Curriculum Units by

Fellows of the

Yale National Initiative

Guide

2008

Contents

Preface

In April 2008 the Yale National Initiative to strengthen teaching in public schools accepted seventy-one public school teachers from fifteen school districts in eleven communities in ten states to participate in seven national seminars held at Yale. The Initiative is a long-term endeavor to establish exemplary Teachers Institutes in underserved school districts in states throughout the country. Following the approach developed in New Haven and demonstrated in Houston, Pittsburgh, and other cities, it builds upon the success of a four-year National Demonstration Project. Teachers Institutes are educational partnerships between universities and school districts designed to strengthen teaching and learning in a community's public schools. Evaluations have shown that the Institute approach promotes precisely those dimensions of teacher quality that improve student achievement.

About two-thirds of the teachers, designated Yale National Fellows, were from seven communities that are planning or exploring the establishment of a new Teachers Institute: Atlanta and DeKalb County, GA; Charlotte, NC; Chicago, IL; New Castle County, DE; Richmond, VA; San Francisco, CA; and Santa Fe, NM. Other National Fellows were from Teachers Institutes that are members of the National Initiative League located in Houston, Philadelphia, Pittsburgh, and New Haven. The Fellows attended an Organizational Session of the seminars held in New Haven on May 2-3. The seminars reconvened during a ten-day Intensive Session from July 7-18.

The seminars, which concluded in mid-August when the Fellows submitted their completed curriculum units, included "Race and Gender in Shakespeare," led by Paul H. Fry, William Lampson Professor of English; "Bridges: The Art and Science for Community Connections," led by Martin D. Gehner, Professor Emeritus of Architectural Engineering; "American Voices: Listening to Fiction, Poetry, and Prose," led by Langdon L. Hammer, Professor of English and of American Studies; "Estimation," led by Roger E. Howe, William R. Kenan Jr. Professor of Mathematics; "Nutrition, Metabolism, and Diabetes," led by W. Mark Saltzman, Professor of Biomedical Engineering and of Chemical Engineering and Physiology; "The Theory and Practice of Democracy," led by Ian Shapiro, Sterling Professor of Political Science; and "Urban Environmental Quality and Human Health," led by John P. Wargo, Professor of Environmental Risk Analysis and Policy.

The twin purposes of the national seminars were to provide public school teachers a first-hand acquaintance with the Institute approach to high-quality professional development, and to cultivate their leadership either in a League Teachers Institute or in the development of a new Teachers Institute. Each participating teacher wrote a curriculum unit to teach students what he or she had learned and to share with other teachers locally

and, over the Internet, internationally. The units contain four elements: objectives, teaching strategies, sample lessons and classroom activities, and lists of resources for teachers and students. The curriculum units National Fellows wrote are their own; they are presented in seven volumes, one for each seminar.

The Yale-New Haven Teachers Institute is a permanently endowed unit of Yale University, which undertook the National Initiative in 2004. The material presented here does not necessarily reflect the views of the funding agencies.

James R. Vivian

New Haven

September 2008

I. Approaches to Teaching Shakespeare

Introduction

I was delighted to lead an enthusiastic group of Fellows in a Summer 2008 seminar for the Yale National Initiative called "Race and Gender in Shakespeare," reading *Macbeth, The Merchant of Venice, Othello, As You Like It, The Tempest, The Taming of the Shrew*, and *Romeo and Juliet*, in that order. We were a diverse group, including several high school teachers, some with AP classes, one from an arts and performance magnet school, one from a vocational and technical school, and one art teacher; several middle school teachers, one a specialist in the teaching of English as a second language; and a third grade teacher. Responding to such a broad range of interests, needs, and educational development, these teachers saw a variety of possibilities for teaching Shakespeare in the classroom, both within the mandated exposure to Shakespeare from the ninth through twelfth grades and in more surprising contexts. The rubric of the seminar, featuring "race and gender," was not of special interest to a number of teachers, though five did write curriculum units specifically on that topic and more broadly concerning character and identity. Four others took up topics involving culture, politics, and religion, topics in which identity understood as individuality shaped by group characteristics is still an important consideration. Even the tenth unit, focused on the sonnets, touches on themes that reflect character.

I have arranged the table of contents according to subject matter in the order indicated above. **Kristen Kurzawski** introduces her students to the concept of literary genre, in this case by way of Shakespearean tragedy and comedy. She cites many plays in her illuminating introductory discussion for teachers, and supplements *Macbeth with The Taming of the Shrew* in the classroom, where she asks her students to what extent genre shapes and delimits Shakespeare's gender roles. **Marialuisa Sapienza** uses scenes from a number of plays (including *Macbeth, Hamlet, and Othello*) to highlight similarities and differences between concepts of race and gender in Shakespeare's time and in our own, pointing the dialogue in these scenes toward discussions of our own conventional thinking and ways in which it might become more flexible. **Barbara Prillaman** is the teacher with English Language Learners, and her unit is designed to help students whose identities are insecure in a strange environment. To this end she uses Shakespearean texts appropriate to the age and language level of her students—comic books, summaries, children's versions—to underline the identity of such characters as Othello, Iago, and Macbeth.

Jennifer Sandoval and **Kimberley Turner** both urge students to develop visual representations of Shakespearean characters, but with very different ends in view. Sandoval, an English teacher, wants to complicate the widely practiced teaching tool called the "body diagram" (thoughts pasted on the head, feelings on the heart, expressions of agency on the limbs) by introducing nuances: for each key character chosen (Iago or

Emilia, for example), she adds color coding, body parts moved around, etc., all to indicate moments of psychological change and such complications as the difference between a character's self-perception and the way the character is viewed by others. Turner is an art teacher, and has in some ways a different purpose: Using both costuming exercises and also the chance of a drawing lesson in oil pastels, she wants students develop an image of a Shakespearean character; but an equally important part of her well-informed unit is the teaching of the relationship between Elizabethan portraiture and contemporaneous art-historical developments on the European continent.

Turning to the units that involve cultural issues: **Catherine Boydstun** has prepared a unit that teaches "Shakespeare's World" across the curriculum for third graders. A part of it is an interesting cartoon version of *Macbeth* that will anchor the unit in Shakespeare. What follows is an instructive gallop through cultural, social, and scientific topics featuring contrasts between past and present where appropriate. **Sarah Humphrey** stresses the influence on Shakespeare's plays (and the parts of *Spenser's Faerie Queene* that feature Britomart) of the reign and personality of Queen Elizabeth. This is obviously a "gender" topic too, but I choose to place it here because Humphrey's sophisticated unit trans-genders Elizabeth—using unfamiliar documents that can still capture students' imaginations—as both a feminine ideal and as an identifier with her father's patriarchal image, all of which she applies ingeniously to Shakespeare, especially to *The Taming of the Shrew*. **Ray Theilacker**, teaching VoTech students, approaches *Macbeth* in a sustained, scene-by-scene reading, together with scenes from other plays, by developing the theme of "power," understood in three ways: natural or cataclysmic power, personal or charismatic power, and authorized or state-imposed power. This unit can clarify a great deal in Shakespeare and in our own lives, and is illustrated by close readings of Shakespeare's scenes. **Pamela Ronson** wishes to teach the principles of Christianity in a contemporary and historical context, and to that end offers a careful reading, with proposed ensuing discussions, of the Christian elements in *Hamlet*, with pedagogically insightful results.

Deborah Samuel offers a unit on Shakespeare's sonnets. Her primary concern is to add new dimensions to the normal teaching of a few sonnets that are chosen and scripted in advance. Her unit provides an introductory account of the history of the sonnet, with its Petrarchan origins, and Shakespeare's place in that history. For teachers she provides an ingenious way of teaching meter and why that matters, together with a summary of the sonnets' main themes, illustrated by readings of particular sonnets in themselves and in clusters.

Taken together, all of these units should inspire and offer points of departure for any teacher of Shakespeare.

Paul Fry

Synopses of the Curriculum Units

2008.01.01
Men vs. Women: Examining the Relationship between Genre and Gender in Shakespeare, by Kristen Kurzawski

This unit is designed for a twelfth grade English class in an inner city high school, but can be easily adapted for anyone teaching a Shakespeare comedy or tragedy at the high school level. The unit centers on two plays by William Shakespeare, first the tragedy, *Macbeth*, and then a comedy, *The Taming of the Shrew*. The use of two Shakespeare plays from different genres is to add a depth of learning which I crave for my students. It will allow my students to study the conventions of two Shakespearean genres, and examine the effect of those conventions on the characters. Specifically we will look at how the genre influences the gender roles in the play. While learning the conventions of Shakespearean tragedy and comedy, the students will examine how those conventions force characters of a specific gender to behave in certain ways. It is my belief that in most cases the way men and women think and behave in Shakespearean comedy and tragedy is decided by the conventions of the genre.

(Developed for English IV, grade 12; recommended for English IV, grade 12)

2008.01.02
Race and Gender in Shakespeare and the Art of Rhetoric, by Marialuisa Sapienza

This unit is primarily focused on the analysis, interpretation, and role of rhetoric in identifying and determining race and gender in some of the most important plays composed by William Shakespeare in comparison with today's expressions and/or belief(s) either in writing or in speech. The unit will start with the following two essential questions: "How do race and gender contribute to my individuality?" and "How do certain beliefs become transparent and obvious in the words I use?" It will present various documents: excerpts from *Macbeth, The Taming of the Shrew, Hamlet, Othello, The Merchant of Venice, Go Back to Black by K.A. Dilday*, published in *The New York Times*, February 27, 2008, *The Words We Use to Talk About Race*, published in *The New York Times*, March 3, 2008, and *Think Gender Is Over? Think Again* by Susan Faludi, published in *The New York Times* on June 15, 2008. Various written documents will be analyzed in order to understand, to compare and contrast, to synthesize, and to evaluate and discuss the concept of race and gender, and the words or phrases that are used to identify or stereotype, and relative causes and effects. The unit will also require numerous writing activities and a final project - a documented essay and a presentation, or a simple documented visual for those students who have special needs.

(Recommended for College English, grades 11 and 12)

(Developed for College English and AP English Literature and Language, grades 11-12; recommended for English, grades 11-12)

2008.01.03
English Language Learners (ELLs) Investigate the Identity of Shakespeare and His Characters, by Barbara Prillaman

Many teachers tend to stay away from using challenging subject matter such as Shakespeare with English Language Learners (ELLS). Do not be afraid! This curriculum unit was created with this in mind and is for middle school ELLs although it can be adapted to include high school ELLs or struggling readers at any secondary level. It spans four weeks and uses three Shakespeare plays: *Macbeth, Othello,* and *Romeo and Juliet*. The reading process is scaffolded by using comic strips, children's versions and original acts/scenes from the plays.

In this unit, students will focus on identity: their own, Shakespeare's, and that of his characters. As they have recently immigrated here, they are acclimating themselves to a new way of life, culture, language, country, and school system. In addition, they are going through adolescence! Imagine the turmoil of this experience for a moment. In fact, it might involve enough traumas to rival a Shakespearean tragedy! In scaffolding this process of learning about and analyzing self, Shakespeare, and then Shakespeare's characters, students will be able to better develop and comprehend the meaning of identity, answering the questions: Who am I? and What are the characteristics that make me unique from others?

(Developed for English Language Learners and Â English Language Arts, grades 6-8 multi-grade; recommended for English Language Arts for English Language Learners, grades 6-12 with modifications)

2008.01.04
Shakespeare's Characters: A Visual Analysis, by Jennifer Sandoval

The students will read *Macbeth, Othello*, and *The Taming of the Shrew* by William Shakespeare and choose from the major characters in each of the plays to create six visual analyses. The plays will be assigned for reading outside of class while some close readings will be done in class.

The visual portraits of specific characters from each of the plays will be an analysis of the characters with emphasis on physical attributes, symbols relating to the character, motivation, important lines, internal and external perspective, and figurative language used to develop the character. The elements of the analysis will be represented on the body with placement of the symbolic and textual attributes in the appropriate places on the figure itself.

The main objective of this unit is to analyze characters in Shakespeare's plays. To this end, the students will need to recognize and analyze methods of characterization as they relate to the meaning of the work as a whole. We will apply close reading analysis skills. The final assessment will be a formal essay analyzing three characters from *Othello, Macbeth* and *The Taming of the Shrew*.

(Developed for English, grades 11-12; recommended for English, grades 9-12)

2008.01.05
To See or Not to See? A Visual Approach to Identity in Shakespeare, by Kimberly Towne

This unit was written for eighth grade students enrolled in an Art I high school credit course. Concurrent to the teaching of this unit in the art class, the students will be involved in a unit of instruction on *Romeo and Juliet* in their English class. The focus of the unit will be on identity and how identity is communicated visually. We will examine how identity is communicated in Tudor portraits and then have the students use the techniques of Tudor artists to create their own "portrait" of a Shakespearean character. During this unit the art students will select one play (*Othello, Macbeth*, or *The Taming of the Shrew*) to explore and will look in depth at one of the main characters from their chosen play. I want them to learn how identity is conveyed, both by writers and artists. They will be exposed to the complex characters of Shakespeare and how he developed those characters. They will also be exposed to the development of portraiture, and how artists contemporary with Shakespeare were also creating "documents" showing identity. This in turn will enable them to begin to be able to read portraits for their complex, deeper meanings.

(Developed for Art, grade 8; recommended for Art, Middle and High School grades 8-12)

2008.01.06
Shakespeare's World: an Integrated Unit for Third Grade, by Catherine Perez

This unit is designed to be used over a six week period across the subject areas followed by another six weeks of drama. It is heavily weighted toward the arts, with hands-on opportunities for drama, dancing, theater, and visual arts. It additionally has lessons in the core subject areas of literacy, math, science, and social studies. These lessons will provide interesting and challenging curriculum based tasks for students to master while they simultaneously learn about Shakespeare and the 16th century. As they study the past, I would like students to realize how much we have changed as a society, to understand that we all have a rich and interesting past and history, and to perhaps develop an appreciation for classic literature and arts through early and appropriate exposure to Shakespeare.

To begin this unit I have gone into some history and background information on Shakespeare and what 16th century England, particularly London, was like. I will need this information to teach the unit to my students so that I can explain to them in vivid detail what life was like back then. I want to be able to answer their questions, draw pictures, and spark their curiosity.

(Developed for all curriculum areas, grade 3; recommended for all curriculum areas, grades 3-5)

2008.01.07
Queen Elizabeth's Influence on Disguise in Shakespeare's Plays and Spenser's The Faerie Queene, by Sarah Humphrey

When Elizabeth I gained the throne in 1558, women began to receive a voice in literature. England had not before had such a dynamic and intelligent female regent. Elizabeth was celebrated in poetry and was herself an accomplished poet. As a woman with a man's job, Elizabeth had to adopt various personas to appease her advisors and subjects. She invoked her father's strength when she needed to overcome her femininity. Elizabeth's ability to transform herself as necessary is what makes her a model for strong women who use disguise as a means to an end. I chose this unit topic as a way to expose my students to several of Shakespeare's plays and an epic poem with strong female heroines and villains. We will examine the role of female disguise in Shakespeare's *As You Like It, Twelfth Night, The Taming of the Shrew*, and *Macbeth*. We will also examine the disguised female knight, Britomart, in book 3 of Edmund Spenser's *The Faerie Queene*.

