arnosky of Philadelphia reports on teaching her unit on children during the Great Depression. This we illustrate with George Bellows's painting, *Cliff Dwellers*, an inclusive view of New York tenement life

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GEORGE BELLOW'S, *CLIFF DWELLERS*, 1913

Contemporary American Indian History

By Ned Blackhawk

In Summer 2016, Ludy Aguada participated in the National Initiative Seminar “Contemporary American Indian History,” along with nine other teachers from across the country. Ranging from Tulsa to San José and including metropolitan districts such as Chicago, Philadelphia, Washington, D.C., Richmond, and Pittsburgh, these Fellows came to New Haven with unique and varied perspectives. Some had longstanding interests in Native American history. Others explored the subject for the first time in an academic setting.

Ludy Aguada examined a range of literary and legal texts throughout our seminar and developed a unit that explored the intersection of these subjects. Entitled “Dreaming from the Margins, Living in the In-Between: Identity, Culture, and the Power of Voice,” her unit compares works by contemporary Native American authors, including Louise Erdrich and Sherman Alexie, and contextualizes them within the changing nature of American Indian law and policy. Her reading of Alexie’s *The Absolutely True*

Ned Blackhawk is Professor of History and of American Studies at Yale University.

Diary of a Part-Time Indian and Erdrich’s *The Round House* traces the lives of each novel’s protagonist and uses each as a window into larger questions about American Indians in contemporary society.

American Indian nations gained increased autonomy across the last decades of the twentieth century, and Native American literature illuminates such developments.

Through creative and expressive works, Native American authors have explored the political and cultural dimensions of questions about reservation impoverishment, cultural resiliency, and the jurisdictional quandaries of law and lawlessness on Indian lands, among many others.

Ludy’s unit placed particular focus on questions about jurisdiction. Reading a series of nineteenth and twentieth century U.S. Supreme Court Cases, she introduces her reading of *The Round House* with questions about law and the distinct sovereign status of Native American tribes. As she relates, American Indians remain recognized political sovereigns within the United States, as articulated by early nineteenth-century Supreme Court cases. Ludy finds Erdrich meditating on challenging questions of politics and violence in her work and on both the vibrancy and fragility of reservation families.

Through such combined legal and literary analysis, Ludy invites students to see how literature illuminates the world around them. Her unit broadly explores the ways that society influences the development of the young and provides particular engagement with Native American law, literature, and history.



FRITZ SCHOLDER, INDIAN, 1976

Teaching Native Life on the Margin through Fiction

By Ludy Aguada

Carmen’s voice trembled as she described her painting: the bright red balloon representing her hopes and dreams; the broken string the

broken relationships, including the one with the father who left when she was seven; the weight cradled in her hands people, especially her mother, who kept her

Ludy Aguada is an English Teacher at Overfelt High School in San José, California.

grounded.

Sergio’s normally calm, measured tones were pitched higher, his movements more animated as he described the bent and mangled buildings inspired by Salvador Dali, the cracks in the concrete stairs to nowhere

symbolic of what he saw growing up in L.A.

Miriam's enigmatic half smile widened as she described her Frida Kahlo-esque self-portrait: flowering vines meandering across her brow, the Lebanese, American, and Mexican flags representing aspects of her heritage, integral and inextricably intertwined with who she is and how she sees herself.

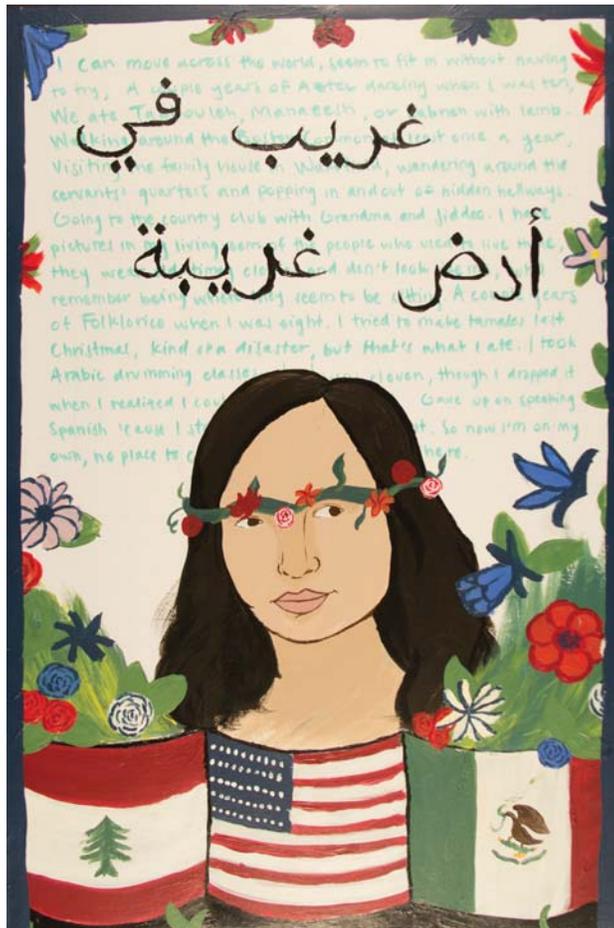
These are three projects submitted for "Dreaming from the Margins, Living in the In-Between: Identity, Culture, and the Power of Voice," the unit I wrote for the 2016 national seminar led by Ned Blackhawk. My goal was to use imaginative literature, specifically Louise Erdrich's *The Round House* and Sherman Alexie's *The Absolutely True Diary of a Part-Time Indian*, to teach non-fiction, skill-based reading and writing — the heart of the AP English Language classroom. A challenging task, but so worth it.

I previewed the novels before students read them over winter vacation. We read the first few pages of each novel and talked about how they foreshadowed the rest. The class was so quiet as I described Joe taking a magazine from a woman's hands and ripping it up in her face, I could have heard a pin drop on the carpeted classroom floor. We laughed at Junior's description of how he had too many teeth, "past human." When I distributed the books, I really wanted the students to love the novels as much as I did. When we returned from vacation and dove into the unit, I could tell they did.

First, I lectured — on world view, the Marshall Trilogy, the Indian Removal Act, the Dawes Act — and students took notes. We analyzed *Oliphant v. Susquamish Indian Tribe (1978)* using the IRAC method (Issue, Rule, Application, Conclusion). They analyzed Joe and Junior, then worked in groups to find textual evidence to support their claims. But it

was in Socratic seminars and fishbowl discussions that they began to make the connections I'd hoped they would.

At first, it was clear they saw Native peoples as historical peoples, their comments replete with past tense verbs. As their conversations progressed, however, verbs became present tense, and they made fewer



MIRIAM GHAREEB GUDIÑO, غديوة, IDENTITY, IDENTIDAD, 2018

references to "back then" and more to "nowadays." One of their richest discussions occurred when I asked them the question Ned had posed to me: "Which of these young boys do you think represents the future of Native youth?" As I did, students fell silent before a quiet voice ventured, "Joe." Conversation erupted. Some argued Joe could not and should not represent anyone's future because murderers are not heroes. Others viewed Joe's act of killing

his mother's rapist as one in which he reclaims his people's integrity and sovereignty, exacting justice on those who would violate them. Students then turned to Junior. They questioned his conclusion that leaving the reservation was his best option for a better life. They explored the effects his leaving had on family and culture — what was gained, what was lost. Some likened it to their parents' decisions to leave their home countries, and some saw Junior's decision paralleled in the ones they will be making in a year's time: "We're leaving for college next year. Isn't that, like, the same thing?"

These activities primed them for the culminating activity, "The Identity Project." Using as inspiration artwork in *Dreaming in Indian: Contemporary Native American Voices* by Lisa Charleyboy and Mary Beth Leatherdale, students created their own pieces that represent who they are. On presentation day, we gathered in the library for a gallery walk. As I watched them circulate, listening and questioning, their expressions revealed an appreciation for the art, for their classmates and their stories, and their willingness to be honest and vulnerable. They were connecting with each other in ways they had not before.

