

Curriculum Units by  
Fellows of the  
Yale National Initiative  
Guide  
2017

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## *Preface*

In March 2017 the Yale National Initiative to strengthen teaching in public schools® accepted public school teachers from twenty school districts in eight states and the District of Columbia to participate in six national seminars held at Yale University. The Initiative is a long-term endeavor to influence public policy on teacher professional development, in part by establishing exemplary Teachers Institutes for high-need schools in states around the country.

Teachers Institutes are educational partnerships between universities and school districts designed to strengthen teaching and learning in a community's high-poverty, high-minority public schools. Evaluations have shown that the Institute approach exemplifies the characteristics of high-quality teacher professional development, enhances teacher quality in the ways known to improve student achievement, and encourages participants to remain in teaching in their schools.

Fifty-three of the teachers, named Yale National Fellows, were from school districts that are planning or exploring the establishment of a new Teachers Institute for the Bay Area, CA; Chicago, IL; the Diné Nation, AZ and NM; the District of Columbia; Pittsburgh, PA; Richmond, VA; San José, CA; and Tulsa, OK. Other National Fellows came from existing Teachers Institutes located in New Castle County, DE; New Haven, CT; and Philadelphia, PA. Overall, more than half of the National Fellows were participating in national seminars for the first time.

The National Fellows attended an Organizational Session of the seminars held in New Haven on May 5-6. The seminars reconvened during a ten-day Intensive Session from July 10-21 and concluded in mid-August when the Fellows submitted their completed curriculum units. The six seminars were:

- “The Illustrated Page: Medieval Manuscripts to New Media,” led by Jessica Brantley, Professor of English;
- “Chemistry of Cooking,” led by Gary W. Brudvig, Professor of Chemistry and of Molecular Biophysics and Biochemistry;
- “Literature, Life-Writing, and Identity,” led by Jill Campbell, Professor of English;
- “Poetry and Public Life,” led by Paul H. Fry, Professor of English;
- “From Arithmetic to Algebra: Variables, Word Problems, Fractions and the Rules,” led by Roger E. Howe, Professor Emeritus of Mathematics; and
- “Engineering of Global Health,” led by W. Mark Saltzman, Professor of Chemical and Biomedical Engineering.



## ***I. The Illustrated Page: Medieval Manuscripts to New Media***

### **Introduction**

Picture books offer children their first way to engage the written word, but they also offer more experienced readers a rich series of encounters with complex representational systems. The Yale National Initiative seminar “The Illustrated Page: Medieval Manuscripts to New Media” considered how combinations of text and image can be read in a range of media forms, old and new. In the seminar, Fellows explored the ways that these combinations address all audiences as we considered the history of picture books, broadly understood—from the first board books that teach vocabulary to babies, to graphic novels and comics that engage teenagers, to avant-garde productions designed for the most sophisticated connoisseurs of contemporary art. As we moved through a series of case-studies, we asked the following questions: what are the effects of combining words with pictures in each of these examples? How does the combination change the experience of reading? When and how do picture-word combinations tell stories—or, conversely, when and how do they construct static emblems for meditation and reflection?

These questions enlivened discussion of a wide range of multi-media objects, beginning, in the Organizational Session, with Claudia Rankine’s prose-poem *Citizen*. We framed our discussion of *Citizen*, and launched our general conversation about how pictures engage with words, by reading an interview with W. J. T. Mitchell, a leading scholar of this subject. In the Intensive Session, we approached text-image relations through a series of historical case-studies. We explored objects such as the Bayeux Tapestry, a historical narrative told in pictures and captions; the St. Albans Psalter, a medieval manuscript that engages readers in prayer through both texts and illuminations; Renaissance emblem-books, which combine text with images in order to teach memorable moral lessons; William Blake’s self-produced, illustrated *Songs of Innocence and of Experience*; Walker Evans and James Agee’s experimental collaboration in the photoessay *Let Us Now Praise Famous Men*; mid-twentieth century concrete poetry in which language becomes art; children’s picture books that depend on both media to instruct and delight; and, finally, exciting recent graphic novels such as Alison Bechdel’s *Fun Home* and John Lewis et al.’s *March* trilogy. We made visits to Beinecke Library to look at illuminated manuscripts and early engravings, and to the Yale Center for British Art to examine a number of William Blake’s works.

The seminar included Fellows from all over the United States teaching very diverse groups of students, from kindergarten to high-school seniors. The curriculum units they developed were accordingly quite various, but all focused on how images and texts can combine to further pedagogical goals. Our subject offered opportunities for very young learners, such as Anna Tom’s kindergarten class studying “Writing as a Form of Art” from Egyptian hieroglyphics and Chinese calligraphy to the origins of the Latin alphabet.



## Synopses of the Curriculum Units

### 17.01.01

#### [Image as Text: A Bridge to Critical Literary Analysis](#), by Brandon Barr

In this unit, students will be taught to closely examine images and art to consider how meaning is created. Students will closely look at four canonical paintings: *Guernica*, *Washington Crossing the Delaware*, *The Problem We All Have*, and *Detroit Industrial*, to construct meaning through guided inquiry. For each art piece, contextual information, discussion questions, and supplemental web resources are provided to help frame the analysis. Suggestions for classroom activities are provided as well as an authentic assessment in which students contribute to a larger classroom mural.

This unit is designed for sixth grade students to build interpretative skills through art. The activities and conversations that revolve around each art piece scaffold the same academic language that is needed to successfully interpret literature. The unit could be used in middle school or high school art, humanities, or English classes. It assumes little-to-no background knowledge in analyzing art or in the history associated with the works of art.

(Developed for Reading and Writing, grade 6; recommended for Reading, Humanities, and Art, grades 6-12)

### 17.01.02

#### [In Their Own Images](#), by Yolanda Bezares-Chavez

This unit represents an effort to introduce my young students to the Mexican Muralism movement, and its three main protagonists: Diego Rivera, David Alfaro Siqueiros, and Jose Clemente Orozco. The unit offers biographical information about these celebrated artists, and describes the historical and social circumstances that set the stage for the creation of this movement. One of the main components in this unit is the exploration of the significant visual narratives embedded on the Mexican murals. These narratives send strong social messages that continue to reach new generations and, in my opinion, deservedly so.

To ensure that this unit provides my students with meaningful first-hand experiences that help them to understand and appreciate their community, I am including a section about the Richmond Mural Project. This project, which involves the efforts of local and international artists, has made Richmond the city with most murals in our country. To provide my students with a first-hand understanding about the social and artistic contributions made by those artists, we will go on a field trip to see some of the local murals. In addition, one of the artists participating in the project will visit my classroom

to talk to my class. The students will conclude the unit creating their own painting, which will be accompanied with a written piece.

(Developed for Spanish Immersion, grade 1; recommended for Art, Social Studies, and Foreign Language [Spanish], grades 6-12)

### **17.01.03**

#### **Bringing Alive the Art of the Past: Modern Tattoos and Illuminated Manuscripts,** **by Donna Bonavia**

In this unit, high school students will look at medieval illuminations in the *Book of Kells* and today's Celtic inspired tattoos to see how art of the past influences art in the present. One commonality among my students is their love of tattoo art. Many are "tatted up," and they take great pride in the images that decorate their bodies. Many of the images within my students' tattoos have cultural and historical backgrounds that have the potential to enhance the overall meaning and appreciation of their tattoos. Strategies in art criticism, visual literacy, journal writing and the production of art will support the unit. The main theme in the unit is to explore how text and images support or conflict in a work of art. Intellectually developing the ability to read images will enhance students' creative ability to produce more innovative and meaningful works of art. Activities in the unit include journal writing that will lead the student into self-discovery, and drawing lessons that will provide a platform of self-expression. This unit addresses the socio-emotional aspects of learning that schools often omit. Elements of this unit could be used language arts, creative writing, literature, history, and social studies.

(Developed for Advanced Drawing & Painting, grades 10-12, and Foundations of Art, grades 9-12; recommended for Visual Arts, grades 6-12)

### **17.01.04**

#### **From Panel to Pen: Using Greek Mythology to Create Graphic Stories to Enhance the Writing Process for Young Learners,** **by Shannon Foster-Williams**

In this curriculum unit students will create **graphic novel** components based on historical references in order to explore how pictures tell stories. By introducing students to the stories and characters of **Greek mythology**, this unit integrates visual arts, language and arts and history, connecting social studies and writing objectives with the **illustrating** content of visual arts. The visual arts aspect focuses on the study of skills and techniques for creating **visual narrative with illustrated panels**, drawings that will be adapted to create **comic strips** or graphic narratives. These drawings will be used to retell the stories of Greek mythology, and in the process of making them, students will learn about a culture of the past. The students will use the images to help create a **written narrative** related to a mythological character of their choice. This unit is intended to encourage

**storytelling** and thinking creatively about the combination of pictures and text to communicate information, understand other cultures, and share stories of the past.

(Developed for Elementary Art, grade 3; recommended for Social Studies/History, Language Arts/English, and Library Science, grade 3, and Social Studies/History, grade 4)

### **17.01.05**

#### **[Using Navajo Contemporary Art to Teach Descriptive Writing to ELL Students](#), by Irene Jones**

This unit revolves around prints and images from Native American contemporary artists like Ronald Chee, Shonto Begay, and Ryan Singer to help students compose a piece of descriptive writing. Ronald Chee and other contemporary artists create works that have strong ties to their Native American heritage and culture. They consider themselves storytellers and information holders for their generations of progressive art.

In order for students to enter a mainstream class, their writing skills have to demonstrate competency in writing based on the knowledge, skills, and abilities specified in the Performance Indicators at the High Intermediate level. This unit was designed for 3<sup>rd</sup> to 5<sup>th</sup> grade ELL students to help them improve descriptive writing, with a focus on adjectives that can help them improve syntax and sentence structures. Strategies include using word explosion, activating prior knowledge, and taking a field trip to practice what they learned. This unit will allow a smooth transition to narrative writing where students will use higher level thinking to include details to convey experiences and events.

(Developed for Writing and Grammar, grades 3-5)

### **17.01.06**

#### **[Bringing Indigenous Stories to the Classroom through Art and Comics](#), by Amandeep Khosa**

This unit revolves around prints and images from Native American contemporary artists like Ronald Chee, Shonto Begay, and Ryan Singer to help students compose a piece of descriptive writing. Ronald Chee and other contemporary artists create works that have strong ties to their Native American heritage and culture. They consider themselves storytellers and information holders for their generations of progressive art.

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(Developed for Writing and Grammar, grades 3-5)

### **17.01.07**

#### **Multiple Literacies Being Developed in the Literature Classroom: Hieroglyphics to Graphic Novels, by Meghan Senjanin**

This curriculum unit analyzes the image-text relationship throughout literary history in an effort to keep students engaged by connecting the current sophomore curriculum to their lives today. Despite being products of a vastly image-saturated and technological world, many don't have a well-developed visual or media literacy--the ability to critically evaluate images independently and images paired with text. This unit focuses on unifying the year's curriculum through analyzing and studying the image-text relationship, while improving students' multiple literacies--a valuable 21<sup>st</sup> century skill.