(Developed for AP Literature, grade 12; recommended for Language Arts, grades 11-12)

2008.01.08
The Language of Power in Shakespeare, by Raymond Theilacker

This 10 day, 90 minute block-scheduled curriculum unit directs students to three of Shakespeare's plays: *Macbeth, As You Like It*, and *Romeo and Juliet*. The unit has the purpose of exposing twelfth grade students to themes, conflicts and characterizations in the plays. Using an analytic protocol, students turn a critical eye toward understanding power. Power is defined at three distinct levels early in the unit. The unit also focuses on the poetic features of the language, especially as specific words and phrases emphasize an understanding of power. The goal is to provide students with a clear linguistic and literary focus as they study requisite Shakespearean writing. The lessons are designed for collaborative teamwork, and for some direct instruction toward literary and linguistic analysis and literary evaluative writing. The work of the unit coheres throughout in small and large group activities and discussions, culminating in an evaluative piece of writing, as well as in opportunities to respond in creative performances. By the conclusion of the unit, students have encompassed the enduring understanding that power plays an intimate

and inextricable role at all levels of human activity, and that Shakespeare's language and poetry explore issues of power in most ingenious ways.

(Developed for English and Honors English, grade 12; recommended for English, grade 12)

2008.01.09
Religious Elements in Shakespeare's Hamlet, by Pamela Ronson

This *Hamlet* unit is designed to enlighten students about the influence, permanence, and potency of religion in our lives. By looking at a Shakespearean play through a religious lens, students can comprehend more deeply the context within which the play was written. Once they understand the religious allusions made within the play, they can then analyze their purpose. Afterwards, students are able to interpret and discuss religious influence, permanence, and potency in contemporary society. My aim with this unit is to illuminate religion's influence in the decisions of people during the 16th Century, and then pose the question to my students: Is this still the case today? I want my students to understand how religion, according to believers of various faiths, may serve as a guide for personal improvement and as a foundation for ethics.

(Developed for AP English Literature, grade 12; recommended for English, Language Arts, and Literature, grades 6-12)

2008.01.10
Detecting Shakespeare's Sonnets, by Deborah Samuel

In this curriculum unit, students will do close readings of Shakespeare's sonnets, connecting the nuances of his language, meter, and structure to the meaning. We will review the structure of a sonnet and notice its rhyme scheme, learn to scan the sonnet, interpret its meaning, and look for the shift in tone. Students will be working in groups and examine a number of sonnets organized by theme. The four themes are those found quite frequently in the sonnets: the power of love to change reality, attitudes toward love and lust, the never ending passage of time, and the power of poetry to bestow eternal life. With my guidance, students will search and hopefully find much evidence to discuss each theme intelligently, and will learn to carefully explicate the intricate workings of the sonnet. The culminating activity would be for each group to teach the class what they have discovered, proving their theses with evidence presented in power point presentations.

(Developed for AP English Literature and Composition, grade 12; recommended for English, High School grades)

II. American Voices: Listening to Fiction, Poetry, and Prose

Introduction

Young people learning to read literature need to learn to hear voices. This may be especially true for American readers. The literature of this nation arose in a vital culture of oral performance: sermons, speeches, debates, and drama were crucial forms of expression in early America. This tradition lies behind a continuing preoccupation with voice in American literature: over and over again, American writers imagine themselves not as writing, but as speaking, to their readers. Responding to American literature, we respond to its long history of individual voices.

This seminar explored American literature as the creation of particular speakers in multiple forms: fiction, poetry, and prose. We studied and discussed some of the most famous and arresting American voices—the poet who calls to us across time and place in Whitman's "Crossing Brooklyn Ferry," the entertaining teenager who narrates *Huckleberry Finn*, and the visionary Civil Rights leader who declared, "I have a dream"—while exploring the rhetorical techniques by which these voices were created, and through which they go on speaking to us today. For voice in writing is always a special kind of illusion through which an author's words, although silent on the page, enter and resound in the reader's mind.

Our readings and discussion included, in sequence, some classics of American literature: sermons and speeches by Patrick Henry, Abraham Lincoln, Sojourner Truth, and Martin Luther King, Jr.; poems by Walt Whitman and Emily Dickinson, Robert Frost (and Frost's letters on what he calls "the sound of sense" as well as his lecture "The Imagining Ear") and Langston Hughes; and Mark Twain's *Huckleberry Finn*. We were concerned in all of these classes with the ways in which voice is constructed on the page, and the particular expressive functions of sound in writing.

Twain's novel introduced the question of dialect, and its repeated use of the word "nigger" prompted extended discussion of the history of that word and its usage today. We read and discussed an essay called "Teaching the N-Word" by Emily Bernard, a professor of African American literature at the University of Vermont, which speaks about the author's experience discussing the word in her college classroom. We also read newspaper articles and personal essays dealing with the question of Black English, including material relating to the controversy of the status of Ebonics in the Oakland, California, school system in the 1990s. We read James Baldwin's short essay "If Black English Isn't a Language . . ." and selections from Alice Walker's novel *The Color Purple* and Ralph Ellison's novel Invisible Man. Ellison's novel, like Twain's, presents a view of American literature as multi-voiced, mixing multiple forms of speech and tradition.

Some of the teachers in our seminar teach students whose first language is Spanish, and we included two weeks of discussion of Latino/a authors who speak of the experience of learning English, and who reflect on the situation of Spanish speakers in a nation dominated by English. We read essays by and interviews with Richard Rodriguez, and essays and fiction by Julia Alvarez, Gloria Anzaldua, and Sandra Cisneros. These authors helped us extent our discussion of dialect to the question of language acquisition and the experience of speakers of English as a second language.

My idea in creating this seminar was that a focus on voice would be a useful way into the study of literature for students of all levels. Students are frequently intimidated by reading and writing assignments. In school, they learn to use language in unfamiliar ways; in a sense, even if English is their first language, they are learning another language in school, or, more precisely, they are learning how to use language in new and unfamiliar ways. The challenge is especially acute for students who speak a non-standard dialect or whose first language is not English.

But most students already understand and have access to the power of language through oral experience, and my hope was to devise ways to draw on this strength as we help them come to writing. Students are indeed more often than not resourceful and expressive speakers and shrewd listeners, well acquainted with the pleasure and power of speech from their daily interactions with each other and their families, and from their experience of music, video, and other media. The seminar aimed to develop conceptual and practical strategies for drawing on students' existing talents by using their oral skills to establish a foundation for their work as writers and readers.

The fellows took up this project in a wonderful array of ways in a series of curriculum units designed for a wide spectrum of public school classrooms.

Octavia Utley has designed a unit that introduces elementary and middle school language arts students to voice through the poetry of Langston Hughes. Utley's concentrated focus on Hughes sensitizes her students to poetry—to the expressive pleasures and potential of sound—in the context of one important African American writer's work. Using Hughes's biography to frame the poems and suggest connections to her students' own experiences, Utley also teaches her students about Black History.

Zuri Bryant, working with eighth-graders, also focuses on poetry in her unit, where students read and write poetry. Her premise is that the special emphasis on the sound of words that poetry insists on will give her students access to their own inner voices and a heightened awareness of language as they encounter it in other forms of writing and daily life. Listening, for Bryant, is a step toward learning to speak for one's self and to write in a way that speaks to others.

Like Bryant, Nicole Schubert teaches in an arts academy. Like Utley, Schubert has designed a language arts curriculum, rich in writing and reading assignments, that could easily be adapted to a class in Black History. Her focus is Frederick Douglass's great autobiography. Schubert introduces her students to the painful yet triumphant history by which American slaves and their advocates fought—often through acts of speech—to grant them the privilege of self-determination and self-representation, everything that "having a voice" means in our society.

The dominance of oral over written forms in African and African American culture, which is sometimes held up as a problem for African American students to overcome, is the exciting starting place of Bonnee Breese's curriculum unit. Breese's unit introduces students to the richness and power of vocal experience—of speaking, singing, and listening—in the cultural traditions of the African diaspora. Focusing on poetry, song, and public speeches, she encourages memorization, recitation, and performance. These "vocalizations" are presented as interpretive, expressive acts that will help form a bridge to writing and reading, even as they serve as essential cultural forms in themselves.

Like Breese, Sharon Ponder teaches in an inner-city school whose students are challenged by systemic poverty, youth violence, and racial discrimination. Like Schubert and Breese, Ponder approaches voice both as a vital tool of African American self-expression and an important metaphor for hope and social aspiration. Her unit is intended to enable students who feel voiceless in American society to begin to talk about their lives while she introduces them to influential African American voices from James Weldon Johnson to Tupac Shukar, from Countee Cullen to Spike Lee.

Danielle Gothie's students are sixth-graders, rather than the high school students Breese and Ponder teach, and Spanish is the first language of many of them. Her curriculum unit plans to reach these students by exploring the voices they both hear and see in picture books, a form with which they are already comfortable, before moving on to poetry and other forms. Gothie focuses on materials from African American culture and history, including stories, poems, and a video she made in New Orleans following Hurricane Katrina. She wants to give her students a perspective different from the one they are familiar with in their New Mexico community, which they can use to reflect on their own experience.

We see a similar idea in the units created by Victoria Deschere and Karlene McGowen, who invite students to read about the experience of other people and to experiment with writing in the voices of others as a way to develop their own voices. Deschere describes this process as learning "to walk with another author's stride," or in someone else's "shoes." It is a kind of role-playing that will help her young teenagers to establish an identity in writing at a moment in their lives when their identities seem unsettled. Deschere's insight is that voice is not a skill for young writers to develop only once they

have mastered the basic elements of composition, but rather the first, essential quality that gives writing purpose and character—that makes it matter to writer and reader alike.

McGowen also wants her middle-school children to experience how authors project themselves in the voices of other people; her intention is to help those students to learn to do the same thing and, in the process, to develop the verbal and imaginative skills to speak for and as themselves. McGowen introduces her students to recent works of realistic fiction for and about young people. She wants them to read books that are relevant to their lives in an immediate, obvious way, while presenting positive attitudes (rather than stories that shock or discomfort young readers); the point for them is to enjoy their reading, and to gain strength from it, as they experiment with their own writing using these models.

Langdon L. Hammer

Synopses of the Curriculum Units

2008.02.01
Voice in Poetry: Dream a World with Langston Hughes, by Octavia Utley

This curriculum unit entitled "Voice in Poetry: Dream a World with Langston Hughes" is designed to teach voice in poetry to 3rd - 5th grade students. The students, who are predominantly African American, have diverse learning needs, experiences, and ways of learning. Poetry by Langston Hughes is used to teach voice in poetry. Hughes expresses different voices through his poetry using language, experiences, and musical forms of the African American culture. Hughes's poetic voice calls attention to words and sounds. This unit is implemented in a standard-based classroom during the two-hour literacy block. The three-part lesson framework is used during Reader's and Writer's Workshop. The three-part lesson framework consists of a mini-lesson (before the learning), student work time (during the learning), and sharing (after the learning). Students will be provided with oral and written language experiences that enable them to develop their unique voices in writing. During Reader's Workshop, students will read aloud, analyze, and listen to the powerful voices in the poems by Hughes. During Writer's Workshop, students will learn about poetic devices and elements of voice. Hughes's poems will be used as writing samples, as students follow the steps of the writing process to write their own poems.

(Developed for Language Arts, grade 3; recommended for Language Arts, grades 3-5)

2008.02.02
The Poetry of Self: Using American Voices to Shape Your Own Voice, by Zuri Bryant

After teaching middle school students for a few years, I've realized that these students are mere clones of what they see on television and in movies. They have no idea of who they are as individuals. While teaching them poetry will not be the answer to all the questions they may have about who they are, where they've come from and where they're going, it can help them voice some of the emotions they may begin to feel along their journey to self-discovery. Throughout this unit, students learn to appreciate the difference that using their own voice can make in the interpretation of a piece of writing. They learn that there are many ways of expressing themselves and see that they have a voice that can become powerful, whether or not it is heard. The students will learn that their voices are essentially their backgrounds or identities. They've come from somewhere that is important and it's now necessary that everyone knows.

This unit, produced as a result of the American Voices seminar, combines poetry writing and interpretation, poetry in performance, and various American authors and poets. I teach eighth grade Communications (English grammar and Reading combined) at an arts

academy. Our school works in partnership with a local arts organization, Manchester Craftsmen's Guild (MCG) to integrate arts into the curriculum.

In this unit, the students will find their voices by completing a myriad of reading and writing exercises. Those newly found and/or formed voices will enable the students to create their own individual poetry anthologies, a class anthology, and to deliver a poetic monologue, about a topic of their choosing, to an audience. With the assistance of MCG, the monologues will be audio and/or video recorded for the students.

(Developed for English, grade 8; recommended for English Language Arts and Poetry, grades 6-9)

2008.02.03
The Role of Rhetoric in the Abolition Movement: A Study of Voice and Power in Narrative, Speech, and Letters, by Nicole Schubert

This unit is designed for my eighth grade Language Arts class; however, it can easily be adapted to work in a high school English or U.S. History class because the readings and activities are interdisciplinary. The theme of this unit is particularly important to me as a middle school Language Arts teacher because my students tend to feel like their voices are not being heard by their communities. Instead of focusing on the components of an autobiography, I will use this book to teach voice in writing; immersing them in lessons and discussions about the power of voice in writing, thereby helping them develop their voice in writing. Students will be exposed to many different texts written, or spoken, by Frederick Douglass in order to gain an understanding of the role of rhetoric in the Abolition Movement and to develop their own sense of voice. Although *Narrative of the Life of Frederick Douglass: An American Slave* will be the main text used in this unit, many letters and speeches will be supplemented throughout the unit so students can understand how one's voice may differ from text to text; the relationship between the writer and his audience; and the different rhetorical devices employed in various texts.

(Developed for Language Arts, grade 8; recommended for Language Arts, grades 7-8 and English, grade 9)

2008.02.04
Speak Words, Recite Messages: The Oral Interpretation of the Word, by Bonnee Breese Bentum

This unit explores, discovers and recognizes how vocalizations of poetry and political speeches by African-Americans have influenced the students' community and American society. Students will learn to become listeners as another part of oral presentations. Students will be given opportunity to perform at spoken word venues and witness performances of speeches, spoken word poetry, and oral recitations.

Students will reflect on historical implications and political overtones of the oral performances. Students will learn prominent uses of vocal incantations, tone, lexis style, physical expression, and vernacular dialects. Students will be exposed to oral, video and audio recordings of spoken word poetry, and speeches drawing attention to their social function highlighting political occurrences in American society and the Black community. This unit gives a broader knowledge of orality and important texts, speeches and performed works in the history of African-Americans.