I know I will teach this unit again. Though it wasn't always smooth sailing — I learned quickly to read their body language (the side glance to a tablemate, the one-eyed squint, the slow head swivel to see who else was stumped) for when to slow down, elaborate, or both; I learned to celebrate tiny victories, the slow nods and wide smiles of sudden understanding. As I was hanging up the posters and paintings and drawings with the help of two of my AP English Literature students, one said, "These are really cool. I wish I could've done one." Tiny victory trophy.

Using Film in the Classroom, How to Read a Film

By Brigitte Peucker

Given today's media-saturated world, it is more important than ever to teach our students how to analyze images. Our seminar had a double focus of concern, with attention to "reading" a film and to problems in the adaptation of literary texts to film. We began by discussing formal aspects of the film medium — color and the composition of the frame, sound and music, lighting, and editing, among others — using carefully chosen films viewed outside the seminar and analyzed with the help of clips. Films tell stories by means of images, camera work, and editing procedures; color, sound, and

Brigitte Peucker is Professor of Film Studies and Elias W. Leavenworth Professor of Germanic Languages and Literatures at Yale University.

music are also central to narration. The formal procedures of the film medium convey information, but they also produce emotion in the spectator. A film sequence may be long or short, thus creating suspense, anxiety — or boredom. It may be shot with a mobile camera or a stationary one, from above or below, prompting us to ask whose eye is looking. Is it a character that looks; is it a narrator? A garish color scheme may set the tone for violence, or it may simply be theatrical or suggest gaiety. Music can be part of the story — as, for example, when a character sings or plays the piano — or it can be superimposed on the images, as in the scary music that accompanies a horror film. These devices shape the way we read films. In the seminar, we analyzed films from these formal points of view in order to answer the following questions: How is a story told? How does it

color our emotions? What is its aim in doing so?

Using the strategy of "close looking," Meg DeWeese's imaginative curriculum unit centers on the nature of suspense in Poe's short story, "The Tell Tale Heart," as well as in Hitchcock's *Strangers on a Train* — a perfect topic for the integrated American Studies course that she teaches to eighth graders. Her course focuses on character point of view and mood with respect to the Poe tale, and editing, lighting, and the camera with respect to Hitchcock, all with the goal of asking how our emotions are engaged by these texts. Each student created Poe "foldables" to expand their knowledge of Poe and his time and place as well as a film storyboard to help them understand how film narratives work — a perfect meld of learning strategies that "tricked" students into reading image and text.

Teaching the Art of Suspense with Poe and Hitchcock

By Margaret M. DeWeese

As a lover of film, I yearned to use film in a deeper way with my eighth-grade students; as a vehicle for the mastery of content instead of "film as filler" or as a cursory treat. As a participant in the seminar "Using Film in the Classroom" with Brigitte Peucker, I knew immediately that I could empower my students to view film in a different way. My students were reading great literature for the beauty and relevance of it, yet depth of analysis was usually lacking, especially when applying the elements to later lessons. Perhaps, through a cohesive unit about film and literature, my students would be able to sharpen their analytical skills.

My students and I were rewarded! At the initial seminar meeting I immediately

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found myself engaged in film techniques, elements, and other lore as we analyzed a wide variety of films. The seminar was extremely enjoyable, as participants quickly became conversant in the language and culture of film. My unit soon declared itself.

The suspense genre had successfully engaged my students in the past, even the most reluctant of readers, making it a prudent choice for a focus on the connections between the suspense elements in literature and film. This would allow us to move beyond the study of literary elements as separate and individual components and instead identify them through the analysis of rich, high interest narratives in text and film compared.

I decided to develop my curriculum unit around some questions: How do writers and filmmakers create suspense for their audiences? How do we as readers "view" a story? How do we "read" a film? I started with Edgar Allan Poe's "The Tell Tale

Heart." We first studied his biography, the dark passages of his life capturing my students' attention. We read the story together the first time for the sheer enjoyment of Poe's narrative. I then introduced the element of suspense (adding to it with a glass eyeball marble and rubber heart placed discreetly in my pocket!), while pointing out how cleverly Poe crafted his story to make the reader *feel* suspense. They then read the story again in groups, identifying the various literary elements. My students gobbled Poe's narrative up, wanting more!

They were now curious about suspense in narratives. After I explained that a famous director of suspense, Alfred Hitchcock, drew and captioned his own storyboards for every scene in every film he made, they began to view film as a narrative as well. Like Hitchcock, they made storyboards for "The Tell Tale Heart" as if they were going to make a movie of Poe's work themselves. I asked that their storyboards not only capture the "shot," but reveal the lines of text

Fry: Expanding Horizons

from Poe's narrative that helped them visualize the scene they would film. They also added the type of music and sound that would create the suspense that Poe had made them feel with his words.

Once we had finished with the written narrative, I showed them a classic Hitchcock film, *Strangers on a Train*. Prior to viewing the film, we practiced all the elements of cinematography with our camera "lenses," made of rolled up construction paper, viewing scenes around the classroom with wide lens, close ups, panning, and numerous other "shots." They had learned that when directors use specific camera angles or lighting choices they may be trying to say something about the character or situation, or they may be creating the all-important elements of a narrative: point of view, mood, suspense, and symbolism.

They were now fully prepared for film analysis, armed with a film tool box that would enable them to identify narrative in and as film. Most of my students had never seen a Hitchcock film, and as opening credits rolled, the usual groans about old black and white movies began. However, the groans of displeasure were soon replaced by the quiet of serious film buffs on the edges of their seats, finding satisfaction in the "aha" moments while spotting film and literary elements. They shouted warnings to Miriam when her death at the hands of Bruno appeared imminent in the Tunnel of Love, only to realize that Hitchcock has tricked them with shadows and an unsettling cacophony of carnival sounds. They could barely stay in their seats when we were ultimately allowed to view Miriam's murder in a stunning point of view shot, through her own broken glasses which have been knocked to the ground as she is being murdered.

Viewing a film will never be the same for any of us. Not only have films taken on a new sense of relevance and enjoyment for my students and me, but we now look on narrative itself with more constructive interest.

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that focuses on children. Arnosky says her students were fascinated by a grandmother who found the wherewithal to bake a pie, so we've chosen an image that's bleak, yet still holds out the hope that someone in this depicted world will be able to bake a pie.

In 2016, Ned Blackhawk led the seminar on "Contemporary American Indian History" in which Ludy Aguada of San José participated. Part of Blackhawk's subject matter, as he says, was to perform the tension between government and native interests, to illustrate which we provide one of Indian artist Fritz Scholder's images of an American native incongruously draped in the American flag. As we move towards an Institute for the Navajo Nation of the Diné in northeastern Arizona (another state in which teachers have succeeded in improving their condition), we think it fitting that contemplating the tension between independence and the hope of restored unity can be constructive. Aguada's moving account of teaching her unit points toward student self-discovery. Having read Sherman Alexie's and Louise Erdrich's novels in which young people are torn between tradition and assimilation, Aguada assigns as a culminating activity an art project in which students represent "who they are." We print here, with permission, an extraordinary artwork by one of her students, Miriam Ghareeb Gudiño.

After another Humanities seminar, Brigitte Peucker's "How to Read a Film," Meg DeWeese of Tulsa taught her unit on suspense in Poe and Hitchcock. Her unit had been called "Don't Look Behind You," and her report on teaching her unit concentrates on the experience of suspense students come to understand through the divergent practices of reading literature and film. Jill Campbell's seminar, "Literature, Life-Writing, and Identity," led to the unit "Teaching Identity in the Kindergarten Art Room" taught by Bobby Graham of Delaware, who emphasizes that it's not just self-portraiture that conveys identity. We accompany his report with Jasper Johns's

Target, featuring the primary colors from a child's watercolor box with which the targeted goal of self-identity will be achieved. Johns's signature on the left line — you can see it if you look closely — awaits a student's achieved signature on the right.