Part one (2-3 weeks at the beginning of the year, but could also stand alone) sets the stage for the sophomore curriculum with the following goals: defining what various literacies are, establishing and identifying the interplay and synergy of text and image, assessing students' current level of visual and media literacies, and making a connection between how humans have read in the past and how they read now. Part two will improve students' multiple literacies by moving through literary history, analyzing the evolution of the text and image relationship while keeping the Statement of Inquiry and essential questions constantly in mind. There is also an emphasis on introducing the feminist, Marxist, archetypal, and reader response literary criticism lenses. Authors and texts include *The Canterbury Tales*, Shakespeare, Blake, Cummings, emojis, and more.

(Developed for English II, grade 10; recommended for English, Art, and Reading, grades 9-11)

### **17.01.08**

#### **An American Myth: How Pictures and Texts Have Changed the Narrative of the American Revolution, by Lynnette Shouse**

The overall goal of this unit is to use both texts and images to discover the real history behind one of the most famous stories from the American Revolution. Students will discover that the events of the winter of 1777-1778 at Valley Forge, Pennsylvania did not occur exactly as stated in their social studies textbook. Narratives and pictures surrounding history can be inaccurate for many reasons, including but not limited to:

skewed perspective of the author, creation of political propaganda, or an attempt to create a collective patriotic memory.

The unit consists of a variety of texts, images and activities that will help students make connections between history and the media used to record it. Students will be reading texts, researching primary sources, participating in discussions, and learning to respond to differing views with respect. Connections between the past and the present will be a targeted focus of instruction. This unit is geared towards students in fourth through sixth grade and the resources could be modified to align with other state or district standards.

(Developed for Language Arts and Social Studies, grade 5; recommended for Language Arts and Social Studies, grades 4-8)

### **17.01.09**

#### **Kindergarten Writing: Writing as a Form of Art, by Anna Tom**

As writers, kindergarteners go through a tremendous leap from experimental writing at ages 15 months-5 years to formal text writing in kindergarten. Formal writing demands prerequisite skills such as memory of the letters, phonic skills for spelling, and fine motor skills for handwriting. There are also social-emotional skills to work on such as stamina to continue writing and the motivation to find writing meaningful. Writing is a powerful tool for children to express themselves, tell stories, and fight for justice, yet it is something that many students find challenging.

This unit targets kindergarten writing and focuses on how art and text has an interlaced relationship. It explores how Chinese pictographs, Egyptian Hieroglyphs, and Latin alphabet parallels with kindergarten writing. This unit also looks into how the arts can support various types of learners and make learning culturally and personally relevant to the students. Activities for this unit includes interactive read aloud, art projects, and writing pieces that revolve around the theme of self, family, and culture.

(Developed and recommended for Writing and Art, Kindergarten)

### **17.01.10**

#### **Minds in the Gutters and Bleeding on the Page: Literacy and Civil Rights History through the MARCH Comics Trilogy, by Krista Waldron**

This unit was created for multi-age high school students as a supplemental, whole-school literacy project emphasizing social justice while targeting image and text literacy skills. The students tend to be struggling and reluctant urban readers. This unit could be used for several high school grades and courses, especially language arts and social studies. The central texts are the MARCH graphic novel trilogy by John Lewis, et. al., with extra

focus on the first volume. There is a short history of comics, plus information on reading and teaching them, as well as a short list of resources for teachers. The work will encourage growth of multiple literacies as students learn how to read and analyze the comics genre. Scott McCloud's books will be the key sources for learning specific strategies to read, analyze, and create comics and graphic texts.

(Developed for English Language Arts/Advisory, grades 9-12; recommended for English Language Arts, Social Studies, and American History, grades 8-11)

## *II. Literature, Life-Writing, and Identity*

### **Introduction**

The tumultuous times in which our seminar on “Literature, Life-Writing, and Identity” met in the summer of 2017 gave a special sense of urgency to our work together. In the context of newly aggressive threats to vulnerable groups, from migrants and undocumented individuals to poor folks without health insurance to men “driving while black” to queer and transgender people—not to mention the growing dissonance between clear, even catastrophic evidence of climate change and the brazen refusal to address it—discussion of novels, poetry, and life-writing might seem frivolous. Instead, the heightened sense of uncertainty and peril of these times seemed to strengthen the fervency of our shared conviction of our work’s importance. Although we did not often dwell on political developments in our seminar meetings, we shared an understanding that any resources our teaching can offer young people to strengthen their pride, courage, and resilience and to support their capacities to reflect, to think critically, and to feel agency in shaping their own lives, are more desperately needed than ever.

The philosopher Hilde Lindemann Nelson offered us one set of terms with which to formulate our understanding of the vital human stakes of the expressive and interpretive arts. From her book *Damaged Identities, Narrative Repair*, we gleaned ways to describe the damage done to identity by cultural stories that demean individuals perceived first as members of a devalued group. In our shared readings for the seminar, we traced the consequences of such cultural stories again and again—whether in Mary Shelley’s 1818 novel *Frankenstein*, in which the “creature” turns to violence in the face of repeated rejections; or in Gene Luen Yang’s 2006 graphic novel *American Born Chinese*, in which the protagonist directs the bigotry he encounters against both himself and others; or in Claudia Rankine’s 2014 work, *Citizen: An American Lyric*, in which the speaker confronts a barrage of racial projections and misprisions so relentless that the lyric “I” cannot be sustained. These literary renderings from science fiction, fantasy, and poetry all resonated strongly with what we know well from daily life, from the news, and from the struggles of our students to sustain a sense of self.

We found ourselves often remarking on the fundamental human need to be attended to—to be seen and heard, as individual selves—as well as the deep human needs for imagination and beauty. More specifically, we drew on the concept of “counter-stories” developed by Lindemann Nelson and others—a strategy of resistance that allows identities to be narratively “repaired”—as a flexible model to describe the resource provided by creative personal expression. We jokingly developed an imaginary hashtag, “#HumanitiesSaveLives,” that conveyed the improbable nature of our conviction in a time when schools and universities as well as government and the media question the value of Humanistic pursuits. Perhaps such a hashtag does, or should, exist, to spread the word through social media’s wide-reaching channels. In the context of our seminar,

however, part of the joke of the hashtag was that we didn't need one, given the special intimacy of our daily gatherings. We fully savored that experience of immediacy, in which we spoke honestly and listened intently to each other. We left our intensive two weeks together with a renewed respect for the vital importance and power of the act of listening.

At the same time, each member of the seminar also developed and carefully crafted a curriculum unit informed by these concerns to use in his or her own classroom, and thanks to the extraordinary reach of the internet, these original curriculum plans, along with thoughtful accounts of their rationale and aims, are available here to teachers around the world. The units range from projects for lower-grade students in the elementary art classroom, to reading and writing projects for middle-school students, to curriculum for high-school students in Sociology, English, and History of the Americas.

Two of the curriculum units developed for the seminar draw on the power of visual art-making as well as the language arts as means for creating and conveying a strong and dynamic sense of identity. Affirming young people's natural creativity, Robert Graham has designed a unit in which the activities of scribbling, collecting, and curating offer methods for young children's rich exploration of their sense of self. For her older students, all of them English learners and many of them recent arrivals in the U.S. after harrowing journeys, Sara Stillman combines language-learning opportunities with "art-based research." Following discussion of both words and images in a graphic memoir of a refugee's journey, students will create narrative mobiles about their own journeys—works of art that lend weight, balance, and motion to chosen memories, with embedded audio-recording of their narratives in their own voices.

Marissa King's unit, designed for the fifth-grade classroom, draws directly on Lindemann Nelson's ideas to strategize ways to shore up identity for students who face unchosen changes in their lives. "Fiercely optimistic" about young people's potential for resilience, King uses carefully selected reading and writing assignments to remind students of the depth of their inner resources, and to insure that their identities are sustained by many strands rather than being narrowly defined. Toni Aliskowitz's unit provides her fourth- and fifth-grade students with ways to think and talk about the great variety of human abilities and "dis"-abilities. Employing both fictional and nonfictional works, the unit introduces students to people whose complex individual identities cannot be reduced to the physical or mental disabilities that onlookers might see first.

Joyce Tsinijinnie's and Priscilla Black's units are both designed to increase their students' knowledge of Diné (Navajo) language, culture, and disciplines as essential sources of identity and resources for living. Tsinijinnie's unit for third graders concentrates on the practice of self-introduction, so important in Diné culture. In a carefully-planned sequence of lessons, the unit not only provides her students with a practical skill but also develops their language abilities, knowledge of their clans, and understanding of the origins of the clans, to place each student in the web of identity that

is their rich inheritance. Black's unit, for sixth-grade students, emphasizes the Diné value of balance as a guiding principle. Entering the unit through *American Born Chinese*, a graphic novel that incorporates a different culture's ancient stories in a contemporary context, Black's students will come to appreciate what their own people's sacred stories, traditions, and literary works offer them alongside other aspects of their identities.

Patrice Henry's unit for junior-high students seeks to help them distinguish the questions "Where am I *from*?" and "Who *am* I?" and to explore the relationships between those questions. In an innovative pairing of literary and historical materials, the unit focuses first on August Wilson's play *The Piano Lesson*, which stages a debate about the simultaneous burden and richness of family history, and then on a complex episode from Tulsa history, which encompasses both the achievements of Black Oklahomans and their violent persecution: the prosperity and self-sufficiency of the Greenwood District and the Tulsa Race Riots of 1921. Capitalizing on the interest of "real life" stories for young people, Jennifer Vermillion's unit for high-school sophomores artfully assembles a variety of non-fiction texts and journaling activities with which students examine several key aspects of adolescent identity: names, speech, and the experience of "teenage" life.

All of the units designed by seminar members seek at once to strengthen students' understanding and acceptance of their own identities and to heighten their open-ness and empathy towards others. Robert Schwartz's unit particularly emphasizes this double aim, boldly presenting his high-school freshmen with the great variety of life-stories and kinds of identities that surround us. His unit works to counter the monotony and exclusive bias of the "master narratives" of dominant culture by plunging students into a sequence of "multicultural, multimedia" texts that feature protagonists with very different stories to tell. Tharish Harris's unit for high-school freshmen also foregrounds the double aim of "finding me, knowing you," as her students move through topics ranging from hair and food to more abstract bases for defining identity such as race, class, gender, and sexuality, with an eclectic mix of reading and writing assignments clustered around each.

Eduardo Valladares's IB Histories of the Americas curriculum takes a broader hemispheric and historical view, combining required units on the Civil Rights movement and on foreign policy in the Americas in order to foster critical inquiry about the connections between power relations among countries and within them. His unit also prompts students to rethink how we habitually define "American" in implicitly U.S.-centered terms. Designed for a high-school course in Sociology, Barbara Prillaman's unit addresses the central place of gender and sexuality in defining personal identity; it introduces students to the complex interplay between "given, chosen, and imposed" in the social construction of gender. Recognizing that gender and sexuality are highly personal and sensitive subjects, Prillaman opens her unit with a module devoted to active listening skills—in order that, as she says, students may "be more involved in what their peers are trying to convey." This aim of sensitive attention to individual expression is central both

to the work we undertook together as a seminar, and to the aims of all the units that seminar members have developed with such care.

Jill Campbell

## Synopses of the Curriculum Units

### 18.02.01

#### [Identity of Persons with Disabilities: Looking at People and Characters in Novels and Media](#), by Toni Aliskowitz

How we see ourselves versus how others see us can have a positive or negative impact on our identity. For the disabled student, showing themselves to others in a way that's free of judgment can be a difficult, if not impossible task. This unit will examine the way persons with disabilities can have their identities supported or dismantled by their interactions in the world. Through readings of novels with disabled main characters, students will get a close look at how persons with disabilities experience the same sense of longing to belong that we all do. We will come to a new understanding of persons with disabilities, and learn how to more effectively communicate to change the negative stereotypes that come along with surface judgement. We are creating a new narrative about "disabled persons" through the recognition that persons in the mainstream may themselves be only temporarily "abled."