The unit is designed for use in an English Language Arts, American History, Civics, and General Law classroom at the high school level. The lessons can be adapted for use in Advanced Placement courses, as well as, in a learning support environment. This unit uses the Pennsylvania State Academic Standards from Reading, Writing, Speaking, and Listening; Arts & Humanities; and History.

(Developed for English I and IV, grades 9 and 12; recommended for English Language Arts and American History, grades 9-12)

2008.02.05
"Lift Every Voice and Sing" An Analysis of Social Change "Hope" through Voices of Hip-Hop, by Sharon Ponder

(Developed for Language, Visual, and Performance Arts, and Social Studies, grades 7-10; recommended for Language, Visual, and Performance Arts, and Social Studies, grades 7-10)

2008.02.06
In Their Shoes: Finding Voice through Personal Narrative, by Victoria Deschere

Voice is the connective tissue that holds reading and writing together. It is the personality, intonation and enthusiasm in communication. Without it, literature would be form without life, words without sense. Voice is found in the relationship between writer, composition and reader. It is crucial to foster, especially in the teen years when self-concept is newly burgeoning. To develop voice, students must read quality literature and emulate the techniques in their own writing. Furthermore, the students must copy what they hear in their everyday lives: not just to take from the masters, but their familiars as well. The students' personalities blossom in their writing and their lives. Additionally enthusiasm is fostered through the writing of personal narratives: teenagers' lives revolve around themselves. The story they most want to tell is their own, and this passion comes through in their writing. Using the writing process, writing traits, reading strategies, guided comprehension, read alouds and metacognition, teachers will help students walk with another author's stride: deciding if it fits their own personality and intentions. In this unit, students will read autobiographies from a culturally diverse set of writers to analyze and emulate the authors' techniques to develop an authentic, individual voice.

(Developed for English Language Arts, grade 7; recommended for English Language Arts, grades 6-8)

2008.02.07
Getting Into Character: Finding Voice in Realistic Fiction, by Karlene McGowen

A good writer can write from the voice of someone unlike himself. This is what professional authors do all the time, they take a fictional character and give him voice and thought and sell it to the reader as something believable. Middle school students can do this very task, if given the right instruction and right models. This unit is designed to exemplify uses of voice in young adult contemporary realistic fiction. Writing a character in realistic fiction requires that the author use a style that is indicative of human nature. The unit is designed for an eighth grade literacy classroom that is implementing the readers/writers workshop. The unit will introduce and discuss various use of voice in young adult novels, whereby students will be able to apply that knowledge to their own writing strategies and write from different voices/different character voices. The goal is for these middle school students to use voice as a means of writing fiction through the perspective of characters unlike themselves and create an original short story in the genre of realistic fiction. Writing from this outside voice allows students to strengthen themselves as writers.

A variety of contemporary realistic fiction novels will be used as guides. The following books are used as guides for this unit: *Becoming Naomi Leon* by Pam Munoz Ryan, *Heat* by Mike Lupica, *Stuck in Neutral* by Terry Trueman, *The Taking of Room 114: A Hostage Drama in Poems* by Mel Glenn, *Monster* by Walter Dean Myers, *Don't Call Me Ishmael* by Michael Bauer, *Notes From the Midnight Driver* by Jordan Sonnenblick, and *I'd Tell You I Love You But Then I'd Have to Kill You* by Ally Carter.

(Developed for Language Arts and Literacy, grade 8; recommended for Language Arts, grades 7-8)

2008.02.08
Finding One's Voice, by Danielle Gothie

This unit is designed to teach "voice" to sixth grade students by incorporating reading and writing activities. Voice is a writing trait that brings personality and depth to an individual's written expression. Voice will be taught through three different genres: picture books, poetry, and novels. The unit will take about three weeks to complete. Voice can be an abstract concept to teach. It is critical that teachers model voice by reading very rich descriptive poetry and literature to their students. I will structure this unit by using picture books for read aloud, poetry books for small group instruction, and the unit will culminate with the reading of age appropriate novels written in first person

that the students will be exposed to through read aloud, literature circles, and independent reading.

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

III. Democracy in Theory and Practice

Introduction

The twelve units comprising this volume were all completed during 2008. They range from concerns with electoral politics in the U.S. (partly prompted by this being an election year), to constitutional politics and the founding, to the impact of the media (including the internet) on US democracy, to democratic politics as viewed through and influenced by literature, to the enfranchisement of marginalized groups, and specific policy issues such as the distribution of income and wealth and terrorism and civil liberties. Most of the units are aimed at high school students in courses in history and social studies, but two are designed for literature courses, and one is designed for fourth graders.

Units by **Adam Kubey**, **Lisa Lee**, and **Ralph Russo** are primarily concerned with American electoral politics. In addition to primaries, conventions, and the general election, Kubey explores debates about electoral reform and different electoral systems. Lee focuses centrally on political parties and the Presidency in light of the Constitutional Convention of 1787. Russo uses the lens of two knife-edge elections two centuries apart (1800 and 2000) to illuminate such institutions as the Electoral College and the ways in which the system responds to political crises.

Units by **Jesse Senechal**, **Art Concordia**, and **Elouise White-Beck** look at democracy through literature and political theory. Senechal explores early twentieth century African-American literature to illuminate the tensions between the ideals spelled out in the Declaration of Independence, the Constitution, and the Bill of Rights, on the one hand, and the realities of racial injustice on the other. Concordia uses a variety of historical sources to explore these same tensions, with a focus on excluded minorities and mechanisms for their empowerment. White Beck deploys an intensive study of Bryce Courtnay's novel set in mid-twentieth century South Africa, *The Power of One*, to illuminate the tensions among democratic and other values, and the ways in which leadership operates in democratic settings.

Three units attend to the nature and adequacy of American political institutions from the time of their design down through the present. **Sarah Pooner** focuses on a systematic comparison between the U.S. and the Roman Empire, with an eye to whether there are lessons from the decline and fall of Rome for the contemporary U.S. **Megan McGowan** and **Valerie Schwarz** focus on the mechanics and fairness of the system of representation created at the Constitutional Convention. Schwarz's unit spans the period between the Revolutionary War and the adoption of the Constitution and the Bill of Rights, and deploys simulation activities to get students to grapple with the problems the founders were trying to solve. McGowan's unit is intended to get students to evaluate U.S.

constitutional arrangements in the light of evidence from other democracies concerning federalism, the separation of powers, an independent judiciary, and different electoral systems—illuminating the plusses and minuses of different institutional arrangements.

Units by **Samuel Reed**, **Christine Shaub**, and **Meredith Tilp** deal with particular policy issues confronting U.S. democracy. Reed's concern is with the internet, focused on getting students to understand how the proliferation of new media outlets, networking sites, search engines, and electronic media shapes democratic practices. Attention is also paid to the ways in which these new media can be abused or operate as instruments of responsible democratic empowerment. Shaub deals with the challenge to U.S. democracy posed by the War on Terror since 9/11, with a particular focus on court cases and how the pursuit and prosecution of terrorist suspects affects civil liberties. Tilp's concern is with the economic inequalities that persist despite the democratic institutions that many, since Alexis de Tocqueville wrote in the early nineteenth century, have thought would erode inequality. Tilp's focus is on New Mexico, and features a contrast between the ways in which distributive politics are made in the New Mexico legislature and by the tribal system deployed by the Pueblo of Pojoaque.

Ian Shapiro

Synopses of the Curriculum Units

2008.03.01
Road to the White House: Campaign for the Presidency, by Adam Kubey

This unit will cover the many facets of the campaign for presidency: public opinion, political socialization, political participation and voting, the media, and the election process. While the goal of the unit is for students to better understand the election and post of the presidency, my true hope is that the students will become informed citizens, making educated, calculated decisions in the election process.

Upon completion of this unit, students will have learned about the presidency and the election process. Students will apply that knowledge through research and a debate about the 2008 presidential election. Students will work in small groups to research one issue currently being discussed/debated by the candidates, as well as finding the current US stance on this issue with supporting laws. In addition to researching each candidate's stance on said issue, students will also look at the implementation plans upon election. Students will use this information to determine the most effective compromised policy for local constituents and the US. Students will conduct a poll of local community members to determine their stance and reasoning on the issue, to ascertain the needs of their constituents. By analyzing media coverage and opinion polls, students will establish the reasons behind the candidates' stance on the issue. Collecting data from various sources will enable students to make a compromised policy plan.

The information that the students gather will allow them to participate in a debate with Yale National Teaching Initiative classes around the country, who will be completing a similar project. As students from classrooms across the country share the concerns of their specific constituents, all students will gain a deeper appreciation of how complex and multidimensional these issues truly are — as complex and multidimensional as the office of the presidency itself.

(Developed for U.S. Government and World History, grades 9-12; recommended for U.S. Government and U.S. History, grades 8-12)

2008.03.02
I'll Vote for That, but Why? The United States Constitution and Presidential Elections, by Lisa Lee

One of the most important legacies which we can provide our students is an understanding of the importance of being informed citizens. It is easy to take the privilege of living in a democratic society for granted. I find that my students are often cynical about our government, and I worry that this will translate into future apathetic citizens. This unit will focus on what the Framers of the Constitution intended when they

created the roles of the President and the Electoral College. Students will study the two major political parties, focusing on their differences and the platforms each has presented for the 2008 election. It addresses the voting process and voter apathy, culminating with a community voting drive, and school wide mock election.

Although this unit is intended to be taught prior to the 2008 election, it can be presented at anytime. It was written for eighth grade, but the information and lesson plans can be modified for middle and high school. It includes background on the Constitutional Convention of 1787, and incorporates graphs, surveys, and editorial cartoons. Students will also critique presidential speeches as they write their own. Socratic Seminars and numerous debates are used throughout the unit.

(Developed for Social Studies, grade 7, and Georgia Studies, grade 8; recommended for Social Studies and Civics, Middle and High School grades)

2008.03.03
The Elections of 1800 and 2000. How Crisis Elections Have Shaped the Practice of Democracy in United States History, by Ralph Russo

I propose that critically examining two crisis elections in American history in my 10th grade United States History I class will allow my students and me to address questions about crisis elections and the electoral process while we cover required historical material from the district curriculum. The elections of 1800 and 2000 were knife-edge elections that raise important issues about the form and function of democracy in America. From an historical perspective, one can gain much knowledge of the electoral process in studying these elections. "Who can vote?" and "how they vote" in each election reveals a cultural portrait of democracy in America over the course of 200 years. Additionally, how these crisis elections were resolved also demonstrates procedural differences in the electoral process from then to now. Moreover, the Supreme Court's role in the resolution of the election of 2000 distinguishes the Supreme Court as a factor in national politics today. This unit contains assignments in reading multiple texts and ideas for class simulations. The readings and activities blend historical study with the work of political theorists.

(Developed for U.S. History, grade 10; recommended for U.S. History, Civics, History, and Social Studies, grades 9-12)

2008.03.04
Our Spiritual Strivings: Understanding African American Identities in a Conflicted American Democracy, by Jesse Senechal

The primary purpose of this unit is to create an historical and theoretical framework that can be used by the students to understand African American Literature as a potential

resolution to the fundamental contradiction between the rhetoric of democratic ideals and the realities of racial injustice. The texts for this unit will include some excerpts from the primary documents of our democratic republic (*the Constitution, the Declaration of Independence, The Federalist Papers*), a number of arguments and historical accounts from both black and white perspectives about racial injustice in the 19th century, and a variety of early 20th century African American writing (both essay prose and poetry) that speaks to this issue. African American writers covered include Booker T. Washington, W.E.B. Du Bois, Marcus Garvey, James Weldon Johnson, Paul Laurence Dunbar, Langston Hughes, and Claude McKay This unit culminates with classroom project that involves students writing about and publishing poetry and personal essays that address issues of injustice in their community.

(Developed for American Literature and English, grade 11; recommended for American Literature and U.S. History, grades 9-12)

2008.03.05
Democracy (in)Action: Promoting Critical Youth Consciousness and Participation, by Artnelson Concordia

"Why should I learn this?", "This shit doesn't matter.", "Things will never change, anyway." These are the sentiments of many of my students - black, Latino, Chinese, Filipino, Samoan, white, Cambodian, among many others; poor and working-class; male and female; cynical and at times angry. The purpose of this unit will be to engage my students to hold established power and themselves, accountable to actualize the vision of the founders of America - to unite democratic *theory* on the one hand with conscious youth and student *action* on the other.

Given the rate of incarceration, violence and other social ills afflicting working-class, poor, youth of color, any level of participation in the democratic process (traditional or otherwise) needs to be furthered exponentially and in a way that more effectively reforms, alters, challenges and even counters the existing prescription for change. That prescription being: follow the rules, go to school, work hard, get a good job and live "the Dream".

In my process of coming into consciousness, I realized that the recipe for improving one's life is actually more complex than that. Indeed, our students need to do these things, but they must do more. The commonly held belief that the existing system is fine and the cause of failure is intrinsic to the students themselves, denies the institutional nature of the problem. This is an attempt to expand my students' analysis of the various problems facing them and their respective communities, as well as compel them to take critical action to address the problems.

This unit, *Democracy (in) Action: Promoting Critical Youth Consciousness and Participation*, will be implemented in my 12th grade, American Democracy class, at Balboa High School. Couched in the Southeast section of San Francisco - an historically working-class and immigrant community of the City - my students will have a broad range of issues and problems from which to apply their newly learned tools.

As they enter broader society, I wish for this 6-week series of lessons to provide concrete, relevant and convincing responses to their queries - that they may answer definitively, "I need to learn this, because this can change my life and the lives of my people."

(Developed for American Democracy, grade 12; recommended for American Government, grade 12)

2008.03.06
Bryce Courtenay's The Power of One: An Examination of Democratic and Other Political Values as Depicted in Literature, by Elouise White-Beck

Whatever I know about history began with *stories*. This unit is centered on a single novel, Bryce Courtenay's *The Power of One*, the Classic Novel of South Africa. Beginning with a chart on government types, students discuss what they know about government, leading to the study of the novel as a contrast to democracy. This 7-week unit treats the novel as a classic *bildungsroman*/coming-of-age novel. The main character's development is shaped by the split between the three distinct groups of individuals that comprise his society, the black Africans, the Afrikaners, and the English. His movement among these disparate groups shows him as an iconoclast, a man for all peoples. His relationship to many groups of people, speaking their language, and Courtenay's use of boxing as a transcendent activity bringing boxers together from these groups show our hero as the coalescent force in his society, played out against the background of impending war (WWII), and post-war conditions. Study questions, three essay exams, a final essay, research project, and video guides are included.