Two science seminars by Gary Brudvig are represented here. After "Chemistry of Cooking," Chris Moy of Chicago describes teaching his students about the chemistry and the nutritional pros and cons of sugar, culminating in the preparation of caramel apples, represented here by one of Wayne Thiebaud's famous images. "Energy Sciences" inspired Josh Bearman of Richmond to teach the past, present and future of energy in Virginia, with special focus on the heritage of coal, the fossil resources for which — part of his topic — are represented in the image we have chosen from the Field Museum. Two math seminars taught by Roger Howe are also recalled here. The seminar on Word Problems led to the unit taught by Jolene Smith of the Diné Nation, who explores the uses of word problems in the Navajo hooghan, here imaged in an appealing watercolor by Navajo artist Robert Draper. The seminar on the Number Line, which we illustrate with an elegant graphic of the number line by Roger Howe's daughter Kate Howe, inspired Aaron Bingea of Chicago to attack student learning impasses with broad applications of the number line, for which he has provided his own graphic.

We conclude with two reports arising from units in Mark Saltzman's seminar, "Engineering of Global Health." Kwame Adu-Wusu of Washington, D. C. has taught his unit on the cellular characteristics of muscular dystrophy, which we illustrate with a visual contrast between healthy cells and cells impaired by that disease. Finally, Beth Pellegrini of Pittsburgh reports on her demonstration of how microscopic elements of disease spread on a global or "macro" scale that exhibits structural similarities with the micro universe of the viruses and bacteria transmitting disease.

Literature, Life-Writing, and Identity

By Jill Campbell

Meeting in the summer of 2017 gave a special intensity to our YNI seminar on “Literature, Life-Writing, and Identity.” In the face of political events that have heightened the vulnerability of many young people to bigotry and injustice, dedicated teachers feel an ever greater urgency to strengthen their students’ powers of critical thinking, of empathy, and of active self-definition. Working with seminar Fellows, I was humbled and awed by the enormity and urgency of the needs they address on a daily basis and the difference their efforts make to young people, many of whom struggle to formulate and sustain a healthy sense of self in a cacophonous and uncertain world. Our work together gave me new courage and conviction about the essential value of Humanistic study.

A seminar on the topic of literature and identity was originally proposed by teach-

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ers in the Yale-New Haven Teachers Institute, and a focus on “identity” as a broad and flexible concept proved immensely fruitful both in discussing a variety of literary texts and in reflecting on pedagogy, classroom dynamics, and the struggles of individual students. We drew on Erik Erikson’s classic study to establish the complex interactions between external forces and internal processes that constitute identity, which can be particularly fraught for adolescents. Critical Race Theory on counter-stories and the work of Hilde Lindemann Nelson on “damaged identities, narrative repair” pointed us to the essential resources provided by narrative for a robust and resilient sense of self, while readings of poetry suggested the potential of the lyric both to afford space for memory and to capture the experience of the self in a moment of time.

Among the wonderful array of curriculum units developed by seminar members, Bobby Graham’s unit is unusual in its departure from these narrative and lyric

modes in the means it provides students for exploring and expressing identity. Designed for the youngest among public-school students, the unit builds on common activities of young children — scribbling, making marks, collecting and cherishing objects that adults might regard as without value — and cannily affirms the functions of these seemingly ordinary activities in creative expression and identity formation. Graham positions these universal activities of young children within his “choice-based art room.” He insists, through the very structure of his classroom space and mode of instruction, that art exists as an essential means of individual human expression, albeit one that benefits from practice and cumulative learning, and not as one more social standard or discipline. By building a challenging and revelatory sequence of activities around the habits of children’s everyday lives, Graham reminds us that identity is not a specialized construct of literary craft but a continual practice of discovery and making.

Expressing Identity in the Elementary Art Room

By Robert Graham

In all that I do in my classroom I focus my practice on my elementary students’ individuality. My goal of an authentic and personalized art education keeps me focused on what is important to my students. I wrote my unit “Curating an Identity: Exploration and Expression in the Elementary Art Room” to motivate my students to find new ways to express who they are. I want my students to be active in realizing their identity as they see it, not as it has been proposed to them. During the creative process I often ask my students why they are making a specific artwork. The

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answers students give crafts my response and my ensuing questions.

The unit on identity was greeted by my students with excitement. They were eager to look into the idea of telling their stories with images and artifacts, instead of words — but also with some shallow thinking. Students were eager and quick to give the answers they thought I wanted to hear when I asked, who are you? They responded with information about their age, race, culture, and grade; but I was looking for their own ideas of who they are.

I began teaching the unit by placing some prompting questions on the wall. I left these questions posted for students to casually notice for a few classes. On the first official day of the unit I had a discussion

with my classes, asking students if they had noticed the new questions on the wall. As I gestured towards the back wall where the questions had been posted a couple of students in each class remarked that they had read them. The one question my students reacted to the most was “Does how you see yourself match how others see you?” The conversations I had with my students sparked by that question took me back a step. We talked about how our parents view us, our friends, and our teachers. I shared with my students the interactive poster I made for the YNI fall conference. As I had them read the responses on the poster I told them that the answers were from teachers as far away as California. They loved it. We worked through the

Kisker: Updating the Theory of Change

responses from the conference and when I prompted them with the question, “How do you view yourself?” I stopped taking answers. I asked them to hold on to their thoughts as we started making art for the day.

Initially when the artmaking started, I received lots of portrait style artwork. “This is me playing at the park” or “This is my family” were two common sketches I saw. I began to challenge my students to think about what a self-portrait could be. We looked at some abstract portraits, and I left them free to create with those new models in their heads. It was at this moment that I saw the idea of identity as self-expression click in several students’ minds. One young artist created an abstract self-portrait so real to them that I could not be happier. This student laid out a web of graphite scribbles and words, erased parts and re-marked them exactly, to build emphasis, and tied it all together with an extremely personal artist’s statement.

The impact of this unit on my classroom is becoming much larger than the unit itself. As a result of going through this process of self-exploration, I find that my students are making more personal art. I have seen a small movement in the direction of meaningful and highly personal art on the part of my young artists. My stu-

dents are expressing their identities, emotions, and dreams, without my prompting. I am watching them create images and compositions that reflect their personal style, which was an important part of the identity unit I had written. I wanted each of my students to feel that they are entitled to their own personal artistic style. Several of my young artists have found themes that they are working with through several



JASPER JOHNS, TARGET, 1971

mediums. The experience of working with my students on the topic of how they see themselves has opened my eyes to how much they have to say, and why I need to work this topic past the initial push-back and into a deeper understanding. Identity has transformed into a focus topic for the year, and I have plans of writing it in as a year’s curriculum for next year’s young artists.

(continued from page 7)

research design to explore the pathways and measure the magnitude of Institute impacts on intermediate and longer-term outcomes is needed to confirm that the theory of change provides an accurate map from Institute participation to outcomes.

Note

1. All effect sizes cited are in standard deviation units.

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Chemistry of Cooking

By Gary W. Brudvig

Do you want to teach science that is relevant to everyday experiences? Look no further than your kitchen. We all are familiar with cooking. Yet, most people do not realize that cooking is chemistry. The aim for this seminar was to discuss the science related to cooking. We used *What Einstein Told His Cook* by Robert Wolke as the primary reading for the seminar. Learning about the chemistry of cooking is a great way to make science relevant to the everyday lives of our students.

My own interest in science stems from my hands-on experiences as a child. Cooking offers a wealth of hands-on activities and opportunities to learn about chemistry. Therefore, many cooking activities and demonstrations were included in

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Science is Sweet

By Chris Moy

What greeted Fellows during our initial meeting of Gary Brudvig's seminar on "Chemistry of Cooking" looked like the result of a raid on the local grocery store. Along a crowded countertop, everything from apples to the more exotic mesquite smoke could be found. After donning eye masks and placing visors under our noses, we sampled surprising flavor combinations resulting from the food pairings our partners selected from the vast inventory. This was more than just an activity to bond

Chris Moy is a Fourth-Grade Teacher at Stephen K. Hayt Elementary School in Chicago, Illinois.

this seminar. These cooking activities were chosen so that they could actively involve the students and at the same time illustrate the scientific principles related to cooking.