(Developed for English/Language Arts, grades 4-5)

### 18.02.02

#### [Identity of Past and Present Diné](#), by Priscilla Black

Every generation has their own conception of identity. In 2017, five generations of Diné understand, interpret, and express their identity differently. For my students, the Diné creation story is a familiar concept but it doesn't resonate to a level of deep understanding. The history of our leaders, our language, and our values are not integral to the daily lives of our youngest members. My unit strives to offer coping mechanisms and develop a sense of pride in our culture via the explicit teaching of our creation story. It is astounding to see all these five generation at once. However, in my interviews I was able to only interview two generation. It is through these interviews, each generation had their own definition of identity. It is in these perceptions that will allow my topic of identity and its interpretation to be explained and parallel to modern literature written by Native American Indians. Teacher and students will read a scenario that relates to identity through religion and identity through cultural teaching. Once the two types are presented, students can interview and begin to categorize their family's source of identity. Students' goal is to create a comparative writing piece about their own findings from interviews, literatures and nonfiction books about Dine history and leaders. How much will it differ from the past and present? The results will be discuss and it maybe that the new generation may acquire their own unique definition of identity. In addition this unit, students will re-examine the importance of telling origin stories to keep our identity embedded in each generation. If the Diné stop telling the stories and practicing the clanship system, our identity as Diné Nation might be just a story to tell.

(Developed for ELA Reading, ELA Writing, Social Studies, and Art Presentation, grade 6; recommended for Navajo History, grades 9-12, and United States History, grade 12)

### **18.02.03**

#### **[Curating an identity: Exploration and Expression in the Elementary Art Room](#), by Robert Graham**

Considering the idea of identity, through the creative and expressive view of art, this unit focuses on the manifestations of identities in students and how they are expressed. This unit discusses the practice of collecting as a personal act of projecting one's identity onto objects. The idea of a narrative identity, or a personal story, is discussed and synthesized with the role of a curator. The curator's job of assembling and organized artwork for use in a museum is use here to explain to students one way of expressing their identity through art. Addressing art's expressive features, the unit highlights artworks, techniques, and characters that can be used to help students visualize identity and learn about ways to express it. The unit is grounded in the elementary classroom but speaks to students of all ages.

(Developed for Visual Art, grades K-5; recommended for Visual Art, grades K-12)

### **18.02.04**

#### **[Finding Me, Knowing You: Exploring and Expressing Identity through Language Arts](#), by Tharish Harris**

Teenagers are in the process of identity formation, and this unit aims to help students learn about a variety of identities through carefully chosen thematic excerpts, poems, and full novels. Students will closely read and respond to the texts through writing and discussion. This unit's goal is that adolescent students begin to understand the events and conditions that shape identities. Students will follow characters and writers as they explore what forms their identities, while simultaneously examining their own concepts of their teenage identities. As they go through this process—of learning about their own identities and those of both fictional characters and historic/public figures—the goal is that each student will learn to appreciate, accept, respect, and understand identities different from their own. This unit is designed for grade 9, but could be easily adapted for grades 10, 11, and 12.

(Developed for English/Language Arts, grade 9; recommended for English/Language Arts, grades 9-12)

### **18.02.05**

#### **[Uncovering Individuality in a Scripted World](#), by Patrice Henry**

Who am I? and Where am I Going? are two questions that many teens struggle to answer in efforts to define their identity. For some, these two questions, although seemingly connected, are confusing to ponder and overwhelming to decide. For others, these two questions are redundant, and original responses are ludicrous when the answers have already been defined. In an effort to help my students more clearly define the difference between their *person* and their personal *experience*, this unit allows students to view life and identity through the characters in August Wilson's *The Piano Lesson* and selections regarding the Greenwood District and the Tulsa Race Riot of 1921. Through the process of research, analysis, and theatrical character development, students will be able to explore various aspects of individual identity in connection with familial, social, and political constructs.

(Developed for Language Arts, grade 7; recommended for Language Arts, grades 8-12, United States History, grade 11, African American Studies, grades 11-12, and Oklahoma History, grade 9)

#### **18.02.06**

#### **Identity in Transition: Narrative Repair for Changing Times, by Marissa King**

Sudden illness, death, family changes, and other tragedies can shatter safe routines and everyday comfort at any age. For middle grade students, changing bodies and the nerve-racking transfer to middle or high school adds to the inevitability of transition. Many students feel *subjected* to change. An apartment eviction can mean a sudden school switch or double-bunking with relatives across town. In precarious moments of transition, identities are especially at risk and in desperate need of attention. In order to support students during unwanted change, this unit combines four research-based identity strategies with reading and writing goals. Using a bibliotherapeutic approach, students analyze how characters in novels and poems face change. Then, students participate in writing projects designed around acts of self-affirmation, identity broadening, and positive future-looking stories. The research, activities, and strategies in this unit offer ways to shore up student identity while meeting important academic goals. Although designed for middle grade students, the unit can be adapted for other grades by switching texts.

(Developed for Language Arts/Writing, grade 5; recommended for Language Arts, Writing, and Reading, grades 4-6)

#### **18.02.07**

#### **Given, Chosen, and/or Imposed: My Gender, Myself, by Barbara Prillaman**

In this unit, high school students will explore the sociological concept of gender through their investigation of identity. Through the use of common and choice text sets, students will be able to answer the following questions: How are sex and gender defined and

understood?, How are gender expectations learned and/or imposed throughout one's lifetime, and what does this mean to individuals and society?, and What is my understanding of gender and how does it impact my life? Common Core Standards are addressed, as students will need to evaluate and synthesize these multiple sources to answer the above questions individually as well as discuss them collectively. Students will practice active listening skills to truly hear their classmates' gender identity stories. These will be presented by individuals' artifacts and pictorial gender exhibitions.

(Developed for Sociology, grades 11-12; recommended for Social Science courses, grades 9-12)

### **18.02.08**

#### **[American Born Readers: A Multicultural, Multimedia Attempt to Challenge Perspectives and Inspire Reading](#), by Robert Schwartz**

The need to make time to read mirrors the need to discover multiple perspectives. Both are important culturally, intellectually, and socially; both sometimes require that we challenge ourselves. When faced with so many of life's mundane challenges and distractions, it is easy to fall into our screens and our self-centric viewpoints of what is, to put down good books as well as our willingness to accept that not everyone comes from the same place or sees things the same way we do. This curricular unit is intended to correct both behaviors, creating a classroom atmosphere where these corrections – becoming readers and becoming people who are aware and accepting of all our differences and similarities – are the dominant culture. Utilizing Gene Luen Yang's *American Born Chinese* as well as provocative new media by Claudia Rankine, stories by Chimamanda Ngozi Adichie, transgender author Janet Mock, and other multicultural and multimedia work that represent us all, students will find stories of themselves and, of equal import, stories of many others. Students will explore how discovery through this practice can awaken interest in finding out more about the world, ourselves, and each other through reading.

(Developed for English, grade 9; recommended for English, grade 9)

### **18.02.09**

#### **[Growing Roots, Stretching Wings: An Exploration of Identity and Voice for English Learners](#), by Sara Stillman**

Navigating the balance of a past and present life is a large part of adolescence. Taking on adult roles and leaving childhood behind is something many high school immigrants endure well before adolescence. In addition, newcomers have often missed significant portions of school, sometimes placing them grade levels behind their new peers. Educators meeting the academic and social emotional needs of these students face numerous challenges and often find great success through hands on learning experiences.

This unit uses the Visual Arts to explore immigrant memoirs while empowering students to write and record their own stories to embed into sculptural art. With reading and visual analysis activities focused on Thi Bui's graphic novel *The Best We Could Do* students will examine the relationships between text and image through narrative storytelling. Using Art-Based Research teachers of 6<sup>th</sup> through 12<sup>th</sup> grade in both English and Art can integrate art making and English language concepts to reach a broad range of learners. (Developed for Visual Arts, grade 10; recommended for Visual Arts, English Language Arts, and English Language Development, grades 7-12)

### **18.02.10**

#### **"Shi" - Child of the Holy People, by Joyce Tsinijinnie**

In this unit Diné children will learn to properly introduce themselves. The importance of Diné way of introduction connects a child to their family, culture, and language. Their Diné name makes a connection to the Holy Beings. Their parents are the vessels of bringing them into this world, their clans identify how they connect to their immediate family and non-immediate family members, and how they can make a connection to where they are from. Simply introducing yourself may sound so basic to by non-Natives, but within the Diné culture it creates the balance and harmony between you as a human being and with the Holy Beings. We need to teach our children today how their self-identity is very unique. The understanding of their history, language, culture, and disciplines will balance them; without that balance they will wander, or become lost psychologically. Overall, if you know your clans then you are a rich Diné, because now you have disciplines that will get you far; you will see how big a family you have and that you can reach out for help when you are in need psychologically and physically. Introduction of this unit will also include children books on the Diné Emergence story, 'Asdzáą Nádleehé Changing Woman, Diné Twin Warriors, and the creation of clans. These readings are related to the importance of how a Diné person introduces himself.

(Developed for Elementary Social Studies, grade 3; recommended for Social Studies and Navajo Culture, grades 3-5)



### *III. Poetry and Public Life*

#### **Introduction**

The curriculum units I received for my Summer 2017 seminar, “Poetry and Public Life,” reflect the possibilities of this topic in wonderfully diverse ways. Our poetry seminars are always an occasion for teachers to learn about poetry as a medium in order to teach it with more confidence, and that purpose is reflected in most of these units. In the seminar we had mainly to do, however, with the kind of poetry that openly addresses public affairs, not the “private” or “personal” kind that comes to mind for most people when they think of poetry. Hence politics, protest, and social identity were topics that loomed large both in our discussions and in the Fellows’ teaching plans. It would be possible to cluster these units according to subject matter, as my summaries below will make clear, but to honor the diversity of approach and interest that I mentioned above I shall simply review them alphabetically.

**Rich Cuminale** of New Haven wants his high school students to write and in the process to become expert in responding to the writing of others, both published poets and the students’ peers. He wants his student poets to reflect their communities in a critical spirit, and in the process not just to articulate a poetry of public life but to experience the public life of poetry by circulating their work among relatives, friends, and even strangers—not online merely but in direct social interactions.

**Matt D’Agostino** of Chicago has an ambitious year-long project in which his unit plays an intermittent part. In his high school English classes he teaches an impressive list of quite difficult novels (Woolf, Camus, Achebe, for example) and plays (*Lear*, *Streetcar*, and *Godot* in this latter category), all of which concern our social existence in all its amplitude. In his unit he has chosen a different poem to use as a point of departure for interpreting each of these novels and plays in turn. My favorite is Margaret Atwood’s poem on King Lear in a nursing home.

**Liz Isaac** teaches fourth and fifth graders in the Diné Nation, and needs at once to improve their skills in English (in effect most of them are ESL students), to introduce them to poetry (about which they have mandated testing), and to acclimatize them to descriptions of their own culture. With these goals, to convey a sense of sound and rhythm she has chosen both nursery rhymes with poems by Shel Silverstein, and also, to make the world of poems seem congenial, poems by Native Americans on familiar topics.