(Developed for English IV PSP Scholars, grade 12; recommended for English IV PSP Scholars, grade 12)

2008.03.07
Why Rome Fell and Is the United States Next?, by Sarah Pooner

In this unit students learn about the causes of fall of the Roman Empire and compare those factors with some of the challenges America faces today. In this way students examine conditions toward the end of the Roman Empire in relation to our American society today, ultimately drawing lessons, if any, for the United States to learn from Rome. This unit is designed to meet established History-Social Science content standards for California public schools for seventh grade students. The overarching standard

applicable for this unit calls for students to analyze the causes and effects of the vast expansion and ultimate disintegration of the Roman Empire. In addition, students will be able to understand and explain problems that contributed to the decline of the Roman Empire through analyzing American political cartoons as an entry point into gaining an understanding of the complexities for why Rome fell, which can extend to why civilizations end in general. Students will also be able to identify democratic practices in Rome and the United States as both aspired to mold their government to follow democratic principles. Through learning the definition of democracy students will be able to judge whether or not these ideals were achieved or merely aimed for. Lastly, students will be able to compare and contrast reasons for the fall of Rome to conditions in the United States today. After students are grounded in popular theories for the fall of Rome and can clearly decipher between ideological ideals and practices, in this case democracy, they will be well-equipped to participate in a culminating class debate over whether or not the United States is doomed to follow Rome's demise, through using as evidence all they have learned about both societies.

(Developed for World History and History, grade 7; recommended for World History and Social Studies, grades 7, 9-10)

2008.03.08
Is America a Successful Democracy: A Critical Inquiry, by Meagan McGowan

This unit is intended to introduce students to the concept of American democracy and the United States Constitution. The original audience for the unit is high school aged United States History students. Students at this level have previously studied United States History. The hope is that this unit will approach the idea of democracy from a few unique perspectives; first looking at what defines "democracy" and "successful democracies", second exploring the intentions of governments in general, third comparing possible democratic styles that America didn't adopt, and fourth rating the successfulness of our American democracy. In so doing, students will be given the opportunity to reflect upon the democracy in which they live. The key question posed is "are we a successful democracy?" The unit makes a comprehensive study of the question by recreating the conventional context in which our democratic system is studied, making it a global comparative study that addresses both past and present perspectives. In this way teachers may teach democracy outside of the bubble of the American past and appeal to the desires of students to create a relevant and present-focused discussion on topics previously considered as archaic and extraneous.

(Developed for U.S. History, grade 11; recommended for U.S. History and U.S. and Comparative Government, grades 10-12)

2008.03.09
Taxes, Rebellion, and the Birth of a New Nation, by Valerie Schwarz

This unit is written for a fourth grade Virginia studies class, but large parts of it could be used or adapted for middle and even high school classes. It is designed to be taught for 45 minute periods for 20 days. The unit spans from the causes of the American Revolutionary War through the adoption of the Constitution and the Bill of Rights. The students experience taxation in a token economy until a rebellion ensues. The students write their own Declaration of Independence and use a primary resource as their declaration is compared to parts of the actual document. The main emphasis is on the Constitution and the Bill of Rights. It has numerous simulation activities designed to teach the Proclamation of 1763, forms of government, James Madison's fear of tyranny of the majority, equal representation vs. representation by population, the three-fifths compromise, and the freedom of religion clause of the Bill of Rights. The activities are engaging and involve discussion and debate to recreate what the founding fathers went through at the Constitutional Convention.

(Developed for Virginia Studies and Social Studies, grade 4; recommended for U.S. History Middle School grades, and Elementary School grades 4-5)

2008.03.10
MySpace in Democracy: inquiry on how social networks and media technologies promote and disrupt democratic practices, by Samuel Reed

This unit draws upon social studies, and media literacy and inquiry to explore how social networks and media technologies promote and disrupt democratic practices. It is intended for middle grade students (grades 6th-8th). Students will conduct inquiry on how the proliferation of social networking sites, search engines, and electronic media shapes democratic practices. Inquiry and critical thinking will be core skills students will master. To lead students to master research skills this unit will use media literacy and free speech topics to provide students with seed ideas for their own inquiry. Students will analyze, explore, compare and contrast the impact various communication technologies have had on the press and free speech practices. Students will research, and explain pros and cons of "cyber" free speech. Students will use critical thinking skills to evaluate and assess the credibility, accuracy, and reliability of search engines and social networking sites. Students will conduct Webquests to evaluate internet safety websites for their relevance, bias, reliability, media style and persuasion techniques. Furthermore, students will learn effective searching technique and safe practices for using the Internet. Lastly, students will synthesize what they have learned to create their own media public service products. Students' public services media products will model internet safety practices, and the role search engines and social networking sites play in providing youth a voice in democratic societies. Ultimately, students will conduct inquiry on free speech and information

technologies, using the very technologies and social networks that interplay to promote and disrupt democratic practices.

(Developed for Social Studies, grade 6; recommended for Social Studies and Media Literacy, Middle School grades)

2008.03.11
Democracy, Terrorism and the American Criminal Justice System, by Christine Shaub

The topic of terrorism can be overwhelming for an adult, let alone a child. America's children may be overlooked when dealing with something as serious as terrorism. All young people face the same thoughts and fears of being attacked by terrorist activities. Through *Theories and Practice of Democracy*, students will get an overview of the criminal justice system and the new challenges it face in the "war on terror." This unit was devised so students could learn more about these challenges as it relates to law enforcement and the courts, including counterterrorism, the USA Patriot Act, high court decisions and more.

Students will produce a video against terrorism, participate in a mock trial, develop a PowerPoint presentation from research obtained on a terrorist organization that will be incorporated into a classroom informative book on terrorist organizations, and write a journal on hate crimes. Each activity is related to the topic of terrorism with the emphasis of learning more about this topic to diminish fears.

(Developed for Legal Administrative Assistant and Introduction to Criminal Justice, grade 10; recommended for Social Studies, grades 10-12, and Legal Administrative Assistant and Criminal Justice, grades 10-11)

2008.03.12
Who decides who benefits? A comparative view of wealth distribution using examples from New Mexico's Legislature, Santa Fe City and the Pueblo of Pojoaque, by Meredith Tilp

"Who decides who benefits in New Mexico?" This curriculum unit will enable 75 Capital High School seniors on the south side of Santa Fe to explore democracy and distributive wealth, as well as take a provocative look at current values of our society, fellow classmates and elected representatives.

My students live in **Santa Fe**—a $ 10.50 an hour minimum wage mecca for New Mexicans—the capital of Native American culture and art—profit center to many Mexican laborers, and the offbeat hub of alternative ways of thinking and living. 'Our

city different' attracts both Tibetan monks and citizen legislators who think creatively and proactively. And therefore, hopefully, my students will learn to think in novel ways.

This curriculum unit features student investigations on the citizen legislature, the governor and the checks and balances they exercise. It juxtaposes the New Mexican law making process against economic choices of state, tribal and local government. The values of a good society are the touchstone for evaluating the costs and benefits of raising taxes, efficient use of government funds and the economic outcomes which they produce. Because all priorities in the generation of wealth are not equal, students will be able to see the tradeoffs between capital reinvestment, small business development, jobs and services. And because all legislative actions reflect compromise, they will be able to see the political 'horse trading' involved in decision making.

Using three economic initiatives near Santa Fe: The New Mexico Film Industry, the Buffalo Thunder spa and resort and Santa Fe's school educational plan, students will reflect on and assess their role and responsibility in a democracy. They will compare the New Mexico, Pueblo of Pojoaque and Santa Fe government's resource allocation and decision making process. Students will develop a lens of analysis about their own values and those of their elected representatives. They will learn to ask critical questions, will see how they can participate in a democracy and make choices about their future.

This curriculum unit culminates in a *class visit* to the Pueblo of Pojoaque about 10 miles north of Santa Fe, and New Mexico's film office and Legislature, known as "the *Roundhouse*." Mayor David Coss of Santa Fe will visit our school and discuss Santa Fe's economic development plan. Students will apply their knowledge by listening, observing, asking questions of presenters, and remaining engaged in political decision making in their lives.

By the end of the first Semester, students will be more knowledgeable about the choices they make. They will have a firm foundation to interact with their classmates on issues of local concern, will be challenged to participate and will have knowledge of the state and local democratic process at work.

(Developed for U.S. Government, History, and Economics, grades 11-12; recommended for U.S. Government, History, and Economics, grades 11-12)

IV. Bridges: The Art and Science for Creating Community Connections

Introduction

Bridges are wonderful creations set in the landscapes of all civilizations. Based on the human mandate to traverse the landscape, bridges capture the attention for simple structures as well as for complex artifacts which demand intense daily use. They soar across canyons, rivers, and our earth's terrain with the mark of human ingenuity, pragmatic utilitarianism, and poetic delight. Some connect buildings, some connect activities within buildings, some connect countries, some capture the bonds of human rapture. Bridges are essential in every community of the world. They establish physical links and relationships between communities.

Although the phrase *building bridges* is a metaphor for many kinds of positive human activities, this seminar dwelt on the art and science of building physical bridges. Throughout history, bridges have demonstrated how people have creatively used natural materials together with available current technology to create useful community links. Whether for economics, for social relationships, for symbolic identification, or merely for pragmatic reasons, a bridge establishes links of opportunity for the well being of society. Bridges also have a poetic soul. Their setting establishes whether a bridge exemplifies the symbolic identity of a region (as one might find in the Skyway bridge in Tampa Bay), a romantic moment in history (as one might see in the Rialto bridge in Venice), a graceful connector above crevasses (as one might see in the Salginatobel bridge in Switzerland), or a crowded path for daily travel (as one might see in the numerous bridges connecting Manhattan with surrounding regions).

To create a bridge means that processes for development, planning, resource identification, design, engineering, construction, operation, and maintenance must be successfully orchestrated and achieved. Building a bridge demands the proper use of materials and methods of construction as based on the associated depth of science combined with the knowledge of inherent design parameters. Forces, strength, scale, stability, structural systems, form, and support must be integrated into a whole entity which performs to meet the significant demands of intense use and defying nature's impositions.

The seminar was based on learning about creating a bridge with a focus on the art of design, the science for engineering and constructing, and the historical precedents of bridges over many centuries. The curriculum units emerging from the participating fellows presents an expected variety of interests and applications. Each unit offers a very unique range of classroom study and activities depending on the level, and number, of students in the class, the focus of learning for the topic being taught, and the special

interests of the teacher. The seminar was enriched by the range of expertise of the fellows including, Art, Physics, AP Physics, Spanish, History, Earth Science, Earthquakes, Mathematics, Social Studies, Honors classes, and Special Studies for gifted and talented students.

The range of student levels taught by the seminar fellows involve the entire spectrum from kindergarten through high school. Another variable represented by the seminar fellows, was the range of class size required for each unit. By itself, that factor demanded some innovative approaches to make learning meaningful and individually significant for each student. Over 620 students are expected to learn from these nine curriculum units as initially described. With the dedication and enthusiasm of each of the unit's authors, our seminar's fellows, these students are sure to experience inspiration and discovery of their talents and interests which will influence their subsequent learning in significant proportions. Building bridges will become the metaphor for life experiences.

These nine curriculum units, which you will see are vastly different, have one common classroom activity. All the units include a project where the students are engaged in a project to design and build a bridge. Although each curriculum unit has a unique approach, this challenge invites a student to create and build an object for which they must make decisions. The reality of the process provides direct feedback and self-evaluation of individual efforts. The learn-by-doing process magnifies the learning, especially when seeing the results of colleagues in addition to their own efforts. Visual literacy, knowledge based literacy, and craft ability combine as one potent process of learning.

The curriculum units emerging from this seminar must be considered as stepping stones. Each one when used in their respective settings will necessarily become a format for new opportunities for learning whether in content or in presentation. Some students will blossom with curiosity and seek to learn at individual levels of interests and abilities. In the end, all units have ways to address the arts and sciences for creating community connections in a tangible, visual, and knowledgeable context of our world.

Martin D. Gehner

Synopses of the Curriculum Units

2008.04.01
Puentes, Civilizaciones y Cultura, by Maria Cardalliaguet Gómez-Málaga

As a result of this unit students will learn history- how different civilizations settled in the Iberian Peninsula and contributed to shape the identity of today?s Spain, how the Romans invaded Hispania and built aqueducts, bridges, roads, theaters. Students will also learn basic art history features in order to recognize and differentiate styles and also, basic architecture concepts such as form, materials, construction methods, aesthetics, etc. They will reflect on how bridges are built in order to connect people and communities. Students will also learn Spanish geography as well as the importance of identity in the different regions that divide the country.

Puentes, civilizaciones y cultura intends to present a multilayered purpose. First of all, it aspires to introduce students to art. A second goal, would be to introduce students to Santiago Calatrava, a brilliant contemporary Spanish architect, engineer and artist. We will take a close look at his architectural and engineering designs first in order to be able to value and appreciate many of the bridges he has designed through Spain.

The unit is recommended for Spanish students with at least an intermediate level.

(Developed for Spanish III, grades 9-12; recommended for Spanish, grades 9-12)

2008.04.02
Building Bridges in Earthquake Country: From the Past to the Present, by Lisa Ernst

In order for students to be motivated and concerned for their community, I have designed an integrated curriculum unit called, "Building Bridges in Earthquake Country: From the Past to the Present" to be taught to sixth grade students. In the Bay Area there are numerous bridges that are the key to the economic growth, transportation, and cultural diversity. In a given day in the Bay Area, an individual can expect to travel over at least two to three bridges. Over time, many geologists have stated, "Earthquakes do not kill people, but buildings do". The centerpiece of the unit is the connection of the structural design of bridges being built in Earthquake Country. In order for the students to apply their knowledge, the integrated unit includes the content areas of Earth Science, Ancient History, Language Arts, Technology, Art and Physical Science. There are five goals in this unit. The first goal in this unit is for the student to use the scientific method as well as an inquiry based labs to decide the structural design of bridges being built in the Bay Area. The second goal is the building of a bridge to be placed on a shake table to interact with an earthquake. The third goal is for students to role-play and apply an active approach in the decision process of building bridges in Earthquake Country. The fourth

goal is for the students to use technology to build a bridge, to withstand a simulated earthquake, with epicenters located on the San Andreas or the Hayward Fault. The final goal is for the students to summarize their knowledge as well as their application of studying bridges in Earthquake Country with a poster presentation.

As an educator, the labs and the activities are designed to be station driven, but the lessons can be used in a small group or a whole group setting. The teaching strategies as well as the modifications that are addressed in this unit, can apply to a special needs student, the gifted student, as well as the English language learner in the classroom. Through the exposure to the content, along with an integrated curriculum unit, which includes a variety of labs, technology, and project-based activities, the students will be inspired to be an active participant in the development of structures in Earthquake Country.