During our seminar meetings, each Fellow prepared a cooking activity. These

Most people do not realize that cooking is chemistry. Cooking offers hands-on activities to learn about chemistry.

included making pancakes, making Navajo fried bread, making cupcakes, making cornbread, making honeycomb candy, making mayonnaise, making salsa, making caramel apples, popping corn, analyzing the tarnishing of spoons from the acid in ketchup, analyzing bacterial

newly acquainted teachers. Gary designed it to demonstrate olfactory referral — the

I was inspired to devise a unit that could engage my fourth-grade students. What surprised me was the extent to which it ignited real curiosity among them.

nanced interplay among receptors that influence the flavors we detect when eating,

contamination, and extracting the fat from chocolate. These demonstrations provided opportunities to delve into chemistry and provoked lively discussions. We all enjoyed sampling the results of the cooking activities.

The Fellows prepared an outstanding collection of curriculum units that include information on the math and science principles related to cooking activities, as well as connections to the everyday lives of students. An excellent unit entitled "Science of Sugar" was prepared by Chris Moy. Mr. Moy has developed a unit that uses the theme of sugar to introduce fourth-grade students to foundational ideas of science. As described in the following article, this topic sparked curiosity-driven inquiry that led to interdisciplinary learning experiences. I encourage teachers of elementary through high school students to review the curriculum units from the "Chemistry of Cooking" seminar. These materials provide a valuable resource for incorporating topics of science related to the chemistry of cooking into the classroom.

Throughout the ensuing seminar, food and cooking demonstrations continued to be the basis for robust discussions about chemistry. An array of concepts naturally emerged from the demonstrations, highlighting the role of hands-on experiences in learning. I was inspired to devise a unit that could similarly engage my fourth-grade students in the pursuit of knowledge. To apply the ideas I brought away from "Chemistry of Cooking," I decided to focus my unit on sugar as a means of introducing children to foundational ideas of science. From my experiences in the seminar, I anticipated that the lessons would help make abstract principles accessible to students. What surprised me was the extent to which it ignited real curiosity among them,

leading to interdisciplinary learning experiences that made school, dare I say it, fun.

To set the scene for our explorations, we imagined our classroom to be a kitchen laboratory, replete with safety guidelines and imbued with scientific purpose. Because we were a cohort of scientists, we utilized vocabulary commensurate with this role. Students learned to refer to the white table sugar we studied as sucrose, and were quick to remind me about the importance of precision when I lapsed and used the everyday term. Enhancing our classroom's transformation into a laboratory, we displayed a molecular model of sucrose on the board after discussing its constituent parts. Equipped with goggles and an induction cooktop, we were ready to begin our investigations.

Students decided that the ability to measure accurately was a prerequisite to any work in our laboratory. We discussed various measuring tools, and readily made connections to our lessons on fractions. To hone measuring skills, I asked students to bring in the nutrition labels of their favorite foods so we could model the amount of sugar contained in these products. Once they established a ratio to convert grams into teaspoons, students tasked themselves with measuring the correct quantity of sugar. Once they could see it, students were struck by the sugar contained in some products. To the dismay of many, this was most apparent for juices, candies, and cookies. The students then hoped to learn more about the effects of sugar on health, and soon made more careful decisions choosing snacks.

As we worked, students learned about the intensely collaborative nature of science. Seeking to design a system to grow sugar crystals, everyone crafted a proposal to share with peers. When the moment came to consider the various approaches, students applied our mutually agreed upon norms to comment respectfully on the merits of a groupmate's ideas. Laboratory teams coalesced around plans

that integrated the best insights from each member.

With designs established, students then grappled with devising a clear procedure for the experiment, and debated how to adequately control for a range of variables. Once the experiment commenced, they recorded observations in their notebooks, striving to depict the progression of any sugar crystal's growth as accurately as possible. Reflecting on the experiment led students to consider the implications of their findings, and they generated additional questions that could be used for future investigations.

For the culminating activity, students integrated the essential principles of the unit to prepare caramel apples. They deftly conversed about the fractions involved

when measuring ingredients, and adhered to the recipe's procedure with scientific precision. As the smell of caramelizing sugar wafted throughout the classroom, students identified the evidence of sugar undergoing chemical changes when heated. They marveled at the occurrence of a Maillard reaction that resulted from the addition of cream. As the caramel began to take on its characteristic golden hue, I remembered Gary having said during our seminar that hands-on explorations from his childhood served as the catalyst for his interest in science. I can only hope that the explorations we pursue in class can similarly inspire a future generation of scientists. As we dipped apples into the freshly made caramel, a jubilant student remarked to a friend that "science is so sweet."



WAYNE THIEBAUD, CANDY APPLES, 1987

Energy Sciences

By Gary W. Brudvig

With concerns about the environmental impacts of our use of fossil fuels, energy is in the news on a daily basis. Many students are familiar with issues relating to energy use, but they may not know much about energy science. The aim for this seminar was to discuss the science related to current sources of energy and potential future sources of energy. We used the books by David Walker entitled *Energy, Plants and Man* and by David J. C. MacKay entitled *Sustainable Energy – Without the Hot Air*, and also read Daniel Yergin’s *The Quest: Energy, Security and the Remaking of the Modern World*.

Because I know that my hands-on experiences as a child made me interested in

Gary W. Brudvig is Benjamin Silliman Professor of Chemistry and Professor of Molecular Biophysics and Biochemistry at Yale University; and Director of the Yale Energy Sciences Institute.

science, I included demonstrations in this seminar. These demonstrations were chosen so that they could actively involve the students and at the same time illustrate the scientific principles related to energy.

During the seminar we discussed the connection between natural photosynthe-

The aim for this seminar was to discuss the science related to current sources of energy and potential future sources of energy.

sis and artificial processes of solar energy utilization, noting that the excess production of biomass that has been buried to form the “fossil fuels” provides most of our current energy. We also delved into various forms of energy, including hydro-

electric, biofuels, wind, geothermal, solar and nuclear. A highlight of the seminar was the production of biodiesel fuel from cooking oil that culminated in the combustion of biodiesel fuel in an oil furnace burner.

The Fellows prepared an outstanding collection of curriculum units, including many excellent activities that will engage the students’ interest and teach them about energy sciences. A particularly innovative unit was prepared by Josh Bearman, entitled “What is Our Energy Past, Present, and Future?”. As described in the following article, Mr. Bearman has developed a unit around the theme of coal, which connects his state of Virginia’s mining history to earth science and current energy usage. I encourage teachers of elementary through high school students to review the curriculum units from the “Energy Sciences” seminar. These materials provide a valuable resource for incorporating topics of science and society related to energy sciences into the classroom.

Teaching Virginia Energy, Past to Future

By Josh Bearman

I am always looking for ways to make my content meaningful to my Earth Science students, placing it within a larger context of time and space and connecting topics throughout the year. Upon acceptance into the Energy Sciences seminar with Dr. Gary Brudvig, I grabbed the chance to dig deeper into a facet of my content while also having the luxury to create a long term and integrated unit.

For two weeks in 2016, I joined a group of teachers from varied locations and classrooms — Washington, D.C. to the Diné Nation, kindergarten to AP Physics — to soak up as much as possible on the science of energy production and storage from Dr. Josh Bearman is a Science Teacher at Lucille Brown Middle School in Richmond, Virginia.

Brudvig. Every day we covered a different type of energy, going into details on the physics and chemistry of biodiesel, solar power (the many different types), wind, natural gas, tight oil, and natural and artificial photosynthesis. We took field trips to the chemistry labs to see the production of biodiesel that is used in Yale vehicles, and to the West Campus to view the magnificent facilities.

I gained just as much from the other teachers in the seminar. Each of us took a turn in the mornings presenting a small lesson from our nascent units. Having only taught middle school, it was enlightening for me to see how elementary and high school teachers process and translate information in order to craft a lesson that would engage and excite their students while pushing them forward academically.