**Jenny Kim** of San José is a middle school American history teacher whose unit introduces poems in a comparison of the Progressive Era with recent times. She starts with Whitman as bard of industrialized democracy, then moves to the Dunbars and

Edwin Markham as voices of protest still marginalized in the Progressive period, pointing out that Roosevelt supported poetry but not Black poetry, just as union leaders excluded Blacks and immigrants to support white workers. These early poets she places alongside Kendrick Lamar, Dolly Parton and other lyric voices of our era to underline the persistence of their themes.

**Mike McClellan** is also an American history teacher from San José. His unit focuses on the Revolutionary and Federalist periods, and he wants to show how the Hartford Wits—Joel Barlow, David Humphries, and John Trumbull in particular—influenced sentiment against the British first and then, in opposition to widespread support for state sovereignty, the movement for federation under the Constitution. In the course of making this claim, hoping to recover the Wits from obscurity, he examines the public roles of satire and panegyric.

**Kathleen Radebaugh** of Philadelphia has devised a unit responding to the concerns of the growing Muslim population in her middle school classroom. She will juxtapose relatively secular modern Middle Eastern poets in translation--showing how they negotiated rigid poetic conventions that were first Persian and then Islamic--with a popular podcast by two young Muslim women living in Los Angeles who balance their beliefs with living realistically in a secular world. All students will learn about poetic conventions while applying the ambivalences of these poems to their own social experiences.

**Jo Anne (Stafford) Flory** of Tulsa, the Coordinator of our seminar, has amassed a large repertoire of ethnic voices, especially Hispanic and with special emphasis on Juan Felipe Herrera, to impress upon her under-represented high school students the commonality of their concerns. Like Terry Anne Wildman below, Jo is interested in situating her students in their immediate environment, waking with them through Tulsa neighborhoods to inspire writing about their own condition in emulation of the poets they have been studying.

**Debra Titus** teaches young students in an Afro-centric Pittsburgh school, and wants to introduce them to poetry from traditional hymns to Langston Hughes to the present as a form of both analysis and self-discovery. She hopes first to focus the theme of beauty in relation to Black identity, next to show how her chosen poets negotiate the issue of acceptance, self-acceptance as well as acceptance by others, all in relation to the problem of race. In keeping with her school's curricular emphasis, she wants students to take pride in their origins.

**Tara Waugh** teaches high school in Tulsa. In response to current political rhetoric, she has organized a unit to bring attitudes to America into dialogue, using the medium of poetry. Drawing on Tulsa's Woodie Guthrie and Bob Dylan archives, she will emphasize

a tradition that begins with Whitman and passes through Langston Hughes and on to Guthrie and Dylan, with attention paid too to Gil Scott Heron and the Malvina Reynolds of “Little Boxes” fame, mindful that Tom Lehrer called that song the most sanctimonious ever written, and eager here and elsewhere to balance attitudes of celebration and critique.

**Terry Anne Wildman** teaches fourth and fifth graders in Philadelphia, and hopes to instill a sense of being Philadelphian through poetry. She will begin with Jack Prelutsky’s use of place names in his book of children’s poems, *Ride a Purple Pelican*, then turn to Rudyard Kipling’s very interesting poem called “Philadelphia,” followed by Sandburg’s “Chicago” and other poems. In walking her children through neighborhoods and having them write about what they see, she hopes to show the difference between stereotype and authentic observation.

Paul H. Fry



## Synopses of the Curriculum Units

### 17.03.01

#### **Poetry in Public Discourse: Reading, Writing, and Circulating the Political Poem,** **by Richard Cuminale**

This unit aims to give students a sensitivity to the value of political poetry and an understanding of how it works and can work for them. They will read a variety of poems and consider the political situation of the poem and poet while at the same time considering their own political situations and how poetry can speak for them. Students will ask and answer questions like, “Why would this poet write this poem?” or “What in this poet’s life and circumstances led to this poem?” The unit includes opportunities for students to refine their close reading and essay writing skills, collaborative analysis and composition, and discussion through Socratic Seminars and writing workshops. The students will also practice responsive writing through a poetry reading journal and creative writing as they write their own political poetry. The resources for this unit list contemporary political poems and books for approaching political poetry and poetry in general.

(Developed for English 3, grade 11; recommended for English, grades 10-12, and AP Literature and Composition, grade 12)

### 17.03.02

#### **Poetry as a Dialectic in the Public Sphere,** by Matthew D'Agostino

Various access points are necessary to allow for a diversity of thought in the public sphere. The premise of this unit is to set forth a series of outcomes that will allow students to engage in challenging college level material with the aid of poetry. Poetry will serve as an access point for a deeper analysis of a novel or play that shares a theme, character type, or time period. The unit does this in two main formats. It begins by offering a text set of 6-10 poems for 8 canonical novels that will be read throughout the year in preparation for the Advanced Placement (AP) Literature exam.

As the year progresses poetry will be considered on a weekly basis. A brief discussion of one poem per unit is included to offer you a glimpse of the reasons why a poem might be included. Also included is an analysis of one poem from each of the three categories (theme, character, time period). While the reason for including many poems is oftentimes clear from the beginning, some do require deeper analysis to see the connection to the novel or play with which it is paired. It is in this way that we begin to broaden our horizons to see connections that may have been missed previously.

(Developed for AP Literature, grades 11 and 12; recommended for World History, grades 10-12, and English 4, grade 12)

### **17.03.03**

#### **Making Our Communities Visible: Poetry, Rhetoric and Social Justice, by Jo Flory**

This unit centers around the way a variety of contemporary African American, American Indian and Chicano poets have addressed issues of social justice, with the goal of increasing the visibility of marginalized communities in America, and drawing attention to acts of injustice. Students will study the way these poems build community, such as the way performance poetry can create a sense of community by exposing people to different perspectives, and poetry focused on increasing visibility can empower communities by helping people see their worlds differently.

Students will be immersed in reading and writing poetry, as well as discussion of contemporary issues that are important to them. They will also study the rhetorical elements at work in these poems, giving them a fresh understanding of how those elements interact, while they develop a voice to express their own views on issues they are passionate about.

Activities include keeping a poetry notebook, writing a variety of forms of poetry, and creating a photo poem to document community life.

This unit was written for 11<sup>th</sup> grade English III and English Language and Composition students, but it would be well suited for any 11<sup>th</sup> or 12<sup>th</sup> grade American Literature or American Studies class.

(Developed for AP Language and Composition and English 3, grade 11; recommended for American Literature and American Studies, grades 11-12, and AP English Language, grade 11)

### **17.03.04**

#### **Poetry and Public Life through Cultural Perspective and Relevancy, by Elizabeth Isaac**

The intent of this unit is to help third to eighth grade Dine students to enjoy reading poetry and find it entertaining. In addition, the unit teaches students the importance of poetry through research-based strategies, and to comprehend the content of the poem. Three objectives will be the focus of the unit in a span of 15 days. First, students will learn the vocabulary needed to discuss poetry. Second, students will learn to identify the text features or elements of a poem. And third, the students will compose a poem, choosing from among the different genres of poetry. Culturally relevant materials and

activities will be used as a resource to help students grasp the concept of poetry. Selecting poems written by Native Americans will give the students a better understanding of the poems because the content will be familiar. This will help students enjoy reading poetry without intimidation. Another reason for choosing familiar content is to activate the prior knowledge and creativity of the students.

(Developed for English Language Art and Writing, grade 3; recommended for English Language Art and Writing, grades 4-8)

### **17.03.05**

#### **Poetry of Defiance-From the Progressive Era to Today by Eun Jung Kim**

In a music-obsessed generation, how do I make history fun and engaging and relevant? Tapping into their love of contemporary music, this unit is designed to help my students discover their voice in a world where they feel they have no voice.

During this unit students will read and analyze selected poems of the Progressive Era and compare it with contemporary music lyrics. This curriculum will provide a concise background of events leading up to the Progressive Era and examine poets from disenfranchised groups of the progressive era to provide a type of voice that is missing from the narrative of our history textbooks. Students will understand that African-Americans, women, and the urban poor—despite institutionalized oppression—found creative ways to speak out and protest, then as now, against the status quo.

My unit is written for 11<sup>th</sup> grade U.S. History classes, but can be modified for A.P. U.S. History.

(Developed for United States History, grade 11; recommended for AP United States History, grade 11)

### **17.03.06**

#### **Poetry in Notion: The Hartford Wits and the Emergence of an American Identity, by Michael McClellan**

Although a Revolutionary War figure and a close friend of George Washington, Colonel David Humphreys is not a familiar name to Americans. He belonged to a group of poets called the Hartford Wits, mainly John Trumbull, Timothy Dwight, and Joel Barlow. These men, through satire and poetic verse, gave voice to their dissatisfaction with English rule and, later, to the struggle to ratify the U.S. Constitution. Why has history forgotten them, and are they now more deserving of study? The Hartford Wits faded from memory because they were judged on artistic rather than political merits. Given the success of the Broadway musical *Hamilton*, with its hip-hop perspective, one could say

that the Hartford Wits were the rap artists of their day. Espousing a message in defiant tones and delivering it in a regular meter, these social commentators were the voice of the disenfranchised in the Founding Fathers' generation. Writing about such topics as Columbus, anarchy, and strong versus weak government, their poetry points to the inadequacies of successive governments. When they are seen as crafters of a new American identity in the years immediately following the Revolutionary War, it becomes much easier to appreciate their true role as political activists.

(Developed for United States History, grade 8; recommended for United States History, grade 11, and Civics and Government, grade 12)

### **17.03.07**

#### **[A Private Moment in Public View: Analysis of Muslim Poets and Political Activists from the 20th Century to Today](#), by Kathleen Radebaugh**

Over the past several years, my student population is becoming more diverse. Many of my students are recent immigrants to America from various countries in the Middle East and Africa. A growing number of my students and their families are Muslim, and they share with our school community many of their customs and traditions. I especially enjoy reading about their religious practices in the students' journals. It is the intent of this unit to provide a canon of poems and prose by Islamic authors and leaders from many different communities around the world about migration, assimilation, falling in love, and political unrest. This unit is designed for eighth grade students in the early part of the second semester. My students follow a 90-minute ELA block for the whole course of the year. This is an introductory unit on poetry with a focus on the use of figurative language, development of syntax, and author's purpose. Students will analyze a selection of poems by contemporary Muslim poets through the use of close reading with little emphasis on historical and biographical context. These poems will be compared to selected episodes of a podcast series entitled *Good Muslim, Bad Muslim* by Tanzila "Taz" Ahmed and Zahra Noorbakhsh. While listening to the podcasts, students will contextualize the biographical and historical significance of several segments of the episodes. The culminating assessment for the students is to write one or two poems for their writing portfolios, and then digitally record one of their poems.

Muslim, Islam, poetry, immigration, *Good Muslim, Bad Muslim*, podcast, digital portfolio

(Developed for English Language Arts, grade 8; recommended for English Language Arts, grade 7)

### **17.03.08**

#### **America the Beautiful: A Look at Race and Acceptance in America through Poetry, by Debra Titus**

Is your poetry curriculum in need of depth? Is there more to poetry than just similes and metaphors? To what degree is it necessary to read beyond the lines and discover the complexity in which the poet scribes? These questions are pivotal to the educator that teaches poetry. Is it enough to pinpoint figurative language, or should students seek more? Students need the opportunity to transcend the words on the page, and dig for deeper meaning. Analysis of poetry is at a deficit across the educational stratosphere and even more so at the elementary level. Students need to grapple with complex text in different ways. Starting with poetry that they can relate to may be a way to bridge the gap.