(Developed for Earth Science and Ancient History, grade 6; recommended for Science, upper Elementary and Middle School grades 5-8)

2008.04.03
Learning by Mistakes-Bridge Failures, by Shelley Freedman-Bailey

In this unit middle school students will gain insight into the technology and evolution of bridges. Using research and an interdisciplinary approach, they will learn the history of bridges, specifically bridges that have encountered structural or environmental challenges. In the first lesson students will research the history of bridges constructing a classroom time line to display the evolution of materials and technologies. In the second lesson, students will select an activity according to their favorite subject. Students may select to build a cofferdam as the Romans did for their bridge foundations. Other students may choose activities where they may construct an arch, or determine the relationship between a bridge's span and load. They may choose to paint a famous bridge, or reconstruct a famous battle of war in a diorama. In the 3rd lesson students will select a famous bridge that has failed. Using the information in this unit as a starting point, they will reconstruct the bridge and determine the reason for its demise. In the 4th lesson students will research the condition of bridges in their local areas, becoming advocates for bridge safety. At the conclusion of the unit, students will be knowledgeable about the history of bridges, and the technology that has led to the incredible bridges of today. They will be able to reason why bridges have failed in the past, and hypothesize about what bridges might fail in the future.

(Developed for Gifted and Talented, grades 6-7; recommended for Gifted and Talented, Middle School grades 6-7)

2008.04.04
Building Bridges Over Turbulent Middle School Waters, by Kennan Girdner

This curriculum unit examines the role of art in bridging the gap between school and community by using local bridges as a metaphor, and as actual structures of importance throughout neighborhoods. The curriculum will help students understand the diverse nature of the community where they live. The work to replace and repair several of these bridges caused great changes in the traffic patterns in the surrounding neighborhoods. Road closures lasted as long as a year. The importance of timely completion of these projects became very clear to members of the community as walking and driving times lengthened and new traffic routes had to be established.

As students look at the problems which arise when reconstruction starts, they will also study the rather lengthy planning process the community must go through before any of the actual bridge work begins. They will learn that the process is very complex and is filled with controversy, particularly for art work on any of these bridges. Students will examine the reasoning behind the upkeep of bridges of historical interest. Architects, engineers, and city planners can help with these explanations, and we will enlist the help of City of Santa Fe Public Works staff and representatives from the various trades involved in creating these structures.

Additionally students will use the local crossing as inspiration to create prints in the classrooms. Students will be introduced to several printmaking processes, and will create and display their finished works throughout the school.

(Developed for Art, grade 8; recommended for Art and Social Studies, Middle and High School grades)

2008.04.05
The Art, Science, and Mathematics of Bridges: An Integrated Unit for Middle School, by Joan Henderson

This unit on bridges, good for grades 5-9, will address through a history of great thinkers the development of understandings about forces and give students a variety of opportunities, including hands on activities, to demonstrate and experience the dynamics and equilibrium of forces in bridge structures. It creates opportunities to develop understanding of balancing equations through looking at and working with cantilever bridges and the concept of equilibrium, and integrates the application of cross multiplication. Additional activities address proportion and measurement through students' scaled bridge and truss drawings, and graphing through plotting the stress vs. strain of fishing line. Students will begin to work with the following science concepts: force, compression, tension, stress, strain, elasticity, and plasticity. Finally, this unit on bridges develops students' understanding of how math and engineering is used in the real

world through examples, hands-on experience, and interacting with architects and engineers.

(Developed for Math, Pre-Algebra II, and Algebra I, grade 8; recommended for Science and Math, grades 5-8)

2008.04.06
Terrific Ts- Truss, Triangle, Tangram and Technology Exploring Bridge Design with the Elementary Student, by Stephanie Johnson

What is so fascinating about the truss bridges? The truss explains the forces of bridge making to the early childhood student. What is it about bridges that make it a common structure? You can cross obstacles that would otherwise be a problem. This connection that they make from community to community provides a chance for the neighborhoods to be explored. This unit the Four Ts is a way of looking at bridges through the assistance of shapes, technology and bridge design. Histories of bridges that are located in the Pittsburgh area have been included. This unit can be adapted at every elementary level. There are several skills that are used in this unit. The literacy component includes reading and a drawing portfolio. The math has included an interactive computer software game that can be accessed through the Public Broadcasting System. The software game explores the tangram puzzle. Math also looks at the triangle in its relationship to the truss bridge. It is one of the truss major shapes. The unit has included a field trip to John Heinz History Center which has a display about bridges. This field trip will also include a visit to several bridges.

Information is given on bridge development history. This history can be used to develop a concept of time and show progress and growth of bridge design. Throughout the unit there are exciting activities that will keep the student's interest. The students will be making a basic truss bridge and discussing some of the principles of the design based on scientific facts on compression and tension. This unit can be adapted to any learning style. The adaption can be done through the countless ideas that can be developed from the information in the unit. The learning standards have been closely aligned with the activities. Any student or teacher can use this unit and learn some invaluable lessons.

(Developed for Social Studies, Math, and Writing, grade K; recommended for Social Studies, Math, and Writing, grades K-2)

2008.04.07
The Design and Analysis of Structures, by Debra Semmler

The main goal of this curriculum unit is to use the bridge structure to aid students in the analysis of static structures. The unit includes activities in the drawing of free-body diagrams, graphical analysis and mathematical analysis of static structures. Most physics

students have difficulties with the drawing of free-body diagrams and the mathematical analysis of Newton's Laws and this curriculum unit will include a greater emphasis on the graphical analysis of static structures. Students will research bridge design and materials and apply what they have learned about force analysis to design their own model of an elevated trussed bridge structure. The students will draw a full scale diagram of the bridge and construct their bridge models out of dry pasta and hot glue. The bridge model will be tested for its mechanical efficiency after completion of the force analysis. A discussion of the bridge failure will follow the testing and students will evaluate the weakness in their design.

(Developed for Physics I, MYP, Honors AP Physics I, grades 10-12; recommended for Physics, grades 10-12)

2008.04.08
The Use of Bridge Design in Teaching Mechanics, by Stuart Surrey

Bridges are unique structures that are able to traverse natural and/or manmade obstacles. They have been used throughout civilization for transportation, commerce, and communication. They have been used in times of peace as well as during periods of conflict. The aim of this curriculum unit is to use bridges and their different designs to teach mechanics to students enrolled in a traditional high school physics course. Initially, the history of bridges will be presented with emphasis being placed on the correlation between advances in civilization and developmental changes in bridge design and construction. The second goal of this unit is to examine which type of bridge would be best suited for a given situation and what underlying factors govern its use. The primary objective of this unit, however, deals with static equilibrium and the forces associated with bridges such as: compression, tension, stress, and strain. Students will be engaged in graphical analysis, free body diagrams and vector resolution. This unit has been designed to be in alignment with both Pennsylvania's State Standards for Science and Technology in addition to the School District of Philadelphia's standardized curriculum for physics.

(Developed for Physics, grade 12; recommended for Physics, grade 12)

2008.04.09
Bridges: Inspired by Nature, by Karen Yarnall

This unit is designed to spark students' interest in and appreciation of bridges. Through the suggested activities in this unit, students will develop an understanding of the rationale for creating bridges, study bridges in their historical contexts and follow the development of new ideas, techniques, processes, materials and other considerations for the building of bridges. They will become aware of bridges as paths of travel that impact the communities that they connect. Architect and artist Santiago Calatrava will be studied because of the way that he has incorporated the principles of structures found in nature

(such as a leaf) into the design of some of his architectural structures. Calatrava will serve as an inspiration for the students. The students will build their own individual bridges that have been inspired by nature, assessing both their own and those of their peers. This unit will culminate with an art exhibit of the students' bridges and their drawn plans on graph paper. Even though this unit has been created for high school 3-D Design art students, it can be adapted for use in other disciplines, particularly those of science and math, and other grade levels.

(Developed for 3-D Design and Art, grades 9-12; recommended for Art, grades 7-12)

V. Estimation

Introduction

"Estimation" is a word that is heard often in mathematics education, but what the word means tends to be shadowy. It has something to do with rounding, but when you use it and what you use it for are not usually elaborated in much detail. The aim of this seminar was to take estimation out of the shadows, and to connect it with the main ideas of arithmetic.

Most specifically, the goal was to bring out the estimation capabilities of our base ten place value (a.k.a. decimal) system for writing numbers. This marvelously efficient notational scheme can express any whole number using only ten symbols, organized in carefully arranged sequences. A given sequence, such as 123, stands for a sum: 123 = 100 + 20 + 3. Each of the summands has a special form: it is a digit (i.e., 0, 1, 2, 3, 4, 5, 6, 7, 8, 9) times a power of 10. The place of the digit in the sequence tells what power of 10 it should be multiplied by. The 3 is multiplied by 1, which is 10^0; the 2 is multiplied by 10, which is 10^1, and the 1 is multiplied by 100, which is 10^2. The key to making this work is to insert a 0 wherever the corresponding power of ten is not needed to express the number. This principle is most dramatically used in the summands: because the 2 in 20 appears in the second place, with a zero to its right, we know that it means twenty, not two; because the 1 in 100 appears in the third place, with two zeros to its right, we know that it stands for one hundred, not ten or one. This is the principle of place value.

Most children learn place value in terms of vocabulary: ones, tens hundreds, thousands, etc. What is important for estimation is relative place value. This amounts to the observation that the relative value of two places depends only on their separation. Thus, 10 is ten times 1, 100 is ten times 10, 1000 is ten times 100, and so on: any place is worth ten times as much as the place immediately to its right. Similarly, any place is worth 100 times the place two places to the right, and 1/10 of the place just to its left, and 1/100 of the place two to the left; and so forth. The relative place value of two places depends only on their separation, not on their specific locations.

This means that in any base ten number, most of the value of the number is in the leftmost few digits. In fact, one can show that the leading (i.e., leftmost) digit of a number always accounts for at least half the size of the number; the leading two digits always account for at least 90% of the number; the leading three digits account for at least 99% of the number; the leading four digits account for at least 99.9% of the number, and so forth.

Since just the leading digit of the number accounts for most of the number, the place value of this leading digit already indicates the approximate size of the number. This

leads to the idea of order of magnitude. The order of magnitude can be described as the exponent of the power of ten represented by the leading digit. An operationally simpler way to describe order of magnitude of a whole number is, it is one less than the number of digits used to write it. Thus, the order of magnitude of 123 is two. An important idea in estimation is that if you can determine the order of magnitude of a number, you know something important about it.

In fact, when one is dealing with numbers that arise from measurement, that are used to describe the real world, it usually will not make sense to specify more than the leading four, or often three or two digits, and sometimes only the leading digit really makes sense. The radius of the earth can serve as an example. It is somewhere around 4,000 miles, but it does not make sense to specify it to the nearest whole mile. The bulge around the equator caused by Earth's rotation; the lumps and dimples like the Himalayas and the deep ocean trenches; and other irregularities, mean that it only makes sense to talk about the radius of the earth to about ± 10 miles, which means the last decimal place in a figure like 3958 should be ignored. Use 3950 or 3960.

The seminar explored these ideas and their implications at some length. We learned the usefulness of one-digit arithmetic (and even, in some situations, of zero digit arithmetic!). The units produced by the seminar Fellows vary in level from first grade to high school, but they all incorporate these ideas in a meaningful way.

The first grade unit of **Carol Boynton** seeks to incorporate the idea of place value into the beginnings of arithmetic. It emphasizes the idea that a two-digit number is a sum of some tens and some ones, and already uses this in teaching the addition facts, thus preparing a smoother entry into general addition and subtraction of two digit numbers. The main point explicitly related to estimation is simply that tens are much larger than ones, and are what one concentrates on when comparing numbers. The second grade unit of **Sarah Kiesler** deals with similar ideas, but combines them with measurement ideas, and coordinating number with length. Both of these units incorporate ideas from the Singapore mathematics curriculum. **Vivienne Bartman's** third grade unit studies place value through a focus on the key idea that makes place value work: the zero. Her students will learn about Zero the Hero.

The upper elementary and middle school units develop real world projects that incorporate ideas and principles of estimation. Place value, relative place value and order of magnitude will help **Sharyn Gray's** class get a handle on issues of waste, and resource management. **Eunice Rebullida's** unit emphasizes order of magnitude, and develops a pictorial estimation technique based on array sampling. **Elaine Tam's** unit has the theme of rice, its consumption, production and storage. It includes cooking zongs, or "rice tamales." **Kathryn Kinsman** uses baseball as a hook to introduce the key ideas, then progresses to less recreational topics. **Brian Bell's** unit highlights the horseshoe crab, an

important part of Delaware's shoreline ecosystem. The statistical methods used to estimate horseshoe crab population on Delaware's beaches also use a form of grid sampling, and Brian's unit incorporates projects to help his students grasp the issues involved in these methods. Finally, **Patricia Marasco's** project for high school students concentrates on developing a comfort in working with large numbers and gaining a practical understanding of approximate arithmetic. Teachers wishing to give their students a richer experience in estimation, and better appreciation for its potential can find both specific ideas and inspiration in these units, whatever grade they teach.

Roger Howe

Synopses of the Curriculum Units

2008.05.01
Each Number in Its Place: Teaching Place Value to First Graders, by Carol Boynton

This unit seeks to give first grade students a robust beginning to their study of arithmetic through a stronger understanding of place value. The focus of the unit will be understanding ones, tens, and hundreds, their relative sizes, and how they are used to express any number up to 100.

The key ideas of the unit are adapted from the Singapore mathematics program. This curriculum has attracted considerable attention in recent years because of Singapore's consistent first place finishes in the TIMSS (Trends in Mathematics and Science Study) international comparison of mathematics achievement. The unit seeks to bring the insights of the Singapore program to a typical American first grade classroom.

The first main goal of the unit is to achieve strong mastery of the addition and subtraction within 10. This is facilitated by the idea of *number bonds*, in which three numbers are related by addition: for example (3, 4 and 7) form a number bond. The number bond is a more tangible analog of the fact family. When addition and subtraction within 10 is solidly in place, the rest of the addition and subtraction facts are learned via the process of "making and unmaking 10". This provides a principled way to learn the addition facts, and couples it with a beginning of learning place value.

The next stage is to learn to think of two digit numbers as combinations of some tens and some ones. This is combined with addition and subtraction, first without regrouping, and then with. This will include understanding that the tens always account for most of the number, and that, in comparing two numbers, the number of tens is decisive. The unit will culminate, on the hundredth day of class, with the understanding that 100 consists of 10 tens, and makes a new, larger unit that will allow us to deal with yet larger numbers. (Developed for Math, grade 1; recommended for Math, grade 1)

2008.05.02
Take Your Best Guess: Exploring 1, 10 and 100, by Sarah Kiesler

This unit is intended for second grade students after they have had sufficient time to build a solid foundation in numeracy. It is designed to integrate the study of place value, measurement, order of magnitude and estimation. It intends to impress that there is a significant difference in the value of a digit when it is written in different places in decimal notation. Specifically, it seeks to show them that tens are a lot bigger than ones, and hundreds are a lot bigger than tens. It also seeks to further enforce the difference in the "places" using digits other than 1. For example, we'll explore the difference between

5, 50 and 500. These extensions will help solidify the idea that place value is a significant aspect of our numerical notation system. The activities are also built to integrate linear measurement and the study of perimeter. All of the experiences are constructed to give the students enough background knowledge to be able to estimate length with more accuracy.