While we spent most of our seminar digging into the more modern, clean, and cutting-edge forms of energy generation, I focused on one of the older and dirtier forms — coal. Being a Virginian and a bluegrass musician, I feel connected to my Virginia’s mining and labor past. There are countless songs and stories celebrating and decrying the miner’s fate; the first coal mine in the United States — the Midlothian Mine — is less than 10 miles from my school. My unit — “What is Our Energy Past, Present, and Future” — involves formation of Virginia’s energy resources, a survey of our current energy profile, and decisions on the future energy choices they would like to see.

As part of the “Past” section, my classes looked at the conditions in Virginia during the Carboniferous time period — ~350

million years ago — when most of the organic material that makes up the fossil fuels of today was buried. At that time, Virginia was located in the center of Pangaea, just north of the equator. My students researched different organisms from this time period and created fake social media profiles, highlighting their features, habitat, and other facts of note. They really enjoyed this portion of the unit, given the many charismatic organisms from this time period — giant dragonflies, early bony fish, huge ferns, etc.

During our unit on sedimentary rocks, our theme was coal formation. A large part of my research was the chemical and geologic processes that create coal — how the massive amount of primary productivity of the Carboniferous was converted to the coal and natural gas we mine and use in VA. While much of this is far beyond what is required for Earth Science students, I wanted to be able to speak with authority on the topic. Students drew the basic steps of coal formation and compared three grades of coal for density and efficiency in an inquiry lab.

In the “Present” section of the unit, students examined and graphed data from the Energy Information Administration on the amount of coal and natural gas annually

My classes looked at the Carboniferous time period. They really enjoyed the unit, given the many charismatic organisms from this time period — giant dragonflies, early bony fish, huge ferns.

extracted and used in VA. They then read a series of articles about a proposed gas pipeline. Students had to assemble pros and cons on the topic and engage in a “Crash Debate” where they flipped a coin

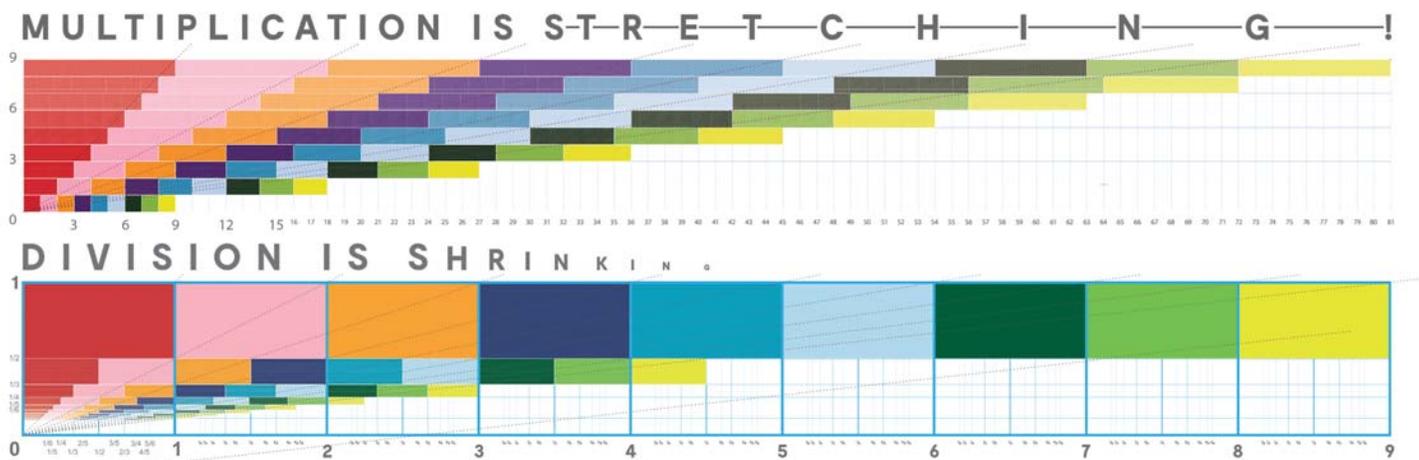
to choose which side they would argue. The class engaged in a single elimination tournament, judged by their peers on the number of arguments and valid citations presented. I created a bracket that charted the matches. The final debate was in front of the entire class and every member of the audience was engaged. The winner in each of my classes received a \$10 gift certificate donated from a local record and vintage clothing shop (I do impose certain important values).

Finally, we examined the prospects of Virginia’s energy future, focusing on a proposed wind farm off the coast of Virginia Beach. Students designed model turbines and tested them in our schoolyard. Students also investigated the prospects of profitable wind farms in our state, using wind maps. This activity reinforced map reading skills — a constant issue for 8th-grade students. Teaching this unit was an immensely rewarding experience made possible in good part by the content knowledge I acquired from my Initiative seminar.



JOHN WEINSTEIN, CARBONIFEROUS FOREST, 1991

From Arithmetic to Algebra and The Number Line in the Common Core



KATE HOWE, MULTIPLICATION IS STRETCHING, 2012

By Roger E. Howe

The articles by Aaron Bingea and Jolene Smith remind me why leading seminars for the Yale National Initiative is so rewarding. As a mathematician who spends a lot of time worrying about mathematics education in the U.S., I need to know more about what goes on in K-12 classrooms: what works, what does not, and why. Leading seminars for YNI lets me learn directly from K-12 teachers: what they do and how they think. We share ideas, and sometimes a Fellow takes a seminar idea in a new and inspiring direction.

Aaron's use of the number line to provide his students with a tool for thinking geometrically and pictorially about signed numbers is this kind of unexpected, wonderful curriculum unit. The number line is a fundamental object in mathematics. It

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encapsulates arithmetic and links it to geometry. The number line has been used in the early grades for visualizing whole numbers, but overall it has not played the strong role in U.S. mathematics education that its centrality in mathematics suggests that it should. I believe that part of the deficit stems from the failure to connect the line with measurement. When the number line is presented with whole numbers located at equally spaced tick marks, students tend to focus on the regular spacing, and think additively about the locations of the numbers: 2 is one space beyond 1, 3 is one space beyond 2, etc. Instead they should think in terms of measurement, and compare to the unit length: 2 is twice as far from the origin as 1 is, 3 is three times as far, etc.

Whole numbers live on the positive half of the number line. Aaron and Fellow Jeffrey Rossiter had the idea that using the full number line could help students deal with adding and subtracting signed num-

bers, using measurement ideas, and also linking sign with orientation. This innovation seemed very promising, and I am delighted that in Aaron's hands the idea has enjoyed considerable success.

Word problems are another trouble spot in mathematics education, not only in the U.S., but worldwide. This is not as it should be. Word problems should be an engine of the curriculum, not an obstacle. They have the potential to help students not only to learn mathematics, but to improve their reading skills, and even to develop good thinking habits. However, this can happen only if teachers themselves are very comfortable with word problems, and appreciate their educational potential. I have devoted several seminars to using word problems more effectively. Jolene's insight, to use math word problems to connect her students with traditional Diné culture, especially with the construction, geometry and use of the hooghan, embodies another fruitful seminar interaction.

Math Word Problems in the Hooghan

By Jolene R. Smith

During the 2016 Yale National Initiative year, I had the honor of participating in Roger Howe's

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math seminar. In prior years, I had mainly focused on the science seminars. So math was a complete 180 turn around, as I had to rethink in terms of numbers, operations, symbols, and expressions. It was a different and challenging way of writing a curriculum for me because math written as a

curriculum unit requires numerous symbols and grids.