In this six week unit, students will read a plethora of poems. Students will study Black poetry, and its depiction of race, acceptance and beauty in America. Students will examine poetry through sequence in time, starting with Negro Spirituals and Hymns, and progress to Blues and Harlem Renaissance Poetry, Contemporary and Modern Poetry and conclude with Hip-Hop. This unit is intended for students in fifth grade, yet can be weaved into poetry units at the intermediate and secondary levels.

(Developed for English Language Arts, grade 5; recommended for English Literature, grades 9-10)

### **17.03.09**

#### **Poetic Visions and Versions of America, by Tara Waugh**

Poetry and America. The two topics seemingly have not a lot to do with each other and certainly, do not seem of interest to most teens across the nation. This year-long unit combines these two dynamic topics into something that will be engaging and thought-provoking for students in a high school setting. Originally designed for an AP Language and Composition class, this unit brings poetry into the conversations about what America is and should be. The goals are to include more poetry in a typically non-fiction focused classroom and to sharpen analysis and writing skills, while deepening students' understanding of the world around them.

What is most useful about this unit is that the poems suggested can be used to pair with novels, plays, essays, and visuals that are also used in a Literature classroom. Poets emphasized are Walt Whitman, Woody Guthrie, and Bob Dylan (a "Whitman tradition") to Emily Dickinson, Gwendolyn Brooks, and Sylvia Plath (women in the same time span on gender and race in America). This unit offers ways to approach the poems and engaging activities to help guide students to create their own visions and versions of

America through poetry -- a much needed conversation in these divisive and confusing times.

(Developed for AP Language and Composition, grade 11; recommended for AP Language and Composition and AP Literature and Composition, grades 11-12; English III, grade 11; and English IV, grade 12)

### **17.03.10**

#### **Philadelphia, Do you See What I See?, by Terry Anne Wildman**

Why is it important to teach poetry in schools? How can we teach it in a way that does not intimidate students but instead excites them? This unit explores various strategies to engage students in writing poetry. In our reading curriculum, poetry is interwoven throughout the school year. It can easily get lost in the shuffle while teachers focus on non-fiction informational texts, text dependent analysis, and constructed responses.

This unit also focuses on using poetry to help fourth graders find their voice in order to articulate their thoughts and experiences about living in Philadelphia. Teachers can modify this unit to fit their own city. My students attend an inner city school with over 600 students ranging from Pre-Kindergarten to Fifth Grade. Our state testing begins in third grade and our benchmark testing is completed in grades one through five. In the midst of this testing environment, teachers find they struggle to cover all topics and genres that they would like to cover. The Pennsylvania Common Core Standards for fourth graders include explaining major differences between poems, drama, and prose and referring to structural elements of each when writing and speaking about texts. This unit uses Kenneth Koch's "poetry ideas" along with other strategies to engage and encourage students to write what they are thinking and feeling about living in Philadelphia. Drawing on Rudyard Kipling's "Philadelphia," Carl Sandburg's "Chicago," and Walt Whitman's "The Great City," students will use poetry ideas to write poetry about living in a big city.

(Developed for Language Arts, Writing, and Poetry, grade 4; recommended for Language Arts, Writing, and Poetry, grade 5)

## *IV. Chemistry of Cooking*

### **Introduction**

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. Cooking offers a wealth of hands-on activities and opportunities to learn about chemistry. In this seminar, we explored questions such as: Why does baked bread smell so good? Why do egg whites become opaque when cooked? What makes bread rise? Why don't oil and vinegar mix? Why are jalapeño peppers hot? and What makes popcorn pop? 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. Therefore, many cooking activities and demonstrations were included in this seminar – at least one hands-on activity, and frequently several, in each seminar meeting. 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.

The book by Robert Wolke entitled “What Einstein Told his Cook” was used as the primary reading for the seminar. The seminar began during our two meetings in May with a discussion of how the perception of flavor is a combination of taste and smell. To illustrate this, the Fellows in the seminar paired up to experiment with the perception of flavor when taste and smell are presented separately. During our meetings in July, each Fellow prepared a cooking activity. These 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 contamination, and extracting the fat from chocolate. These demonstrations provided opportunities to delve into chemistry and provoked lively discussions. A highlight of the seminar was the guest presentation by Professor Elsa Yan who teaches a course at Yale on the “Chemistry of Cooking” in which we learned about the temperature required for browning of chicken and how to make frozen ice cream balls using liquid nitrogen. We all enjoyed sampling the results of the cooking activities.

The curriculum units developed from this seminar are suitable for elementary to middle school to high school students. In all of the units, the science content is integrated with language arts, mathematics and social studies to provide a balanced program that meets the literacy requirements of the school system. The Fellows have prepared extensive lists of materials that can be used in the classroom or as resources. These materials include books that the students can read, textbooks that the teachers can use, demonstration

sourcebooks, suppliers of equipment and many addresses of sites on the world wide web. All of the Fellows developed units around a theme or activity related to cooking. Information on the math and science principles related to the cooking activities, as well as connections to the everyday lives of students, is provided in the curriculum units. The units include many excellent cooking activities that will engage the students' interest and teach them about math and science.

I would encourage all teachers of elementary through high school students to review these curriculum units. These materials provide a valuable resource for incorporating topics of science and society related to the "Chemistry of Cooking" into the classroom.

Gary W. Brudvig

## Synopses of the Curriculum Units

### 17.04.01

#### [The Math and Science of Kitchen Ratios](#), by Jacqueline Alvarado

In the kitchen, sometimes measurements need not be so precise: a pinch of this, a dash of that, or the common phrase “to taste”. Ask any grandma how to make a family dish and I guarantee that while the ingredients and process are very specific, the measurements are not. Baking is the one exception to cooking. Baking is the art of precision and the reasoning behind the necessity of precision is simple math and some kitchen chemistry. The differences in technique, ingredients, and measurements can make a ball of dough for bread, or something that feels like a rock. Every culture in the world has their version of the pancake. The purpose of this unit is to bridge math and science concepts in an engaging, culturally responsive way. It is often difficult to find time for science lessons in a cored or self-contained classroom, when math is at the forefront of scrutiny and high stakes testing. This four-week unit seeks to examine the science behind the ratios in cooking pancakes around the world. The unit is aimed toward middle school students and will best work in a cored math and science block or in a self-contained classroom.

(Developed for Mathematics and Science, grade 6; recommended for Mathematics and Science, grades 6-8)

### 17.04.02

#### [The Chemistry of Baking Bread](#), by Carol Boynton

Who doesn't love the smell of fresh baked bread? How is bread really made and what makes it smell so good? Many young students are not only unaware of where food comes from, many do not spend time in grocery stores or supermarkets to see and shop for food in its natural, whole-food state. Bread is an interesting case when thinking about natural foods. The focus in this six-week curriculum unit is for 2<sup>nd</sup> grades scientists to learn that bread is a composition of ingredients and is formed under chemical reactions influenced by those specific ingredients and a heat source.

The curriculum unit begins with the primary mentor text *Everybody Bakes Bread*, a picture book by Norah Dooley that introduces several types of breads, each a typical example or staple from across several cultures. With the bread recipes as a resource, the students will experiment with various basic ingredients (yeast, baking powder, baking soda, eggs, salt, and sugar) to discover why they are necessary to the success of the product. They will explore the chemical reactions that cause breads to rise or not, research why breads brown in the oven or skillet, and discover what makes bread smell so good while it is cooking.

(Developed for Science, grade 2; recommended for Science, grades 1-4)

### **17.04.03**

#### **Food Preservation: From Edible School Garden to Science Table, by James Churilla**

The fundamental foundation for strong number sense is the development and understanding of numbers through in-depth instruction in place value of whole numbers, computational adding and subtracting using base 10, decimal numbers, and estimation. My unit is designed to support in developing the understanding of these basic relations of numbers. Students will develop place value concepts, a sense of magnitude (small numbers, big numbers), and estimation skills for whole numbers and decimals. Often students do not connect what is happening in their mathematics classrooms with their daily lives, so incorporating relevant content that arise in the context of the students' world are important as well. Connecting math with real world context is more meaningful to students than traditional textbook exercises and it helps them develop a sense of how numbers and operations are used in their daily life. Also, in my unit I implement cultural relevancy using our native language to support our students' connection of self-identity as young Native Americans. Frequent practice and use of the concepts learned is important in the development of number sense, as are regular opportunities for student communication. Discussion of their learning and problem solving helps students strengthen their intuitive understanding of numbers and the relationships between numbers.

(Developed for Mathematics/Number System, grades 6-7; recommended for Mathematics/Number System, grades 4-7)

### **17.04.04**

#### **The Power of Extracts, by Stevara Clinton**

Through this three week high school Chemistry curriculum unit, students will learn about flavor chemistry. This unit is designed for 10th through 12th graders. The big idea of this unit to capture the interest of my students and to promote their learning of chemistry by appealing to their love of food. I want them to know that flavors are chemicals and that chemistry plays a major role in their everyday lives. The unit encompasses several topics including chemicals in flavors, how our bodies process tastes and smells, natural vs. artificial flavors, extractions, and flavor enhancers. Objectives addressed in the unit include connections among sciences, demonstrating and understanding safe laboratory practices, procedures, and techniques, identifying basic lab equipment needed to measure volume, mass, temperature, and pressure, making measurements and recording data, introduction to bonding types: covalent and ionic, and construction and defense of a scientific viewpoint. Throughout the lessons, I use an *I do, We do, You do* model to outline each lesson for ease of use. The culminating end of unit activity will have

students making their own extracts and using them to prepare a bath salt scrub to take home.

(Developed for Chemistry, grades 10-12; recommended for Chemistry and Environmental Science, grades 9-12)

#### **17.04.05**

#### **Being Corny: Using Popcorn to Explore Thermodynamics by Terri Eros**

This unit address the Next Generation Science Standards, NGSS, for middle school as it pertains to matter and its interactions. Although created for sixth graders, this three week unit is applicable to seventh and eighth grade as well. Starting with the phenomenon of popcorn, students will explore the relationship between heat energy and change of state. Through investigations, they will discover that popcorn kernels explode due to increased pressure inside the hull as the liquid water is transformed into water vapor when the seed is heated. They will then look at other changes of state, due to the addition or removal of heat energy, with the focus being on water and its properties. Transformation of energy is also discussed as students learn how electrical energy is transformed into heat of conduction, convection and radiation. This inquiry based unit uses all of the eight science practices of the NGSS as they ask questions, develop and use models, plan and carry out investigations, analyze and interpret data, use mathematics and computational thinking, and engage in argument from evidence. It also incorporates several key math and English language arts' Common Core standards.

(Developed for Integrated Science, grade 6; recommended for Transformation of Energy, grades 6-8; Water, grade 3; and States of Matter, grades 3-5)

#### **17.04.06**

#### **Rise and Bind: Substituting binders and flours in pancakes, by Robin Harris**

This is an elementary fourth and fifth grade gifted and talented unit that can easily be adapted for upper elementary science classes. This unit addresses Next Generation Science Standards on Science and Engineering practices. In this unit, students will learn about the chemical properties of wheat flour and eggs, a traditional binder in pancakes. Students will determine what other flours and binders can be substituted. Learning tasks will include experimenting with binding agents and making a pancake that includes an alternative flour and binder.