(Developed for Mathematics, grade 2; recommended for Mathematics and Science, grade 2)

2008.05.03
The Amazing Zero; Starring in: "Place Value, Estimation and Order of Magnitude", by Vivienne Bartman-McClellan

This unit, "*The Amazing Zero Starring in Place Value, Estimation and Order of Magnitude*" was created for a third grade class. It will show the children how important the number zero is in mathematics. It will especially focus on the use of zero in our base ten place value system for writing numbers. It will also delve into how numbers with lots of zeros, round numbers, help us with estimation by concentrating our attention on the relative sizes of numbers, rather than being mesmerized by their digits. The unit will begin with the importance of zero in place value and then finish with the importance of zero in order of magnitude in real life situations such as adding and subtracting. The main objective for this unit is to build a strong foundation of the concept of Order of Magnitude. Within order of magnitude falls the concepts of place value, place holder, with zero being the main character in the scenario.

(Developed for grade 3; recommended for Elementary Math, grade 3)

2008.05.04
Crunching Numbers for Lunch, by Sharyn Gray

This integrated unit teaches explicit estimation skills through examining environmental issues at the school site. The overall goal for the unit is for students to make sense of statistical reporting and very large numbers through evaluating use and waste habits of the school community. By using estimation techniques and manipulating quantities, students will be able to evaluate numbers over 1000. Beyond recognizing large numbers and understanding their value, these techniques will also provide them with the skills necessary to multiply and add large numbers and evaluate their own multiplication and addition processes to see if their solutions are reasonable. Besides merely recognizing and computing large numbers, students will be able to use estimation and relative place value to compute quantities of length, area and volume using various units of measurements. These skills will be applied to a final project in which students design investigations of use and waste in the cafeteria and present their findings using comparative language as well as graphics.

(Developed for Math and Science, grade 4; recommended for General Elementary Math and Science, grade 4)

2008.05.05
Ballpark Figures: Quantitative Inquiries of Baseball and Beyond!, by Kathryn Kinsman

Estimation is an immense topic that unfortunately gets forgotten because, in most classrooms, it is simply merged with rounding. It's not really our fault though; the little curriculum we have on this subject leads us to assume they are basically the same thing. As adults, we use estimation throughout the day without even realizing it. Just think, how many times today have you asked yourself questions like: What time do I need to leave to beat rush-hour traffic? How long will that gallon of milk last? Do I have enough gas in the car to get home? You didn't round anything! Estimation is so important and needs to be emphasized to our students throughout the year.

Because estimation is so broad, I've focused this unit on introductory topics such as the decimal place value system and relative order of magnitude. It uses quantitative aspects of baseball as the underlying inquiry and motivation for students. It will take approximately two weeks and is intended for 5th or 6th grade students. It starts by developing the basic conceptual idea of place values from the thousandths to the billions place. We want to teach more than whether one number is larger than another, we want to teach how much larger it is, or that certain numbers are close to one another. Students should understand the size of a number before operating with it, and they should understand the relative values of the places. They will then explore larger, base ten numbers by expanding each of the places as a digit multiplied by a power of ten. For example, 6345 = 6 X 1000 + 3 X 100 + 4 X 10 + 5 X 1. Students will eventually notice that the leftmost place value is larger than all the rest of the place values combined. Many students have a hard time conceptualizing, lets say, a hundred thousand dollars compared to a million dollars. By breaking down each place value of a given number, students will realize that each order of magnitude (the place just to the left) represents numbers 10 times as large as the given place! The ultimate goal is for students to fully understand the value of these very large numbers, such as the salary of a major league ballplayer. When students are familiar with this idea, they will calculate real-life estimation problems using baseball facts found on the Internet. Next students will explore relative sizes related to attending a typical professional baseball game and make reasonable estimates for each quantitative aspect, such as concession sales per game vs. per season. After estimates are made, they can be checked for accuracy by using the percent difference formula. An answer less than 10% indicates that a reasonable estimate was made. The unit will culminate with an Internet research-based project. This project can be used as an assessment as well. Students will research given topics for two chosen countries. They will apply their skills by making reasonable estimates and formulating an opinion from what their data shows. The goal is for students to decipher whether large numbers such as

population density results in a greater human impact on the environment in one country versus the other.

(Developed for Math and Number Sense, grade 5; recommended for Math, Place Value, Estimation, and Number Sense, grades 5-6)

2008.05.06
The Power of Estimation, by Francisca Rebullida

This curriculum unit teaches estimation in an explicit and practical way. It is designed for fifth grade Math in English as a Second Language class and could be modified for students in the regular class. This unit presents the key concepts in estimation such as place value and the order of magnitude, relative place value, expanded form in relation to rounding off numbers, using area models and sampling to produce estimates. Estimation is more than just "taking a guess". It requires reasoning to find a useful approximation. The order of magnitude demonstrates the importance of the power of ten in affecting real world quantities or approximations. Students make meaningful connections to the values of numbers. The sampling method is a strategy for estimating numbers of irregularly scattered objects. Literature books are incorporated in teaching the unit to help English language learners learn the mathematical concepts as well as develop their listening, speaking, reading and writing skills. Furthermore, the unit provides essential vocabulary words that they can connect to their native language. Each book shows estimation concepts and strategies. The integration of math/reading language arts incorporates the skills of estimating, calculating and reasoning. Do the students really understand the value of one million? Read and enjoy *A Million Dots* written by Andrew Clements. Students will see what a million looks like when they read the book. Be fascinated when you see how the power of ten dots gets magnified to 100, to 1000 to 10,000, to 100,000 to 1,000,000. How long would it take you to finish reading *A Million Dots*? It would take you eleven and a half days!

(Developed for Science and Math, ESL grade 5; recommended for Math and Science, grade 5)

2008.05.07
Rice to Feed the World- Estimations on Rice Consumption and Production, by Elaine Tam

This is a unit written for 6th grade classes in a Chinese Immersion school in San Francisco. A cooking lesson for the Dragon Boat Festival is the catalyst for this unit. The students explore and synthesize math skills and concepts to make estimations about rice demands and land requirements to produce the rice. There are four sections in this unit. The first part, students will learn about the notation of large numbers. They will build number sense by comparing numbers in terms of the multiplication factors. In the second

part, students learn about unit rate and proportions using a variety of units of measurement, including mass, length, area and volume. Students learn to choose the appropriate units of measure and perform unit conversions for the scale of things being measured. In the third section, students explore the relationship between mass, area and volume to find solutions for rice storage. In the last section, students estimate the area of land needed to produce quantities of rice. In a final cumulative unit project, students will define a situation, gather the information they need, calculate the estimates and present their findings to the class.

(Developed for Math, grade 6; recommended for Math, Middle School grades 6-7)

2008.05.08
Estimation in Ecology - the Horseshoe Crab Census, by Brian Bell

Estimation is a vague topic in most Math classes, regardless of the grade level. In most of the workbooks that I use with my sixth grade students throughout the school year, we see the word estimation in many of the questions. What we don't see however, is an explanation as to what estimation is, what it is used for, or how to use it. Too often estimation is thought of as merely a guess and not much more. Estimation is in fact not a guess, nor an educated guess, but rather an effective way of calculating an approximate answer to a question. Estimation is based on Math, not on a guess, educated or otherwise. There are several math concepts that students must be familiar with in order to effectively utilize estimation in the classroom including, place value, expanded notation, very round numbers, and order of magnitude. A familiarity with the powers of 10 would be beneficial as well. Using the horseshoe crabs of the Delaware Bay, this unit focuses on the correct methods necessary for teaching middle school students estimation in an exciting and engaging way.
(Developed for Math, grade 6; recommended for Math, grades 6-8)

2008.05.09
Estimation: What's the Big Deal?, by Patricia Marasco

This is lesson on estimating with large numbers and is designed for High School students. We have done a problem on estimating the number of bottles of water needed to fill Heinz Field. The first estimation was done using a 3 foot crate filled with 20 oz bottles and the second was done just using the water from the bottles. The numbers were obviously different and the difference was then compared and talked about. The range of these types of problems is endless and can easily be transferred to real world problems such as the number of miles the average American drives a year, or the amount of paper used in a school year or any number of other problems. These types of problems take on a life of their own and can be very interesting to watch the students solve using different approaches and in the process, find more and more questions to answer.

This lesson covers a range of topics and is a great refresher on several others such as conversions, scientific notation, rounding, percent of error and estimating.
(Developed for High School grades)

VI. Nutrition, Metabolism, and Diabetes

Introduction

Humans eat, drink, and breathe to bring into their bodies the raw materials for growth, repair and generation of the energy necessary for life and the actions that bring pleasure to life. In most cases, the adult body achieves a dynamic state of homeostasis, in which the amount of nutritional input balances the energy needs, so the weight of the individual remains constant with time. Issues of food intake, nutrition, and human health are becoming increasingly important in the U.S. The Center for Disease Control (CDC) reports a dramatic increase in obesity in the U.S. over the period from 1985 to 2005. And disorders of metabolism, such as diabetes, create tremendous challenges for many individuals in the U.S. and other nations. This seminar provided an overview of human nutrition from the perspective of biomedical engineering. From a mechanical viewpoint, the human body is an elegant machine that requires inputs for sustained operation. What are the processes responsible for input of nutrients and raw materials? How are molecular nutrients extracted from ingested materials? How are these processes controlled?

Specifically, the seminar covered the following topics:

Healthy diets
Fats, carbohydrates, and proteins
Nutritionism (or the industrialization of nutritional information)
Diabetes — the chemical and anatomical changes that result from this disease, as well as ways to treat the disease
Carbohydrate metabolism
Protein metabolism
Fat metabolism
The Western diet and disease
Drinking and water
Micronutrients
Food allergies

The discussions were enhanced by our reading of two books: *In Defense of Food* by Michael Pollan and *Eat, Drink and Be Healthy* by Walter Willett.

The Fellows prepared curriculum units that covered a breadth of information on diet and metabolism and health. The range of material was impressive, as well as the range of grade levels that the seminar produced units to satisfy.

Several of the units focused on material that was appropriate for high school students. **Emily Betts** prepared a unit called "Eat to Live" that uses hands-on activities to introduce

the chemistry and function of the important classes of biological maromolecules. **Aruna Kailasa** prepared a unit called "Stoichiometry — A Necessary Tool in Chemistry," which uses food chemistry to illustrate the principles of chemical reaction stoichiometry. **Kristin Peterson** wrote a unit called "The Way Food Works" that focuses on the short- and long-term effects of ingested food on body metabolism and health. **Sara Thomas** prepared a unit called "School Lunch: How Healthy is It?" that explores the use of graphic design in the presentation of nutritional information, and encourages students to test the health value of the foods provided in their own schools.

Many of the units were addressed to the elementary school classrooms. **Karen Brinkley** wrote "Fast Food, Fast Track... To Nowhere," which describes some of the problems with obtaining our nutrients from fast food. **Brian Coons** prepared a unit called "Healthy Choices Lead to Healthy Bodies" exploring the use of hands-on activities related to food to teach science concepts. **Kathleen Gormley** prepared a unit called "Getting A Healthy Start on Life" which focuses on the relationship between food, the process of digestion, and exercise. **Lori Paderewski** prepared a unit called "Food Allergies Beware: We Know Your Secret" which provides information to help elementary school teachers and students keep their classrooms safe for students with food allergies. **Christina Pavlak** produced a unit called "Feeding our Bodies, Fueling our Minds" that presents information on digestion, healthy eating, and improved academic performance. **Huwerl Thornton** wrote a unit called "High Fructose Corn Syrup: What is it good for?" that discusses the prominence of high fructose syrup from corn in our national diet. **Cindy Woolery** prepared a unit called "Developing Student Leaders Through Nutritional Empowerment" that uses service learning projects to teach nutritional information and leadership skills.

W. Mark Saltzman

Synopses of the Curriculum Units

2008.06.01
Eat to Live: The Connection between Food, Digestion and Diabetes, by Emily Betts

I wrote this unit for my freshman Biology class to teach the macronutrients - carbohydrates, fats, and proteins - in context of the foods that we eat. My overall strategy in designing this curriculum unit is to use hands-on labs experiences that incorporate actual food items. Through these activities, students should understand how the nutrients that they consume are digested and what their role is in the body. It is also important that they understand how eating certain foods in excess can lead to obesity, and potentially to diseases like diabetes. My students will study the causes, symptoms and treatments of diabetes, as well as the importance of diet in controlling the disease. As a final project, they will research healthy recipes that they would enjoy cooking and eating, and plan a Healthy Eating festival for the entire school.

(Developed for Biology, grades 9-10; recommended for Biology, grades 9-10, and Life Science, grades 7-8)

2008.06.02
Fast Food, Fast Track… To No Where, by Karen Brinkley

What fats and sugars are included in the fast foods that you eat? What happens to the digested food? Do you think we can solve the obesity epidemic? These are a few essential questions that students will analyze throughout this curriculum unit intended for seventh and eighth grade students. Therefore, the main goal of this unit is to help students discover proper nutrition and become aware of alternative methods and resources to incorporate a healthy diet.

Why is nutrition information important? Often we eat without any conscious thought about the innumerable complex structures that work as a cohesive group to bring food on our plate. A tremendous concern for me is that my students do not understand what they are eating. I think it is vital that students become knowledgeable about the food they ingest; I want them to understand how the food impacts their digestive system and overall health. Students need information to counteract the escalating obesity epidemic, because a major portion of their diet consists of processed foods obtained from fast food restaurants. Also, included in the equation are the long- term negative health consequences experienced by low-income people who often eat a deficient diet that consistently lacks the essential minerals and nutrients to fuel the body. Regrettably, deficient nutrition generally results in significant life-threatening illnesses and a restricted quality of life when they reach old age.

(Developed for Reading, Literacy, Science, and Math, grades 7-8; ; recommended for Literacy, Science, and Math, grades 7-8 and High School grades)

2008.06.03
Healthy Choices Lead To Healthy Bodies! A Child's Guide to Good Nutrition and Exercise, by Brian Coons

The primary purpose of this unit is for students to gain a better understanding of the basic principles of both good nutrition and exercise. Students will be presented with information on ways to address their personal eating and exercise habits. Students will participate in activities that identify what makes up the proper components of a nutritiously balanced diet. Children are taught how the human body processes the foods it takes in. The parts and functions of the digestive system are both identified and explored. Students discover how the human body breaks food down into all the necessary nutrients such as vitamins, minerals, lipids (fats), protein, and sugars it needs to maintain proper weight, body mass index, and metabolism. The nutritional content of manufactured food products vs. real "whole" foods are compared and contrasted. Lastly, students gain an appreciation for simple physical activities that will lead to overall improved fitness. They will engage in simple exercises they can do in as little as 30 minutes. This unit was written with 4th graders in mind, however any upper intermediate grade could use this unit.