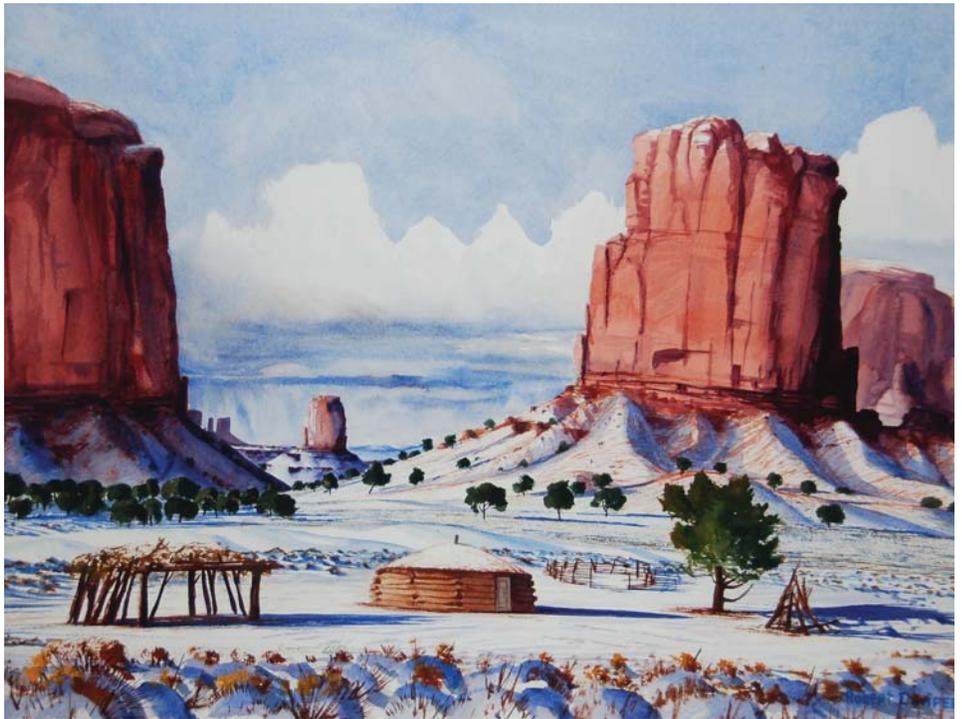
It has been an eye opener to hear and see what our students need to know when advancing to complex levels of geometry, algebraic thinking, and numbers and operations. The other Fellows who were math

teachers really knew their math content. I was impressed with their procedures and strategies for getting their students thinking with and using math. For example, Jeffrey Rossiter, a Yale Fellow who teaches in the Chicago schools, presented his math curriculum of expressions implied in the operation $x+4$. He explained this example of a basic expression and how it can have multiple correct answers. His activity compelled students to think outside the box, and I really liked his simple strategy.

“From Arithmetic to Algebra: Variables, Word Problems, Fractions, and the Rules” was the second seminar in which I had encountered Roger’s rigorous and demanding math problems. His examples of math problems were very concrete but added a level of critical math thinking. When he demonstrated their operations I thought about the level of math my students are proficient at, and concluded that we really do need to get our Diné students more confident with the rigorous demands of math word problems.

As the math seminar progressed, Roger demonstrated his red truck analogy to model various math word problems enabling teachers to write sample problems of their own using the various operations. With this instruction we wrote, practiced, and shared word problems among ourselves. Afterwards he advanced to a more complex problem, from the red truck to blue and green trucks. We chuckled, saying blue and green trucks are a bit difficult! It was fun to see him smile because he often seemed so serious. The Fellows began to tease him about his colored truck problems, but I liked his examples because they showed that he was thinking about K-12 teachers and the kinds of objects we could actually use for word problems with our students.

While he modeled these concepts, I began to think about ways of connecting math word problems to my culture. The cornfield, the Navajo basket, the cradleboard, the sheep, and the hooghan were some of the cultural examples that came to mind. After listening to the other Fellows’



ROBERT DRAPER, DINÉ (NAVAJO) ORIGINAL WATERCOLOR OF RESERVATION LANDSCAPE

descriptions of their units, I decided upon the hooghan because there are so many math operations in hooghan activities that can be described in word problems.

The chores of daily life and the ceremonial events within the hooghan involve numerous math activities. For example, the hooghan is constructed as an octagon with specific procedures for the direction it faces. The significance of the four cardinal directions, and the corresponding seasons, is woven into all ceremonial activities and daily living routines. The hooghan itself is a math word problem!

Based on the sequence of the construction of the hooghan, math word problems were given to students as one word problem on a strip. Each student solves and shares their math word problem. We practiced reading and solving problems using the Read, Draw, and Solve method, which is from the Eureka Math source, and the Poya method from Roger’s seminar. Referring back to the diagram of the hooghan helped my students make connections when they read the math word prob-

lems. This is how we as teachers can make connections between the curriculum and the ways math is used within students’ daily lives. Connecting to the real world makes school more meaningful and important to our students.

This unique curriculum activity, combining cultural context and math, is very different from other curriculum models. I am honored and grateful for being given the opportunity to create a curriculum unit that I have taught to my students. They gained an in-depth knowledge of their culture and math word problem practices while making connections to their traditional home (hooghan). More of our Diné teachers need to see how powerful and rigorous their curriculum can be when teaching our children the content of their own curriculum units combined with Diné culture and language. If it had not been for the Yale National Initiative, I would still be using and teaching scripted curricula. Thank you, YNI, for opening doors to new teaching strategies for our Diné teachers and students. Ahe Hee’.

Overcoming Math Impasses with the Number Line

By Aaron Bingea

When people ask me what I like about teaching middle school math, I usually talk about developing algebraic reasoning or problem solving with proportional relationships. What I do not profess is a love for teaching kids how to add $-4 + 2\frac{1}{2}$.

According to one report, the performance on one particular test item highlights this deficit. Only 24% of the thirteen year olds correctly estimated 2 as the answer to $12/13 + 7/8$, the majority having selected 19 (adding the numerators) or 21 (adding the denominators).

By the time my seventh graders take their seats for the first day of class, most are pretty sure they know whether or not they are a “math person.” I have come to understand that their mathematical identities are linked to their success or struggle with understanding numbers and operations. This is an unavoidable obstacle when, by the end of 7th grade, students are expected to be able to fluently perform operations with all rational numbers, including those annoying fractions and negatives. Tasks such as adding a fraction or subtracting a negative integer are a constant source of anxiety and resistance for students. For a teacher, it is unbelievably frustrating to hear a student say, “I hate fractions,” or “I don’t do negative numbers.”

Over the years I had gone to great lengths to find new strategies and representations to aid students’ understanding. Despite my unremitting efforts to be the teacher who would finally help all kids understand number and operations, I eventually came helplessly to feel that some kids just will never get it.

In Roger Howe’s seminar on the number line, I decided to take on this issue. The unit I created boldly aimed once and for all and as simply as possible to give students a uni-

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Figure 5a: $4 + 3 = 7$

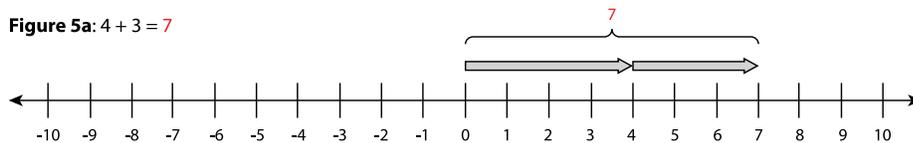


Figure 5b: $4 + (-3) = 1$

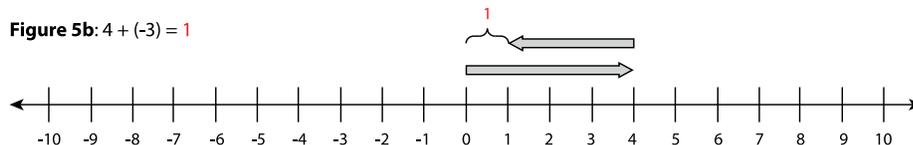
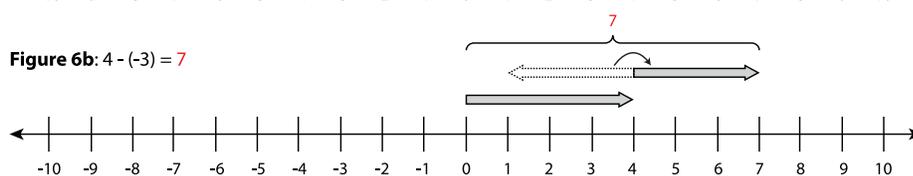


Figure 6b: $4 - (-3) = 7$



fyng way of conceptualizing numbers and operations by using the number line. I was not attempting to find a new “trick” for remembering rules or algorithms. Rather, I attempted to answer the question of what basic understandings of number and operations I wanted students to utilize to grasp more advanced, grade-level concepts. The result was not a ground-breaking, new way of teaching these fundamental concepts. Instead I simply ordered a sequence of ideas using a consistent model, the number line.