(Developed for Gifted and Talented, grades 4-6; recommended for Science, grades 4-8)

#### **17.04.07**

#### **Matter Chatter: Exploring the effect heat has on states of matter using the five senses, by Annie McGill**

Kinderscholars are motivated by curiosity. They want to investigate and explore the world around them. This six-week science unit captures that curiosity and uses it to explore scientific concepts that seem magical to them. The scholars will master the concepts of states of matter, heat, heat transfer and use the five senses to observe the effect that heat has on states of matter in cooking. This unit includes strategies for differentiated learning, learning styles, graphic organizers, journals, scientific method, and the design cycle. The states of matter lessons include read aloud stories that are fiction and non-fiction, research, hands-on inquiry, experiments and presentations. The heat and heat transfer activities include those activities as well as experiments to create butter, applesauce and cupcakes. The standards met by this unit include the Next Generation Science Standards, Common Core, and Oklahoma Academic Standards. This unit is intended for Kindergarten but is applicable to first and second grade as well.

(Developed for Science/States of Matter, Math/Data Analysis, Science/Heat Transfer, grade K; recommended for Science/States of Matter, Science/Heat Transfer, grades K-2)

#### **17.04.08**

#### **Science of Sugar, by Chris Moy**

Cooking is an experience universally shared by children that can be used to tangibly engage them in scientific exploration. Within the context of cooking, sugar presents an interesting topic of study. Found in a variety of food items ranging from drinks to prepared foods, sugar is a substance familiar to children. This unit will lead fourth grade students in an investigation of sugar that shows them the significance of the substance's chemical properties. They will experience foundational ideas of chemistry by creating sugar solutions, growing sugar crystals, and creating caramel apples. Through an interdisciplinary approach that emphasizes experiential learning, this three-week unit will also engage students in the scientific process, familiarize them with the history of sugar, and allow them to develop an understanding of the health implications of sugar consumption.

(Developed for Science, grade 4; recommended for Science, grades 3-5)

#### **17.04.09**

#### **Salt and Health – It's not fair!, by Shirley Paulson**

This unit is a two-week lesson, designed for middle school students grades 5-8 with activities aligned with the Arizona College and Career Ready Standards – Science. The

unit is built around strong content knowledge with integration of Physical Science and Health Education. The focus of this science unit is on salt usage and nutrition. An inquiry-based learning technique will guide most experiments and hands-on activities. In addition, the unit will also incorporate standards and connect to strong Diné cultural influence to study salt from a historical viewpoint, production, current usage and health benefits and risks. The birth of frybread is linked to Diné history's painful experience; yet it has become a featured identity and continues to be a deep pride in Native American culture and many traditions. Frybread, a Diné recipe, makes a great addition to savory meals which is easy to make, is delicious and satisfies an appetite. Changing the recipe to a lighter texture and making smaller portions is a healthier version.

(Developed for Integrated Science, Health, and Diné Culture, grade 5; recommended for Integrated Science, Health, and Diné Culture, grade 5)

#### **17.04.10**

#### **[Confectionery Chemistry: Shifting the Contents of Chocolate](#), by Eual Phillips**

This unit is designed to grab the hearts of 10th grade students with several accomplishments. First, it will challenge the students to choose creativity as a means to overcome oppression (i.e. George Washington Carver). Secondly, students will engage in studying the phases of matter by using separation techniques to remove fat from chocolate, extract juice concentrate from fruits, and apply their knowledge by creating a beverage and juice-containing chocolate confectionery. Finally, students will vlog their use of separation techniques to create their beverage and confectionary and share the recipe via social media as a method of disseminating scientific information to the public. This introductory unit is best implemented at the beginning of the school year to really get students off to an exciting and meaningful start to chemistry. The unit should last about 7 instructional days and can be taught after the basics of chemistry such as identifying reactants and products, distinguishing atoms, elements, and molecules, and the states of matter. Recommended for Chemistry, Grades 10 and 11.

(Developed for Chemistry, grade 10)

#### **17.04.11**

#### **[Everyday Science of Cooking](#), by Cameron Rowe**

This unit is intended for the fifth grade, states of matter, ages 9-11. The unit should take somewhere between 1-1 ½ months depending on your students and the time dedicated to science in your classroom. This unit's primary focus is on the three states of matter: liquid, solid and gas. It will also focus on heat transference, as well as exploring protein denaturation and the chemical reaction in baking soda. It is also cross curricular touching on history and a sizable focus on engineering. All activities are simple to set up and run.

They are safe in any classroom environment. This unit allows students the opportunity to learn about the scientific process and how to set up a science notebook. The unit has a lot of edible components that result from the classroom activities. This is an excellent unit for any teacher who struggles to get their students interested in science as well as scaffolding the scientific method in an easy and concrete way.

(Developed for Science, grade 8; recommended for Science, grade 5)

#### **17.04.12**

#### **[Best Practices for Food Preservation from Lab to Home Kitchen](#), by Thanh-Nhu Tran**

Foodborne illnesses affect several million people in the United States each year. This unit focuses on a few commercial food-processing techniques and at home storage methods for students to become aware of the necessities of preserving the shelf life of their food. Food preservation methods such as dehydration, freeze-drying, and pasteurization are explained to show the common purpose of preventing biological and chemical spoilage. The consumer will need to continue preserving their food through different ways of storage. This unit then describes different storage container materials and how placement of the food in the home continues the preservation process.

The realm of cooking gives common ground to many students as they explore the abstract world of the sciences. This unit is intended for High School students taking Chemistry. Interactions and changes in matter, chemical reactions, stoichiometry, and laboratory etiquette are a few concepts that can be emphasized. This unit allows teachers to modify the activities to meet the needs of students and provides opportunities for students to engineer their own storage methods and understand Chemistry through inquiry-based instructions.

(Developed for Chemistry, grades 10-12; recommended for Introduction to Science or Science Skills, grades K-8)

## *V. From Arithmetic to Algebra: Variables, Word Problems, Fractions and the Rules*

### **Introduction**

The Yale National Seminar, "From Arithmetic to Algebra", was centered around a study of word problems and their solution. Much discussion focused on the taxonomies, of one-step addition and subtraction problems, and one-step multiplication and division problems, given in Tables 1 and 2 of the Mathematics Glossary of the Common Core State Standards in Mathematics (<http://www.corestandards.org/Math/>). Becoming familiar with these taxonomies, and seeing examples of how multistep problems can be broken down into sequences of single step problems, can give teachers a way in to the very substantial literature of mathematics word problems, and enable them to lead class discussions that help their students learn to read word problems carefully and interpret them correctly.

Another topic that received considerable attention was the rather large range of problems that can be approached either arithmetically, by direct reasoning with the quantities in the problem, or algebraically, by defining variables, setting up equations, and solving them using manipulations governed by the Rules of Arithmetic and the Principles of Equality. Looking at the relationship between the two solutions can help students understand what role algebra is playing in problem solving, and give them greater confidence in tackling harder problems in which the arithmetic approach is quite difficult. In producing algebraic solutions, a point of emphasis was the importance of defining the variable(s) carefully, including specifying the units of all variables.

Reflecting this emphasis on word problems, all the units devote attention to solving word problems. At the elementary level, Gilbert Carter's unit attempts to improve both the reading and the mathematics competence of his students through carefully tailored word problems. Brittany McCann's unit uses literature to engage her students in the problem solving enterprise. Valerie Schwarz uses Singapore Bar Models to help her students organize their thinking about word problems. Jolene Smith's unit features a novel collection of word problems devoted to quantitative aspects of the Diné hooghan, in order to promote awareness of traditional Diné culture as well as mathematics.

A group of 4 Fellows took on the task of helping students to make the transition to symbolic solutions to algebra word problems. Rachelle Soroten starts the work by concentrating on translating relatively simple verbal problems into symbolic form, and looking at how to solve the relatively simple equations that result. Jeffrey

Rossiter has created lists of problems that require translating variant phrases into symbolic form. A point of emphasis here is that several different phrases may well have the same symbolic translation. After symbolic expressions have been found, the solution

process often requires that they be simplified. Xiomara Pacheco's unit helps students understand that a large family of expressions, the "first order expressions", can always be converted to the standard form  $ax+b$ , where  $x$  is the variable, and  $a$  and  $b$  are specific numbers. Finally, Sally Yoo's unit puts it all together and helps students use the techniques of the previous units, as well as the principles of equality, to solve the equations that result from algebra word problems. She also presents both arithmetic and algebraic solutions for several problems.

Irina Alekseeva's unit is closely related to the four described in the previous paragraph. Her students also need practice at translating words into expressions, but must progress much faster, since they are taking higher level mathematics. To facilitate progress, Irina has created multipart problems that look at the translation process from many perspectives.

Finally, there are two units that explore more advanced topics. Lawrence Yee discusses sequences, and explores the use of difference sequences and second difference sequences to analyze sequences described by quadratic functions.

Zachary Meyers develops the fundamental idea of proportional relationship to study simple motion, especially motion at constant velocity, and motion at constant speed. This unit can serve as an introduction to a subsequent discussion of motion with constant acceleration, one of Gallileo's great achievements.

Roger E. Howe

## Synopses of the Curriculum Units

### 17.05.01

[Helping Struggling Readers Build Math Understanding through Word Problems](#), by Gilbert Carter, Jr.

When I first started teaching I would find myself thinking that if I had one wish for my students, it would be that *all* of my students had a complete understanding of basic multiplication facts. Over the course of several years of teaching math, another wish would be that my students could read on grade level. However, the reality is that students struggle with math and reading. These deficits make it a challenge for math teachers. This unit will serve 8<sup>th</sup> grade math teachers teaching (pre-Algebra) in the special education setting or the general education setting who have student's reading well below grade level—specifically 2 to 3 grade levels below. This unit can be used by special education and/or general education math teachers who teach pre-Algebra and struggle with students' inability to read, comprehend, and correctly solve word problems. This is the unit that will address struggling readers, who want to strengthen literacy using one-step mathematical word problems. This unit is designed with the goal in mind to *truly* meet a struggling eighth grade student with certain reading and math deficits at their respective levels.

(Developed for Pre-Algebra, grade 8; recommended for Mathematics, grades 6-7)

### 17.05.02

[Solving Problems Multiple Ways: Using Arithmetic and Literature - Hooray!](#) by Brittany McCann

This unit is designed to look at problem solving by using literature and mathematics together. It will start by hooking students with a read aloud from the novel, *The Skin I'm In*, by Sharon Flake, in which the protagonist gets into a lot of trouble by making questionable choices in solving her life problems. Students will identify the problem in the story and brainstorm ways to solve. Following that reading, students will be given carefully written mathematical word problems to solve. The problems are written to include the three types of addition and subtraction problems (change, comparison, and part-part-whole) and the three types of multiplication and division problems (equal groups, area/arrays, and comparison). These types of problems are further divided according to position of the unknown quantity, resulting in 23 different types of problems all together. Following the same procedure as for the novel, students will identify the problem and create a plan to solve. Using the four basic operations, students will learn that, just as in real life scenarios, once you understand the problem, there are multiple ways you can solve it. When one-step problems are well understood, two-step problems

will be introduced. The intended audience is fourth grade, but this unit could also be used with younger or older children who struggle with problem solving.