(Developed for Food Science and Nutrition, grade 4; recommended for Food Science and Nutrition, Elementary School grades 4-6)

2008.06.04
Getting an Early Start to a Healthy Life, by Kathleen Gormley

Making healthy choice regarding nutrition and exercise can be a daunting and confusing task. Through participating in hands-on activities and using real life situations, my goal is to give my students valuable information so they can begin to make choices that are healthier and beneficial. This unit has been developed using an interdisciplinary approach to instruction. Students will learn science content through direct instruction as well as through reading non-fiction text, journal writing, math problem solving, and physical education.

This unit is designed for a third grade classroom and is divided into three concept areas. The first concept focuses on calories in and will teach students about food calories and what is in the food we eat as well as components of a healthy diet. The next concept deals with digestion and in this portion of the unit students will develop their own research project to learn about the digestive process. After they have completed their research, students will be responsible for creating a presentation of the research using, but not

limited to power point, posters, or plays. The final concept spotlights calories out and will expose students to the benefits of physical activity.

(Developed for Science, Math, and Physical Education, grade 3; recommended for Science, grades 3-5)

2008.06.05
Stoichiometry - A Necessary Tool in Chemistry, by Aruna Kailasa

Food is one of the most important basic needs of life and most of us love food. This unit associates the promotion of healthy food habits with understanding of key chemistry concepts. One key concept is stoichiometry, which is a necessary tool for chemists - this unit connects food with stoichiometry to drive student's interest towards chemistry. One particular goal of the unit is for students to do calculations without using the word "stoichiometry". A second goal is to educate students to make the right choices in selecting healthy food, which is good for their body This helps students to be physically healthier as they may tend to choose the right food and would be active in chemistry class, as well. Throughout the unit the activities will involve food and chemistry, which emphasize the importance of chemistry concepts in making healthy food choices. The activities incorporate math calculations that will lead students to stoichiometry and limiting reactant concepts of chemistry.

(Developed for Chemistry and AP Chemistry, grades 9-12; recommended for Chemistry, grades 9-12)

2008.06.06
Food Allergies Beware: We Know your Secret!, by Lori Paderewski

Food Allergies Beware: We know your secret!, is a unit designed for third grade students, which can be adapted for all learners. Learning about nutrition and food allergies can be exciting for third grade students, yet at the same time, scary. The concepts and ideas presented in this unit, as well as most information on the role of the immune system in allergic reactions, are difficult for most people to understand, particularly young children. The goal of this unit is to deliver content information to assist the students in answering the following questions: What are food allergies? How does a person develop a food allergy? What are foods that commonly cause allergic reactions? What happens to our body when we have a reaction? How do we treat the symptoms of an allergic reaction? Can we prevent food allergies? How can we be safe with allergies?

(Developed for Science, Human Body, grade 3; recommended for Elementary School grades 2-4)

2008.06.07
Feeding our Bodies, Fueling our Minds, by Christina Pavlak

"Feeding our Bodies, Fueling our Minds" is a three to four week curriculum unit designed for sixth grade students. It can, however, be easily adapted to meet the needs of students in grades 3-8. The material, created especially for second language learners, is based on Howard Gardner's work with the Multiple Intelligences and encompasses learning standards from language arts, math, and science. It addresses three major questions: How do we make healthy food choices, why do we need to eat, and what is the importance of exercise? Through a hands-on study of nutrition, students will learn that there is a connection between food choice, exercise, and academic achievement. Key vocabulary and concepts such as micro- and macro- nutrients, calories, digestion, metabolism, and the importance of eating a balanced diet will be examined. Additionally, students will develop critical thinking skills as they compare and contrast two popular versions of the food pyramid and reflect about their own eating habits. As a culminating activity, they will complete a series of activities from a Nutrition Multiple Intelligences Contract and will present their work to the class. The unit, therefore, enhances language acquisition for English language learners through content area instruction.

Developed for Science, Language Arts, and Math, Bilingual grade 6; recommended for Science, Math, and Language Arts, upper Elementary and Middle School grades 3-8)

2008.06.08
The Way Food Works: Analyzing the Short and Long Term Effects of What We Eat, by Kristin (Peterson) Anton

Why eat? Every day we must feed our bodies, yet many of us pay little attention to the food we put in our mouths. With rates of obesity and diabetes on the rise, nutrition is becoming an increasingly large concern in today's society, especially amongst our youth. This unit, designed for an advanced-level high school biology course, examines nutrition on a molecular and somatic scale. Students will start by learning about the short-term effects of food: what the food molecules are, their role in the body, how they are digested and metabolized, and the body's energy needs, balance, and storage. In the second part of the unit, students will examine the long-term effects of food: the way that nutrition affects our bodies over the course of a year or a lifetime, the effects of too much food, or deficiencies or excess in certain nutrients or types of food. In addition to learning the biology of eating, students will also gain an understanding of nutrition that will empower them to make better food choices and educate those around them.

(Developed for IB Biology I, grade 11; recommended for Biology, grades 10-12)

2008.06.09
School Lunch, How Healthy Is It?, by Sara Thomas

Due to income levels, television commercials, and lack of parental involvement many of my students are not even aware of what type of food they should be putting into their bodies. Add to that the confusion created by the media, fad diets, and ever-changing recommendations from experts (in the form of food pyramids) — how can anyone know what they should be putting in their body? Students will compare different dietary guide graphics to determine who creates the graphics and how you can determine whether or not they are reliable. Students will then choose a guide to follow and create healthy school meals from that dietary guide. Their final project will be to create a tri-fold brochure aimed at convincing the Board of Education to invest in food service programs that bring more fresh, healthy foods into the cafeteria. The tri-fold brochure will contain three parts: an eye-catching print ad comparing the nutrition they currently receive with what they should be receiving, a section showing options and benefits for bringing in fresh, locally grown produce, and a section containing a recipe for a school lunch and breakfast using fresh produce.

(Developed for Digital Art, grades 9-12; recommended for Digital Art, grades 9-12)

2008.06.10
Childhood Obesity and High Fructose Corn Syrup. What Is It Good For? Absolutely Nothing!, by Huwerl Thornton, Jr.

This unit takes a look at the use of High Fructose Corn Syrup and its potential link to the obesity problem in the United States. It examines the complicated process of making High Fructose Corn Syrup and its make up as compared to conventional sugar. This unit also explores how the human body processes High Fructose Corn Syrup and how it is different than traditional sugar. This unit includes information on the history of High Fructose Corn Syrup, which gives an important example of how food production and agriculture have changed in the US over the past few decades. The unit also discusses how High Fructose Corn Syrup achieved mainstream use in the 1980's. As the use of High Fructose Corn Syrup began to rise, so did the level of obesity in the United States. This unit particularly looks at childhood obesity and some of its causes. Some obese children are exhibiting the health problems of a 40-year-old.

The unit also provides some strategies as to how the childhood obesity problem in the United States can be beat. This unit shows how eating habits can be changed to include more healthy foods. This unit will attempt to start with children, changing how kids look at soft drinks and attempting to choose alternative drinks such as 100 percent fruit juice or water. This change will hopefully spread to their families and beyond.

(Developed for Nutrition and Health, grade 3; recommended for Nutrition and Health, grades 3-6)

2008.06.11
Developing Student Leaders through Nutritional Empowerment, by Cynthia Woolery

Developing Student Leaders through Nutritional Empowerment is a unit developed to empower my fourth grade students to demonstrate leadership qualities. Students will be asked to first take responsibility for making their own healthy choices, then use information gained through the study of food science to inform others (students, staff, community) in a variety of self-selected ways by designing and creating a service learning project. The focus of their project will be on sharing the knowledge/insights gained through this unit with others to help all make healthy, wise choices. The unit will build leadership skills and communication skills through service to others.

(Developed for Science and Food Study, grade 4; recommended for Science and Food Study, grades 4-5)

VII. Urban Environmental Quality and Human Health: Conceiving a Sustainable Future

Introduction

This seminar was designed to explore the relations between environmental quality and human health in urban settings. One unexpected effect of twentieth century prosperity has been a change in the chemistry of the human body. Most people are exposed daily to thousands of chemicals in mixtures that were never experienced by previous generations. Many are recognized by the US and other nations to be carcinogens, neurotoxins, reproductive and developmental toxins, or endocrine disruptors that mimic or block human hormones. Each year hundreds of billions of pounds of chemicals are released to the environment as commercial products and they include plastics, solvents, pesticides, flame-retardants, waterproofing agents, adhesives, fuels and their additives, cleansers, fragrances, preservatives, dyes. Trillions of additional pounds of pollution are discharged to the atmosphere, surface and ground water, oceans and land as by-products of industry, fuel combustion, or as wastes. Often the distinction between commercial chemicals and pollutants is only a matter of time as products lose their utility, are discarded, and slowly degrade releasing their ingredients.

The US Centers for Disease Prevention and Control (CDC) began widespread human tissue testing to detect the presence of hazardous chemicals in 1999 and several years later reported that most individuals carry a complex mixture in their bodies. The government focused some testing on chemicals that the US has banned such as chlorinated pesticides and numerous polychlorinated biphenyls formerly used in the electronics industry, and these demonstrate declining body burdens, indicating the success of prohibitive policies. All of us however have experienced growing exposure to newer unregulated chemicals such as plastic ingredients, some pesticides, fire-retardants, and waterproofing agents. Their concentrations in human tissues vary by age, gender, and ethnicity; children for example often carry higher concentrations than adults.1 2

As society's chemical footprint grew during the past half century, many illnesses increased in prevalence. These include respiratory diseases, neurological impairments, declining sperm counts, fertility failure, immune dysfunction, some types of cancer, and developmental disorders among the young. Environmental contaminants are now recognized to contribute to all of these conditions. There is little doubt that that tobacco, lead, mercury, radionuclides, solvents, vehicle exhaust, combustion by-products, dioxins, PCB's, and many pesticides have caused serious human illness, although those who profit from the sale or release of hazardous substances will always challenge the relation between chemical exposure and illness.

Several trends help to explain the growing chemical burden on the environment and human health. The US population surpassed 300 million in 2006 having doubled in both the first and second half of the century. The US economy expanded 45 times larger than it was in 1950. Life expectancy increased from 47 to 78 years since 1900, doubling the duration of adulthood. People are now living longer with higher incomes while consuming more goods and energy, all as they create more pollution and waste per capita than any previous generation or any other nation. By 2008 those in the wealthiest countries consumed 32 times more energy and raw materials than those in the poorest. Inexpensive energy has been a primary catalyst for many of these trends. 3 4

The effect is a synthetic chemical burden on the environment that is enormous by any measure and it is accelerating. The US Chemical Abstract Service maintains a registry of over 32 million organic and inorganic chemicals, 14 million of which are commercially available. Fewer are traded in significant quantities: nearly 100,000 are registered and reportedly traded in the European Union (EU); and by 2000, 300 were produced in volumes exceeding 1 billion pounds annually, and about 2,700 others exceeded 1 million pounds each year. These are termed "high production volume chemicals" (HPV) and no hazard data exist for nearly 20 percent while sufficient data necessary to judge basic health risks are available for fewer than 15 percent. Among all chemicals traded, the EU in 2007 found that information necessary to understand chemical use, environmental fate, and health risks existed for fewer than 1,000 chemicals, or only 1 percent of all that are traded. This burden is most dangerous in urban settings where people, fuel combustion, commercial products, vehicles, and wastes are concentrated. Population density is positively correlated with intensity of chemical exposures; and population growth together with rising petroleum prices will encourage ever-increasing density.5

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To better understand the origin and scale of challenge we face, our seminar examined numerous histories of dangerous technologies and practices that have changed the chemistry of the environment and our bodies. These include the plastics industry, atmospheric testing of nuclear weapons, contaminated military sites, pesticides, and vehicle emissions. Each example includes the discovery that children have been exposed more intensely than others and each problem has been potent, persistent, and transnational if not global in scale. The five case studies exhibit different dimensions of risk, variety in human susceptibility, and considerable opportunity to reduce future exposure. Two of the cases we explored grew from government pursuit of national security: nuclear weapons testing and defense facility contamination. Two others evolved from private pursuit of profits: pesticides and motor vehicle emissions. Each history is considered in separate parts that follow.

The plastics industry well illustrates the chemical challenges to health we all will continue to face through the 21st century given its scale, global reach, product diversity, and ubiquitous human exposure. Plastic manufacturers introduce nearly 100 billion pounds of resins to markets each year and fewer than 5 percent of products containing them are recycled in the US. Plastics have entered every aspect of our lives, and their chemical residues now can be found in air, water, soils, and the tissues of nearly every human tested. Government studies confirm that children carry the highest concentrations of some plastic compounds produced in enormous volume that either mimic or block human hormones. These are known to induce reproductive and developmental disorders in several species of animals often tested to infer human health risks. Despite compelling evidence of danger, plastics remain virtually unregulated under US law. Chemical production and manufacturing occurs in so many parts of the world that no national government has the capacity to control sales, product ingredients, dangerous exposures, or wastes. Collectively these trends demonstrate the chronic and growing environmental experiment on human health being conducted by the chemical industry, one predominantly neglected but seemingly authorized by the federal law. The plastics overview follows this introduction.

The US nuclear weapons program unintentionally produced the very first paradigm for understanding global environmental problems such as climate change, ozone depletion, and mercury contamination in marine food chains. Discovering the hazards of nuclear testing in the atmosphere had enormous influence on the future of environmental science and law. Nuclear weapons were intended to produce massive loss of human life and environmental ruin, but the Atomic Energy Commission's discovery of global fallout and human exposure was a surprise. The pattern of discovery that radionuclides persist, move through the atmosphere, follow complex ecological pathways that lead to human exposures, and produce life threatening health effects became a paradigm for later efforts to understand and manage pollution and hazardous chemicals.

The history of pesticides provides a different paradigm to understand how society might protect itself from hazardous exposures. Each year 3 billion pounds of pesticides are sold in the US, and nearly 400 million acres of the national landscape are chemically treated. Pesticides are intended to kill different species of insects, bacteria, fungi, algae, parasites, and other species that can harm economic productivity and human health. Their intentional release to the environment causes residues to linger in air, foods, water, soils, and human tissues. They are added to commercial products such as plastics, fabrics, paints, fuels, wood products, swimming pools and spas, personal care products, and some pharmaceuticals. Many pesticides may legally be sprayed in indoor environments including homes, offices, restaurants, schools, hospitals, hotels, and vehicles. Some are encapsulated within tiny plastic beads that slowly dissolve and can cling to insects, but also to clothing, skin and foods. Nearly every home in the nation contains some registered pesticide. Among all chemicals pesticides have the longest history of scientific inquiry to understand their health and environmental effects and to manage human

exposure and associated illnesses. Despite these efforts, everyone in the nation still carries pesticide residues in their tissues and tens of thousands of people report their exposures to poison control centers each year. Understanding the successes and failures of pesticide law could help to guide effective control of plastics and the larger chemical universe just described.