My unit took no basic understanding for granted. In the beginning, I asked students to represent $4 + 3$ on the number line by putting lengths together. These lengths were eventually viewed as vectors oriented in the positive direction. My seasoned seventh graders had no trouble with this task and found it almost comical to do something so simple. To subtract $4 - 3$, they intuitively flipped the vector that represented 3 to show a result of 1. Students needed no convincing about this model; it was clear, obvious and effective every time. When tasked with adding $4 + -3$, students naturally graphed a positive vector together, end to end, with a negative vector.

This methodical construction of ideas, all realized on the number line, enabled my students to make sense of typically abstract ideas. The consistent use of the number line gave students a tool to justify the concept of subtracting a negative value. It was

music to my ears to hear students discover: “If you subtract a negative, just flip the vector in the opposite direction!” With the number line, students did not consider this concept of subtracting a negative difficult.

All of these ideas were reached with minimal explicit instruction. I simply presented students with new tasks to be completed on the number line, each one building off of previously realized understandings. Because I planned a unit that started at ground level, I was able to include all students in building up the making of sense, no matter their proficiency level with numbers and operations. Students who would have readily understood these skills in a traditional textbook unit now have a more conceptual model and clearer language to justify their thinking. Students who find numbers and operations challenging now have a familiar model to lean on for support. Having once written and executed this unit, as a teacher I now have a greater appreciation for the nuanced nature of these concepts and feel more prepared to address difficulties with number and operations in the future. After working through this unit two years in a row, I am convinced that the number line is the best way for students to grasp and make sense of these foundational concepts. My students may still not love subtracting negative fractions, but they will be able to show you what it looks like and explain what it means to do so.

Engineering of Global Health

By *W. Mark Saltzman*

In the summer of 2017, Kwame Adu-Wusu of Washington, D.C. and Beth Pellegrini of Pittsburgh participated in my seminar entitled “Engineering of Global Health.” The work of the seminar revolved around several related questions: What does it mean to be healthy? How does health differ among peoples in different nations of the world? What are the major barriers to health, and can engineering be used to surmount these barriers? To address these questions, Kwame, Beth, and the other Fellows focused on the basic body functions that lead to a state of health, and how failure of those functions can lead to disease. The Fellows considered health at the cellular and molecular level by focusing on four basic determinants: genetic variability and its relation to human disease; the role of the immune system in protecting health; the interaction of microor-

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ganisms with humans; and control of cell function in cancer.

The Fellows in “Engineering of Global Health” explored two major themes. The first was the relationship between health and the underlying biological mechanisms of body function. The second was the potential for engineering of technologies that enhance health, such as vaccines, contraceptives, and insulin therapy.

The materials presented in the Fellows’ curriculum units span an impressive range and are designed for use in classrooms from elementary through high school. Kwame Adu-Wusu prepared a unit titled “Gene Therapy and Muscular Dystrophy: Structure, Function, and Dysfunction of the Muscular System,” which is intended for high school teachers and students. This unit introduces the basic processes of biological transcription and translation in producing proteins, but focuses on the potential effects of mutations in genomic DNA. To illustrate how mutations in a gene can lead to health problems, Kwame describes one kind of gene mutation that produces muscular dystrophy. One of the most impressive aspects of Kwame’s unit is the skill with which he describes one of the most

fundamental subjects in human biology — the genetic code and the role of gene mutations in causing disease — in terms that are easily understood by students, even students without a strong biology background. He does this by use of analogy between the structure of genes and the structure of sentences in English.

Beth Pellegrini wrote a unit titled “Micro Life in a Macro World: Understanding Life at the Microscopic Scale and the Spread of Disease,” for advanced elementary or middle school students. In her unit, Beth describes the basic states of matter and, by increasing the scale and level of complexity, builds descriptions of living systems, including bacteria and human cells. These descriptions of living and non-living materials are used to illustrate some of the ways that the human body protects itself from disease. Like Kwame’s unit, Beth’s should be understandable to readers with little science background. The large scale of her discussion is impressive, covering an enormous range of physical science facts and relating them clearly to the function of cells, thus providing an excellent introduction to molecular aspects of biology.

Teaching Gene Therapy and Muscular Dystrophy

By *Kwame Adu-Wusu*

Although practical constraints necessitate that scientific learning is often presented in discrete bundles (biology, chemistry, physics, anatomy, etc.), science educators know that these subjects emanate from the same fundamental principles: asking questions, gathering and analyzing data from which answers may emerge or better questions be developed. We all benefit from classroom experiences that allow us to emphasize connections between different bundles of science.

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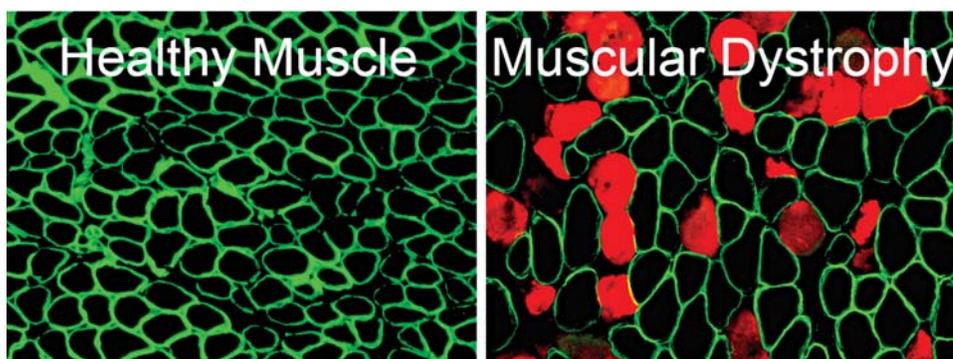
My “Gene Therapy and Muscular Dystrophy” unit allowed me to do just that.

Beyond acknowledging connections within a particular topic (the muscular system), the unit was also implemented to emphasize specific ties between two of the aforementioned *bundles*. To complete the unit, I worked with a colleague to combine AP Biology students and Anatomy & Physiology students in one classroom. Students from both disciplines joined in groups for collaboration throughout the lesson. Within each group, students who were more familiar with specific content played more central roles at various stages of the lesson. The biology students, having previously completed genetics units, were

familiar with DNA, genes, and heredity. The anatomy students came with better understandings of muscle structure and the mechanisms of movement.

The goal of the unit was to emphasize connections among structure, function, and dysfunction using muscular dystrophy as an example. The premise is that physical properties of any object directly influence what it can do and how it can be used. Alterations in those physical properties may then have operational consequences, limiting or possibly enhancing the capabilities of the object. Hence the key to understanding diminished or enhanced capabilities lies in a thorough exploration of changes in structure.

Adu-Wusu: Teaching Gene Therapy and Muscular Dystrophy



XIPING CHENG, *MICE DEVELOP MUSCULAR DYSTROPHY*, 2014

The lesson began by reintroducing the 3 P's paradigm (parts, purpose, peril) that organizes the premise of my anatomy classes: function is determined by structure and dysfunction results from changes in structure. Although biological organization had not been explicitly presented to the biology students in these terms, examples presented by anatomy students cemented the idea. For instance, an anatomy student explained that human bones are durable for reasons including composition (calcium compounds) and arrangement (concentric osteons). The student remarked that the shape of flat bones like those of the skull have a primarily protective function, while the shape of long bones like the femur more easily facilitate a different function: locomotion. Biology students enhanced these discussions by describing the integral roles of structure and function in evolution.

Next, the focus of the unit shifted to structure-function-dysfunction relationships in skeletal muscles. Students examined images (without accompanying verbal descriptions) of individuals living with muscular dystrophy. Groups jointly identi-

fied the most notable features. Anatomy students tended to lead, as they were more familiar with skeletal muscle structure and associated functions (protection, support, locomotion, thermoregulation, etc.). Biology students, noticing that the individuals observed were young males, concluded that the identified features may involve sex-linked traits.