(Developed for Mathematics, grade 4; recommended for Mathematics, grades 4-6)

### **17.05.03**

#### **Understanding Problems: Using Bar Models with Common Core Taxonomies, by Valerie Schwarz**

*Understanding Problems: Using Bar Models with Common Core Taxonomies* explores how to combine the Singapore bar model approach to analyzing math word problems with the Common Core taxonomies for one-step arithmetic problems (addition/subtraction or multiplication/division). The curriculum unit focuses on the six main types: the change, compare, and part-part-whole situations for addition and subtraction; and the equal groups, compare, and array situations for multiplication and division. Through the use of Singapore bar models, Polya's problem solving scheme, and group discussions, the unit is designed to build students' understanding of word problems. This unit focuses on the single-step components that can be combined to create two-step and three-step problems. A point of emphasis is the connections between addition and subtraction, and likewise between multiplication and division. The pros and cons of the model method are also considered. The unit is designed for third grade students, but could be adapted for students in grades 3-8.

(Developed for Mathematics, grade 3; recommended for Mathematics, grades 3-8)

### **17.05.04**

#### **Math Word Problems and the Diné Hooghan, by Jolene Smith**

Math word problems are a common source of difficulties in mathematics classes. Many students' struggle with word problem solving because understanding them involves a complex process, and word problems come in many forms. Students need to comprehend the problem, and then figure how to solve the problem. This is when rigor of math becomes challenging. Teaching math word problems needs to be explicit and progress in careful steps. Of course, students must also practice correctly, apply the skills and make connections with home and school. The problem solving process has been examined by G. Polya, who has proposed a four stage schema for finding solution to math problem. His method has students questioning their thinking while solving math problems.

The unit will cover math concepts of geometry; base ten addition/subtraction, and multiplication/division skills within the word problems. I will introduce my unit to my studying unit chart papers explaining the legend and history of the Diné *Hooghan*. This unit will help students in measuring their understanding of the Diné *hooghan*, in

connection with math word problems. This unit incorporates the Diné culture and language. The classroom activity of constructing a model Diné *hooghan* is an ideal learning tool for students, parents, and educators who want their students to be engaged in learning math word problems while learning about the Diné culture.

(Developed for Social Studies, Navajo Culture and Language, and Mathematics, grade 5; recommended for Mathematics, grades 4-5)

### 17.05.05

#### [Mathematics as a Language of Symbols](#), by Irina Alekseeva

While teaching my Pre-Calculus and AP Calculus students, I have realized that using **mathematical symbols** to create **numeric and algebraic expressions**, and to solve text problems is usually a big problem for them. They struggle to translate a verbal problem statement into symbolic mathematical expressions and equations. However, to be successful in upper level Math, Physics and Chemistry students should be able to create a **mathematical model** based on the given data. This is an extremely challenging task for them. This curricular unit will emphasize an idea that **Mathematics is a language**. It will help teachers build students' competence in writing numeric and algebraic expressions while **“translating” real-life problems** into the mathematical language of symbols.

(Developed for Algebra and Trigonometry, grades 9-10; recommended for Pre-Algebra, Algebra I, Algebra II, Pre-Calculus, and Calculus, grades 7-12)

### 17.05.06

#### ["Simplifying" the Issues with Expressions](#), by Xiomara Pacheco

Going from teaching 9<sup>th</sup> grade to 8<sup>th</sup> grade, it was clear to me that simplifying algebraic expressions is quite challenging for my students in both grades. This unit is intended to help them overcome their difficulties with this topic. It can be taught in collaboration with the units of three other Fellows of the YNI 2017 seminar, *From Arithmetic to Algebra*: Rachelle Soroten, Jeffrey Rossiter, and Sally Yoo. The related units cover the topics of word problems, translating word phrases, and solving equations. This unit will specifically cover translating complex word phrases into algebraic expressions, and then using the rules of arithmetic, also known as the Properties of Operations, to simplify the resulting expressions. The final conclusion is: any combination of linear expressions can be simplified to an expression in the form  $ax + b$  where  $a$  and  $b$  are specific numbers. Collaborative strategies will be used to develop this understanding, with the expectation that independent work allow students to build their confidence when talking about math.

(Developed for Pre-Algebra, grade 8; recommended for Pre-Algebra, grade 7, and Algebra 1, grade 9)

### **17.05.07**

#### **Introduction of the Variable by Forming and Interpreting Expressions, by Jeffrey Rossiter**

My students are unprepared to engage in curriculum surrounding translating expressions from word problems. They have incomplete knowledge of the role variables play in such situations. Students may only know the basic rules of arithmetic on a very surface level and oftentimes lack the depth of content knowledge to translate word problems into equations and then solve them. Starting students off with word problems as the main motivation for using symbolic algebra makes more sense. This allows students to see the mode in which problems are solved and gives them a plan to solve them. The series of student outcomes are split between four units including this one. Each unit will have its own unique place in translating, simplifying, and solving algebraic expressions and equations. This series is aimed at the middle school level and can be taught in succession with Rachelle Soroten's unit titled: Formulating Algebraic Expressions From Word Problems, that has students solve basic word problems using both bars models and algebra. In this unit, students will be exposed to a variety of problem sets that will increase their ability to translate verbal expressions into symbolic ones. They will also get experience functioning in a discussion-based classroom through experiencing intertwined participation strategies. Next, Xiomara Pacheco's unit titled: Simplifying The Issues With Expressions will simplify these complex expressions to allow Sally Woo's unit titled: Making Sense of Solving Equations Through Word Problems – The Cornerstone of Algebra to address solving multi-step equations.

(Developed for Pre-Algebra, Mathematics, grade 7; recommended for Pre-Algebra, grade 7)

### **17.05.08**

#### **Formulating Algebraic Equations from Word Problems, by Rachelle Soroten**

The purpose of this curriculum unit is to help students translate word problems into first order equations, which can be written as  $ax + b = c$ , where  $a$ ,  $b$ , and  $c$  are whole numbers. I will use visual models and discussions to help students identify and organize the given information, unknown value, and relationships of the quantities in the word problem. The models in this curriculum unit are based on the Singapore Bar Method. By organizing the information from a word problem, and representing it with a bar model, students will have an easier time representing these quantities and relationships symbolically. I also hope this curriculum unit gives students confidence to approach more complicated word problems as they progress further in math.

This unit was developed for a pre-algebra class, and is recommended for grades 7-9. It is the first of four complementary curriculum units developed in the 2017 Yale National

Initiative (YNI) seminar *From Arithmetic to Algebra*, about translating, simplifying, and solving algebraic expressions and equations. For the related curriculum units, please see the work of 2017 math Fellows Jeffrey Rossiter, Xiomara Pacheco, and Sally Yoo, in that order.

(Developed for Accelerated Mathematics, grades 6-7; recommended for Mathematics, grade 7)

### **17.05.09**

#### **[Making Sense of Solving Equations Through Word Problems](#), by Sally Yoo**

The purpose of this curricular unit is to improve my students' performance in solving linear equations and word problems by teaching the two topics simultaneously so that they can have a more positive and successful experience in high school math classes. This unit works to fully engage students from different cultures and levels of skill using word problems to flush out and address the many misconceptions and gaps in prerequisite skills and at the same time to help students construct deep conceptual understanding of the procedures of algebra. The focus of the unit is on helping students realize the efficiency of using algebraic equations as they work through progressively more complex word problems using both an arithmetic approach and a procedural algebra approach. It is expected that their reliance on computational strategies will gradually transition to using procedural algebraic problem-solving strategies as problems increase in complexity and as they notice the limitations and benefits of both approaches. Furthermore I hope that facility with both approaches will deepen their understanding of algebra. Moreover I want my students to become flexible problem solvers, which means they can modify their approach when faced with challenges during the problem-solving process. In other words, they can start with an algebraic procedure then switch to an arithmetic approach if they realize their initial approach is too cumbersome or vice versa. Thus, they will effectively learn more about both approaches.

(Developed for Mathematics 8/Solving Equations with One Variable, grade 8; recommended for Algebra 1/Linear Equations, grades 7-9)

### **17.05.10**

#### **[Exploring Kinematic Proportional Relationships](#), by Zachary Meyers**

Physics for many is an intimidating mixture of contemplation and critical thinking about everyday phenomena. Students in particular are often overwhelmed with its multifaceted nature and the complexity involved even with simple motion. Kinematics offers an approachable platform to connect the inherent relationships between mathematics and physics by strengthening students' understandings of proportional relationships describing motion. This four-week unit seeks to explore multiplicative comparisons and ratios in topics ranging from base unit conversion to constant rates of motion. Students in

10<sup>th</sup>, 11<sup>th</sup>, and 12<sup>th</sup> grades will conduct multiple investigations where data will be collected and analyzed to enhance connections between mathematics and physics. In addition, inquiry activities coupled with discussion will provide context and opportunities for students to visualize and refine their conception of common physical phenomena. It is my hope that this unit will motivate students to think critically about their physical environment, prompt active discussions based on their observations, and elevate their mastery in both mathematics and physical science.

(Developed for Physics, grade 11; recommended for Physics and Math, grades 10-12)

### **17.05.11**

**[Sequencing Math DNA: Differences, Nth Terms, and Algebraic Sequences](#), by Lawrence Yee**

A sequence is an ordered list of numbers. Sequences can arise from visual patterns, recursive equations, explicit equations, and graphically. At the high school level, students work with arithmetic (linear) sequences, geometric (exponential) sequences, and quadratic sequences, as well as other types of sequences. With each type of sequence, students are expected to identify key features in order to write an equation that models the number pattern. Many students struggle significantly with writing an equation for a sequence, even when given the general formulas. This unit emphasizes the difference sequence and initial terms of an original sequence to determine a general equation for particular classes of sequences. Also, structures of difference tables, second difference tables, and ratio tables are introduced as tools to assist students with analyzing sequences in order to connect the numerical patterns with their algebraic representations.

(Developed for Mathematics Analysis, Pre-Calculus, grades 10-12, and Mathematics 1, grades 9-12; recommended for Algebra 1 and Integrated Mathematics 1 and 2, grades 8-12, Mathematics Analysis/Pre-Calculus, grades 10-12, and Algebra 2, grades 9-12)

## ***VI. Engineering of Global Health***

### **Introduction**

This seminar focused on several related questions: What does it mean to be healthy? How does health differ among the nations of the world? What are the major barriers to health, and can engineering be used to surmount these barriers?

To address these questions, we focused on the physiological functions that lead to a state of health in an individual and a population. We considered health at the cellular and molecular level by focusing on four important determinants of health:

- Genetic variability and its relation to human disease,
- The role of the immune system in protecting health,
- The interaction of microorganisms with humans,
- And the cellular basis of cancer.

Throughout the seminar, two major themes were explored: 1) the relationship between health and biological/physiological mechanisms (e.g. the molecular basis of inheritance, cellular interactions in the immune systems, microbial interactions with hosts, and lung mechanics); and 2) engineering of technologies that enhance health (e.g. vaccines, contraceptives, insulin therapy) and technologies that harm it (e.g. tobacco, power generation by fossil fuels). The discussions in the seminar were enhanced by our reading from: *Biomedical Engineering*, W. Mark Saltzman, Cambridge University Press (2015).

The Fellows prepared curriculum units that covered a breadth of information on global health and engineering. The material presented in the units assembled in this volume span an impressive range and are designed for use in classrooms from elementary through high school.

Several of the curriculum units were prepared for high school teachers. Kwame Adu-Wusu prepared a unit titled *Gene Therapy and Muscular Dystrophy: Structure, Function, and Dysfunction of the Muscular System*. 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. Monica Cohen prepared a unit titled *A Cell's Story – From Growth to Mitosis*, which provides an introduction to the biology of human cells, putting the biological processes of protein synthesis, DNA replication, regulation, and cellular reproduction into a logical framework. Her unit provides classroom activities that will help high school students make connections between these concepts that underlie human health. Michael A. Doody wrote a unit on *Economics and Community Health – The Wealth-Health*

*Paradigm*. In this unit, Michael describes the differences the health of populations living in different regions of the world, and relates these differences to local economics. His work provides a framework for students to develop skills in analyzing and interpreting data, while enhancing their understanding of the basis of health and how it differs among nations.

Other units were prepared for teachers at the middle school level. Patricia Moncrief prepared a unit titled *Water... “Good To The Last Drop”*. Here, Patricia focuses on the health effects of water, outlining the problems that can develop when the body has too little water (dehydration). The problems develop because of changes in water availability to cells, and are used to illustrate some important basic physical phenomena, such as diffusion and osmosis. Patricia’s unit also describes a service learning project related to water purification. Alexa Freshour prepared a unit titled *Cure for the Common Cold: Fantasy or Reality?*. Alexa’s unit focuses on viral diseases of the upper respiratory system, which cause highly impactful world-wide health problems. In the unit, Alexa discusses the respiratory systems, life cycle of viruses, the lymphatic and immune systems, and the elements of vaccines, as she illustrates the difficulty in making a vaccine for the common cold. Nancy Ibarra wrote a unit titled *HeLa Cells, Cervical Cancer, and the HPV Vaccine*. The unit connects important concepts from cell biology and virology and immunology, by focusing on the power of viruses to transform normal cells into cancer cells, and the role of vaccines in preventing viral infections and, therefore, cancer. Nancy uses the example of human papilloma virus, which can cause cervical cancer, and describes how the HPV vaccine is reducing the incidence of this deadly disease.

Beth Valentine Pellegrini wrote a unit titled *Micro Life in a Macro World: Understanding Life at the Microscopic Scale and the Spread of Disease*. 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. Jessica Johnson prepared a unit of kindergarten teachers titled *Germ Attack!*, which will help to introduce important basic concepts of germs and personal hygiene to young students. Jessica connects her unit to the study of the five senses—which is a common subject of study in many lower elementary classrooms—and describes new ways to improve understanding of the role of bacteria and viruses in human health to even the youngest students.

Mark Saltzman

## Synopses of the Curriculum Units

### 17.06.01

#### [Gene Therapy and Muscular Dystrophy: Structure, Function, and Dysfunction of the Muscular System](#), by Kwame Adu-Wusu

*Gene Therapy and Muscular Dystrophy* is a short unit intended for high school Anatomy & Physiology students who may lack mastery of some foundational biology concepts. The unit employs the peculiarities of Duchenne muscular dystrophy (DMD) as a basis for understanding normal skeletal muscle function. Further, it explores principles of molecular genetics that are the foundation of new treatment strategies associated with DMD and uses these to emphasize the idea that in biology, function is determined by structure and dysfunction results from changes in structure. The unit incorporates Next Generation Science Standards (NGSS) for Life Sciences (HS-LS1: Structures and Processes, HS-LS3: Inheritance and Variation of Traits). It incorporates NGSS Science & Engineering Practices (SEP) - developing and using models; analyzing and interpreting data; constructing explanations and designing solutions; engaging in argument from evidence; obtaining, evaluating, and communicating information. Students develop a simple model they use to understand basic processes of molecular genetics. That model is then used to construct and communicate clear explanations for complex medical innovations whose data they have analyzed and evaluated.

(Developed for Anatomy and Physiology, grades 11-12; recommended for Anatomy and Physiology, grades 9-12)

### 17.06.02

#### [A Cell's Story - From Growth to Mitosis](#), by Monica Cohen

This unit is intended for high school biology students studying biology of the mammalian cell. The unit challenges students to model the cell cycle beyond the usual listing of basic stages; instead, students must explain the intricacies of cellular function and overall importance during each cycle phase. Rather than separating the cell cycle unit from topics of DNA structure, signal checkpoint, protein synthesis, and mitosis, students learn these topics concurrent with the overall cell cycle. Within the unit, students study DNA structure when discussing G1 phase, DNA replication in S phase, protein synthesis and signal checkpoints during G2 phase, and the stages of mitosis. As a finished product, students are asked to model and create a written response of the entire cell cycle and the importance of each phase. Literacy skills and 21<sup>st</sup> century skills, such as utilizing technology, collaborating, and critical thinking, are implemented throughout each component. Students utilize technology to receive content knowledge and graphic organizers to manage information. Activities include a DNA extraction lab with analysis

questions, written responses based upon a rubric, whole class review activities, and individual formative assessments for instructor feedback.

(Developed for Biology, grade 10; recommended for Biology, grades 9-10)

### **17.06.03**

#### **Economics and Community Health - The Wealth-Health Paradigm, by Michael Doody**

This unit, designed for Advanced Placement Environmental Science (APES), helps students to connect economic concepts with human population studies and biomedical engineering to develop deeper understanding of the relationship between wealth and health, termed the Wealth-Health Paradigm. Students engage in various Next Generation Science Standards Scientific and Engineering Practices (NGSS SEPs) to support learning, including asking questions and defining problems, analyzing and interpreting data, obtaining, evaluating and communicating information, and using mathematical and computational thinking. Students spend the bulk of the unit analyzing and interpreting GDP and cause-of-death data from the World Bank, United Nations (UN), and the World Health Organization (WHO) to arrive at an understanding that individuals in poorer regions of the world disproportionately suffer and die from preventable communicable diseases. They use their newly acquired knowledge in the areas of basic economics, human population, and biomedical engineering to make sense of this data and develop lasting meaning for this topic. Successful completion of the unit requires students to use Learning Focused strategies (LFS), such as close reading, jigsaws, and distributive summarization. These increase content mastery and prepare students for the APES exam as well as success in post-secondary education.

(Developed for AP Environmental Science, grades 11-12; recommended for AP Human Geography, grade 9)

### **17.06.04**

#### **Water... "Good To The Last Drop", by Patricia Moncrief**

How many times do you hear middle school students complain of having headaches, or being too tired to pay attention? The answer could lie in the fact they haven't consumed much water that day. This 8<sup>th</sup> grade unit identifies the intake and output amounts of water required on a daily basis. It designates water's importance in regulating constant fluid levels that all cells, tissues, and organs need to maintain homeostasis. Topics emphasized in this unit will cover the problem solving, analytical writing, collaboration, communications and creativity all 21<sup>st</sup> Century learners need to possess. NGSS standards in life sciences, engineering practices, and Earth sciences will be addressed at the middle school level.

The topics address vital transport systems that cells, tissues, and organs utilize for maintaining hydration, and acid /- base balances, and providing an explanation of what happens when water levels throughout the body are out of balance. The unit also covers the serious health effects caused by inadequate hydration levels. Dehydration is one of the major health risks that can affect anyone at any age.

To finish the unit, students will engineer and construct apparatuses displaying possible solutions to making water enticing to increase consumption.

(Developed for Life Science and Physical Science, grade 8; recommended for Science, grade 6)

### **17.06.05**

#### **Cure for the Common Cold: Fantasy or Reality?, by Alexa Freshour**

While teaching my Pre-Calculus and AP Calculus students, I have realized that using **mathematical symbols** to create **numeric and algebraic expressions**, and to solve text problems is usually a big problem for them. They struggle to translate a verbal problem statement into symbolic mathematical expressions and equations. However, to be successful in upper level Math, Physics and Chemistry students should be able to create a **mathematical model** based on the given data. This is an extremely challenging task for them. This curricular unit will emphasize an idea that **Mathematics is a language**. It will help teachers build students` competence in writing numeric and algebraic expressions while **“translating” real-life problems** into the mathematical language of symbols.

(Developed for Algebra and Trigonometry, grades 9-10; recommended for Pre-Algebra, Algebra I, Algebra II, Pre-Calculus, and Calculus, grades 7-12)

### **17.06.06**

#### **HeLa Cells, Cervical Cancer, and the HPV Vaccine, by Nancy Ibarra**

In this unit, I present the topic of cell biology and concentrate on the development, and prevention of cervical cancer to my 7<sup>th</sup> grade life-science students. I use an historical context to address the disparities that exist in cervical cancer rates across the country. Specifically, we explore if the disparities that exist in our healthcare system here in the United States are a product of the Jim Crow laws our country experienced after the Reconstruction Era and slavery. Martin Luther King said, “Of all the forms of inequality, injustice in healthcare is the most shocking and inhumane.” While reading excerpts from the book, *The Immortal Life of Henrietta Lacks*, we connect labs on cells, cell structure, cell membranes, including diffusion and osmosis, and eventually leading to mitosis and how abnormal cell growth can potentially develop cancer. We research and analyze how organizations such as Planned Parenthood combat the disparities that presently exist

today. This unit addresses the Next Generation Science Standards (NGSS), the National Sexuality Education Standards, and the International Baccalaureate's key concepts, related concepts, and global contexts.

(Developed for Life Science, grade 7; recommended for Biology, grade 9)

### **17.06.07**

#### **Micro Life in a Macro World: Understanding Life at the Microscopic Scale and the Spread of Disease, by Beth Pellegrini**

In *Micro Life in a Macro World* ten to thirteen year old students learn how invisible creatures affect our lives. Students are introduced to the building blocks of matter and the states in which it exists. Atoms and their parts, the elements and molecules are covered. Units of measure at the microscopic level are explored to help students understand that tiny things vary greatly in size. Abiotic and biotic matter and the Kingdoms of Living Things are studied. Cells, cell types, organelles and their functions, and DNA are analyzed. Students learn about microbes and how they live and proliferate. Bacterial disease is contrasted with non-bacterial disease, such as genetic disorders. Treatment for illness is addressed. Viruses and their traits are investigated. Human behaviors that promote or inhibit the spread of disease are identified. Students conduct and present research on careers in science related to any segment of the unit. Next Generation Science Standards (NGSS) Science and Engineering practices are intrinsic to teaching the unit. Crosscutting Concepts and Principles of Learning are woven throughout the lessons.

(Developed for Science, grade 5; recommended for Science, Life Science, and Biological Science, grades 5-7)

### **17.06.08**

#### **Germs Attack! by Jessica Johnson**

In this unit designed for kindergarten, students are challenged to conceptually understand that our bodies are made up of tiny cells that we are unable to see with the human eyes. Within the unit students learn how germs, specifically viruses and bacteria, invade our bodies and attack our cells, making us sick. The unit also includes information on how our immune system, with the aid of vaccines and antibiotics, fight off bacteria and viruses. Students will engage in various Next Generation Science Standards (NGSS) including asking questions, defining problems, modeling disciplinary core ideas, and communicating information. In culmination, a science theater activity aids in the unit's demonstration of students understanding. In order to receive content knowledge students use technology. In exposing students from an early age to these concepts, I hope to inspire a lifelong love of science in our young learners and future leaders to look to science for solutions to problems on staying healthy.

(Developed for Science, Kindergarten; recommended for Science, grades K-2)