This line of inquiry segued to the *intro to genetics* portion of the unit. Here, biology students led, as they more readily grasped the *sentence model* of genetics introduced by the unit. Student groups created sentences comprising three-letter words; letters represented DNA bases, words represented amino acid codons, the sentence represented a protein's gene sequence, the sentence's meaning represented the protein's function. The students' nuanced questions and observations about gene and protein structure and function showed that the sentence model effectively conveyed fundamental genetics principles. Students suggested that "in a sentence some words are more important than other words," "the order of the words matters," "some sentences use some

of the same words," "the sentences have very different meanings" and connected each claim to genetics. Biology students even used the model to project possible effects of various mutation types.

A presentation about the dystrophin gene's role in muscle function brought the lesson back to muscular dystrophy. Students illustrated differences between severe forms (Duchenne) and milder forms (Becker): differences between altered sentences that retain little meaning and ones that can convey some ideas. Students crafted thoughtful explanations about the protein's role in DMD disease progression, drawing a logical through-line from micro-molecular DNA structure to images of boys struggling to stand and walk.

In the end, when asked to suggest ways dysfunction might be corrected, most groups decided that in cases where functional deficits result from a structural change in a narrow region, removing the problematic portion might leave a protein with meaningful functional capability — the very idea behind the exon-skipping approach to gene therapy.

Students intrigued by the idea of exon-skipping asked questions like "how does cutting DNA work?" As I hoped, the unit established an understanding of genetic fundamentals and spurred curiosity to know more about underlying mechanisms even in students who professed uninterest in or lack of aptitude for science. Curiosity inspired through today's engaging student experiences may lead to discovery and innovation from tomorrow's medical researchers.

Macro and Micro Comparison in Understanding Disease

By Beth V. Pellegrini

Micro Life in a Macro World: Understanding Life at the Microscopic Scale and the

Beth V. Pellegrini is a Science Teacher at Colfax K-8 in Pittsburgh, Pennsylvania.

Spread of Disease" is a curriculum unit written for my fifth-graders in the Pittsburgh Public Schools. The unit was inspired by Mark Saltzman's seminar, "Engineering of Global Health." When I initially considered applying for the Yale National Initiative, the seminar seemed a

stretch from the work I do with my students. But as I thought about Dr. Saltzman's seminar description, global health and biomedical engineering technologies, I was intrigued, which I knew meant that my students would be, too. My school, Colfax Elementary, was a site of Dr. Jonas Salk's

Kisker: Updating the Theory of Change

first polio vaccinations; in fact, I previously taught in the classroom where the shots were administered. I also considered my students with illnesses: Crohn's Disease, Sickle Cell, Diabetes, Cerebral Palsy, asthma, blindness, together with the many illnesses in their home lives, and the ordinary maladies that beset all schools — colds, flu, viruses, allergies, asthma, and the like. I realized that most children have no way of knowing where these problems come from, or why, which led me to formulate a plan for my unit.

I also contemplated my district curriculum, which consists of science lessons in which projects are put together, like pizza-box solar ovens, or taken apart, like owl pellets, and natural phenomena are observed. While engaging, the science content in these projects is narrow, shallow and disconnected from students' everyday experiences. Through my unit, I sought memorable ways to weave in content that relates to everyday life.

My students are racially, economically, and intellectually diverse: 1/3 identified gifted, 1/3 from poverty and 1/10 English Language Learners. My concern is always to maintain rigorous standards but not to "lose" anyone owing to lack of prior knowledge. Yet I know that students who come from poverty enter school with a huge deficit in the words that they've been exposed to, known as the Matthew Effect. Children who are exposed to rich vocabulary at early ages easily acquire more vocabulary later in life, while the opposite is also true and tends to be the condition of children from poverty. Hence it is imperative that these kids learn many words in comprehensible contexts. Science instruction is the ideal scenario in which this can occur.

Having begun with the nature of matter, we then analyzed atoms, molecules and their parts at the micro level, and how these relate to the states of matter. The kids were fascinated by the steaming and boiling of water in my glass kettle, taking note of bubbles, which seemingly formed from

nothing, as well as melting ice and the swift evaporation of the spritzed water they smeared across their tables. To help understand cells we had to investigate scale. They learned the vast range in size of microscopic particles, akin to the vastness of space at the macro level. Students were astonished learning the scale of the universe on iPads (scaleofuniverse.com), ranging from quantum foam (10^{-35}) to the estimated size of the universe (10^{27}), with everything in between. Throughout the unit I have enjoyed hearing "wow!", "that's so cool!" and "I don't want to go!" when the bell rings. Next came investigating abiotic and biotic matter, all leading to the study of illnesses and how they spread.

Each day I relish the 100% engagement of all students as I hear them debating whether rabies is contagious or whether you can "catch" cancer. Soon we will investigate the different sources of illness, their treatment and the historical advances in sanitation which have led to vastly improved health. "When are we going to learn about the flying corpses of Kaffa?" they ask me, stemming from a tantalizing tidbit I had left them with when we segued into the architecture unit. "Why do only black people get Sickle Cell Disease?" "Do plagues still exist?" When they sniffle or ask to go to the nurse, they wonder whether their problem is likely from a microbe, a predisposed illness, or something in the environment.

As we reach the end of the unit, which culminates in a research project about careers related to any area of science touched on within the unit, I am still delighted by the enthusiasm of my students. But I think what I like most of all is that through this unit, in the face of all the problems we are dealing with — school shootings, political divisiveness, social tensions — I get to show them hope. I can tell them that our many serious problems are nothing like the problems faced by our ancestors, with their poor sanitation and hygiene, lack of treatments, and lack of medical knowledge, and that we are living in the healthiest era the world has ever known.

(continued from page 21)

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Smith: The Promise of America's Teachers Institutes

(continued from page 4)

ments in standardized test scores, and yes, voucher programs) have failed. In every city where Teachers Institutes have been established, all participants have regularly testified to their positive contributions. Yet Institutes remain too few and too limited in size to realize their full potential, both within large cities like my own Philadelphia, and in America as a whole.

What this means is that for American education, Teachers Institutes are a bit like Dorothy's slippers: they are an answer to our problems we have had all along, while failing to recognize their potential. Today, as leaders of higher education institutions realize that they must make more substantial and visible contributions to American education as a whole if they are to regain much of the support from funders and parents that they have lost, and as more Americans are discovering that there is no educational Wizard of Oz that can fix all our problems with the wave of a magic wand, it may be possible to begin to do what we should have done decades ago. The United States needs to invest in its teachers, just like the most successful school systems in the world; and it

must do so in many ways. One of the most promising ways is for institutions of higher education and public school districts to invest in the creation and enlargement of Teachers Institutes in every part of the country that has high-need schools and students at risk — bringing the proven benefits of this great program for improving teacher quality to many more states, cities and towns, and to a far greater percentage of the nation's teachers and students. Making those investments now not only has a better chance than any other route of reform to make America's K-12 education systems “great again.” It has a better chance than any other path to make America's schools what they really should be: *better* — and better for more students of all backgrounds — than they have ever been before.

Notes

1. See e.g. Drew DeSilver, “U.S. students' academic achievement still lags that of their peers in many other countries,” Pew Research Center, February 15, 2017, <http://www.pewresearch.org/fact-tank/2017/02/15/u-s-students-internationally-math-science/>.
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4. *Ibid.*, and see also Katie Pisa, “Who are the world's most valued teachers,” *CNN*, October 5, 2017, <https://www.cnn.com/2017/10/04/health/teacher-pay-and-status/index.html>.
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7. Jenny Anderson, “America is slowly sucking the life out of education,” *op. cit.*
8. For a review of the pertinent educational literature, see Rogers M. Smith, “To Strengthen Teaching: An Evaluation of Teachers Institute Experiences,” March 2009, http://teachers.yale.edu/pdfs/An_Evaluation_of_Teachers_Institute_Experiences.pdf.
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