The history of Vieques, a small island off the east coast of Puerto Rico illustrates how the nation's consuming pursuit of national security produced severely degraded military sites. The US government in 1941 chose Puerto Rico as an Atlantic Basin counterpart to the Pearl Harbor naval base and acquired land for training and conventional weapons testing. The island has long been home to 9,000 residents who have lived between a munitions training range on the east end and weapons storage bunkers to their west. US and allied forces bombed and shelled the east end of the island for 50 years releasing nearly 150 million pounds of munitions, chemical warfare agents, depleted uranium, pesticides, solvents and fuels. The Navy closed the facility and left the island in 2003, leaving behind an enormous burden of chemical wastes and a cratered, toxic moonscape created by the explosions. The toxic substances continue to seep into the coastal environment as they have for nearly half a century.

Vieques is hardly unique as a recipient of government abuse. The US Congress in 2005 estimated that 50,000 sites under the authority of the Departments of Defense, Energy and Interior are intensely contaminated. Costs to contain site hazards but not restore their original conditions, were then projected to be at least $337 billion. Some bases lie on remote islands such as Pacific atolls or the Aleutian Islands in Alaska, while others include highly urban settings such as Hunter's Point Naval Shipyard in San Francisco. Most of these sites are being transferred to private developers for homes, schools, offices and parks without being fully restored to their pre-military and far more natural condition. The Defense Department has often left a toxic chemical soup behind for surrounding communities that have neither to expertise nor resources to identify the precise threat to their human health.

The last history we considered is that of vehicle emissions. The US fleet by 2008 exceeded 240 million motor vehicles, one for every person in the nation eligible to drive. This passion for movement has had an important effect on air quality, human health, climate change, and national dependence on foreign oil. By 2007 US vehicles consumed twice the amount of petroleum produced in the nation. Each year US drivers burn almost 175 billion gallons of fuel as they travel 2.5 trillion miles. They accomplish this remarkable act while sitting less than ten feet from exhaust pipes emitting highly hazardous chemicals to the air. I recently sat on the freeway between Los Angeles and San Diego while traffic was either crawling or stalled in both directions in all 14 lanes. Several thousand drivers idled or crept along for several hours while inhaling each other's emissions. This is considered a normal "rush hour" in Southern California leaving most who experience it exasperated by the wasted time but unaware of their loss of health.

Vehicle exhaust can cause and exacerbate human respiratory illness and public acceptance of these trends rests on a collection of false impressions and collective ignorance that grew from a failure to test new technologies before allowing them to work into the fabric of daily life and human tissues. These include beliefs that: any individual's contribution to the problem is inconsequential; fuel chemistry could have little effect on health; gradual improvements in new model vehicle engines have improved air quality; pollution is dangerous only if visible; living, working or exercising near highways creates no special threat to health; chemical concentrations should be averaged across large regions and time periods to judge the severity of health threat; pollution only threatens respiratory health; and that risk of health loss is uniformly shared in the population. Within the seminar we challenged all of these premises, while exploring the growing burden of air pollution on health.

* * *

The protagonists in this seminar included the Atomic Energy Commission (AEC), the Department of Defense (DOD), and the plastics, pesticide, and vehicle industries. The similarities in their patterns of environmental neglect and public deception are surprising. Each organization thought carefully and creatively how it could shape favorable public perceptions of their products or programs. Whether government official or corporate leader, each developed "narrative advantage" by controlling scientific inquiry that often included conscious choices to avoid investigation. They explained results in stories claiming the benefits and safety of their actions and that any risks were easily recognized and managed. These narratives had profound influence in forming public acceptance of technologies, products, or practices that left many exposed and ill. Their stories were difficult and costly for skeptics to contest, and they left responsible parties unaccountable for damages. The concentration of authority, wealth, and expertise overwhelmed competing interpretations of risk.

Secrecy played a special role in the histories allowing both the public and private sectors to control imagery and representations of danger, remaining unchallenged. Claims of safety were inflated while hazards were either neglected or hidden from the electorate or consumers. The primary intent of trade secrecy and classified information is to protect competitive advantage either in markets or international relations. The effects are menacing; secrecy ensures that the public will be ignorant of hazards. Secrecy empowers public and private officials. It also creates false impressions of naturalness, wildness, purity, and safety and led generations to experience dangerous environments without their knowledge or consent. Yet all secrets have limited lifecycles, and gradually the credibility of government and corporate narratives disintegrated as independent scientists challenged claims of safety with new evidence; or they developed credible alternative interpretations of information disclosed by governments or corporations. The effect was new understanding of the sources danger, patterns of human exposure, and the seriousness of health effects. And this new understanding led government officials to ban

numerous chlorinated pesticides, to stop testing nuclear weapons in the atmosphere, and to eliminate lead from paints and gasoline.

The case studies we examined also illustrate how understanding the vulnerability of children affected government choices to ban risky products or programs. Regulators in all of these instances justified intervention based upon belief in children's heightened susceptibility and exposure. Before you conclude these are success stories, consider carefully that decades often passed before convincing challenges to conventional wisdom led to regulatory action. This delay between chemical release, problem recognition, and government response often induced widespread and serious environmental damage and health loss. If thorough testing of chemicals or technologies had been required prior to their deployment, and if the government reacted by controlling chemical testing, production, sales, and environmental release, the chemistry of the planet and our bodies would be very different.

Together in the seminar we imagined a world where everyone understands the distinction between the dangerous and the benign. This would demand knowledge of chemical presence in everyday environments such as foods, air, water, soil, buildings, and consumer goods. It would also require understanding the association between exposure and the likelihood of health loss. The gulf between what we know and what we need to know is what might be termed the "intelligence deficit". We struggled to explain its origin, prevalence, and causes. The Fellows' curriculum units provide excellent examples of innovative and inspired teaching methods to address these challenges.

The most fundamental antidote is what we termed "green intelligence". To us this meant not just information but the capacity to interpret it to judge the nature and severity of environmental threats to human health. Only if this intelligence exists could prevention become a possibility. Teaching society how to navigate safely among life's imperceptible chemical dangers will demand an enormous investment in public science to produce basic knowledge of chemical behavior and hazard. Students need to be taught to integrate and interpret this information historically, ecologically, and in narrative form. All are necessary to make sense of otherwise overwhelming complexity.

Why do we all carry residues of synthetic commercial chemicals such as plasticizers, pesticides, and pollutants in our bodies? Didn't Congress pass laws to prevent this? What ethical principles should guide corporate and government behavior to create more sustainable urban environments? While waiting for more responsible leadership, how can you learn to reduce your personal exposure, and how could your teach these lessons to students and others? I urge you to read the Fellows' curriculum plans that follow as you will discover many of the answers.

John Wargo

See www.cdc.gov/exposurereport/3rd. See also: www.ewgoorg/reports/bodyburden/.

Sexton, K, Needham, LL, Pirkle, JL. 2004. Human Biomonitoring of environmental chemicals. American Scientist 92: 38-45.

US Bureau of Economic Analysis, May 26, 2005. Web: www.bea.gov.

US Census. 2002. Demographic trends in the twentieth century. http://www.census.gov/prod/2002pubs/censr-4.pdf.

American Chemical Society. 2007. CAS. See. European Union White Paper on the strategy for a future chemical policy. European Inventory of Existing Commercial chemical Substances.

Synopses of the Curriculum Units

2008.07.01
What Is She Eating?, by Myrna Alvarez

No matter where we live, how old we are, or what we do, we have at least one thing in common, we need food to survive. Food will always be a part of our lives. Majority of food provides a feeling of fullness and satisfaction, and, we seldom consider its implications to health and the environment.

Why should we care about what we eat? What chemicals are in food? How do these chemicals affect human health and the environment? What recommendations can students make for the school cafeteria to offer better choices? These are the key questions that this unit will try to explore.

This unit addresses the State Science Standards that focuses on the importance of the nature of science and scientific inquiry. Class activities that will engage students to the processes of the nature of science and scientific inquiry includes; reflecting on their own diet, analyzing the various chemicals found in foods, identifying the three major nutrients needed by the body, discovering chemicals that leach from plastic containers and contaminate foods that result to disorders and diseases, visiting and observing a landfill, and preparing a school-lunch program plan.

This unit is recommended for tenth grade chemistry class.

(Developed for Biology, grade 9 and Chemistry, grade 10; recommended for Biology, grade 9 and Chemistry, grade 10)

2008.07.02
Eat, Drink, and Be Wary: Recognizing Toxic Chemicals in Foods and Beverages, by Ram Bhagat

Eat, Drink, and Be Wary is an inquiry-based unit designed to connect high school Chemistry students to relevant environmental issues. The primary purpose of this unit is to explore the effects and potential dangers of plastic packages on environmental and human health. My overall goals are to motivate urban minority youth to develop creative problem-solving skills and enhance their social and emotional intelligence through the performing arts, particularly drumming.

Yet, the underlying goal of the unit is to stimulate youth activism. To engage my students in this experiential unit, I will focus on an array of plastic packages used for various foods, beverages, and cosmetics that American teenagers consume. In order to build the momentum of my students, towards involvement in social change, I will integrate this

unit into three sections of the course (atomic structure, nomenclature, and molar relationships).

During the final stage of this educational process, I will guide the students in the production of an Eco Arts and Science Project that demonstrates the knowledge and insight gained throughout the semester. Ultimately, I want to inspire my students to formulate a viable set of solutions to the mounting problems associated with single-use plastic H2O bottles.

(Developed for Chemistry, grades 10-12; recommended for Chemistry and Environmental Science, grades 10-12, and Human Anatomy, grades 11-12)

2008.07.03
Relating Air Quality and Prevalence of Asthma in Children, by Ella Boyd

This unit is meant for a middle school science classroom, but could be adapted for upper elementary grades. The primary purpose of the unit is to look at the air quality in our county and relate it to human health, particularly respiratory health. There will be a focus on lung function, particularly how oxygen and carbon dioxide are exchanged in the alveoli. There will be a focus on asthma and how students can look at daily air quality data to help them make decisions about whether or not to spend time outdoors on a certain day, particularly if they plan to exercise. This unit is also meant to make students aware of environmental issues and how all individuals can have an impact on what goes into our air. Students need to be the catalyst for change in their own homes and neighborhoods. They will be looking at the habits of their own families and try to make changes that will reduce the amount of pollution going into our air.

(Developed for General Science, grade 7; recommended for General Science and Earth Science, Middle School grades)

2008.07.04
Our Environment: A World Away?, by Michell Carter

I want my fourth grade gifted students to be more aware of what they are throwing away, how their trash is affecting the environment and their health, and to see an overall reduction in the amount of food packaging in the wastebasket. I will assess this by having the students collect data on the amount of food wrappers being thrown away in the fourth grade and to draw conclusions via researching the most common plastic found in our trash and discovery lessons about the implications for the environment and human health. Next, they will design a new recycling labeling system for plastic and create a campaign to encourage the use of reusable food containers (hopefully an easy to conclude solution). Finally, they will continue to collect and analyze data on food wrappers to see if there is indeed a reduction due to campaign efforts by asking the questions: Did I make a

difference? How can I find out? If not, how could my campaign be more effective? If so, how can I get more people to make the switch to reusable packaging?

(Developed for Gifted, grade 4; recommended for Gifted and Regular Elementary Education, Reading, and Science, grades 4-5)

2008.07.05
Considering Case Studies of Chemical Contamination, by Jeffrey Davis

Students will learn how environmental disasters can happen, what the costs and consequences are, and how they can ascertain culpability. They will watch *Civil Action* to see how the system works when companies and citizens do battle. They will study the Exxon Valdez disaster, Hurricane Katrina and her aftermath, the plutonium contamination of Acid Canyon in Los Alamos, and the current oil drilling controversy in the Galisteo Basin in Santa Fe County. In addition, we will learn how to analyze case studies through short, simple cases on ethical situations. They will also work with a model aquifer to see how the water table reacts when substances are introduced. Finally, they will learn public speaking by listening and debating. We will have a good time learning important skills and standards.

This unit can be taught with a few different emphases; the properties and behavior of matter, hazardous chemicals and the environmental consequences of waste, and civics, economy, communication, and rational reasoning. Useable strategies in teaching the unit include case studies, guest speakers, debaters, presenters, and field trips. We will also use the Internet for research, a model aquifer, and student presentations.

(Developed for Science and Social Studies, grade 5; recommended for Science and Social Studies, grades 5-10)

2008.07.06
Life Cycle Analysis of an ordinary plastic water bottle, by Jennifer Esty

The ninth grade integrated science curriculum spends an entire quarter of the year exploring polymers, including plastics. This unit will be used to teach most of the topics in the second quarter.

The unit will begin with an introduction, which is designed to show the students generally where we are going with the unit. The family history section will come next as a way to introduce students to the concept that humans have existed for thousands of years without plastic water bottles. The conceptions phase of this unit is about the bottle design. The design of an object has a large impact on how easily the object may be reused or recycled at the end of its life, so this phase is really the beginning of the life cycle, as it largely determines the eventual fate of the bottle. The section on the birth of the bottle

discusses how the chemicals that make up a bottle came to be and come together. Adolescence in a bottle is the time when the character of the bottle is formed, in this case the physical processes that are used to transform the amorphous PET into the bottle itself. Adulthood, and the working life of the bottle, follows, after which, seniority ensues. The discussion about seniority will focus on how bottles can be reused and if they really should be reused. Finally, death, and the possibility of recycling if you like are discussed, which brings back the idea of the importance of design which was discussed at the very beginning of the unit.

(Developed for Integrated Science, grade 9; recommended for General Science, grades 6-10, and Chemistry, grades 9-12)

2008.07.07
Mercury: An assessment of its life, by Elizabeth Harvey

Mercury is as ubiquitous as it is toxic, but people don't know where it is, what it is, or what we can do to change levels of it in the world around us. To a great extent, we also may not know how to regulate our exposure. The purpose of this unit is to teach learners about the natural and anthropogenic ways that mercury cycles through our environment, to teach about the different types of mercury, and to teach about the different impacts that mercury in the environment has; on top predators in a food chain, on the ecosystem as a whole, and on human health. Additionally, the unit examines that mercury is a known pollutant with health risks, yet is still is widely used to make energy efficient and electronic devices. The final outcome of the unit of study will be an action plan- learners will be active in changing the status of mercury in the environment by building a recycling plan than allows the community to recycle electronics in our school. Additionally, learners will understand that individual choices balance risk, and that to navigate decision making, the risk involved in all factors must be known and assessed.

By looking at different types of pollutions and green technologies as systems of decisions and actions, and balancing themselves and their decisions within those systems, they can learn to make decisions that are more positive for the environment, and they can learn to share that information with the greater community, further solidifying their roles as active participants in society. Furthermore, they'll realize that each decision has a risk/benefit analysis which is never simple. When you realize the complexity of the decisions involved, you're able to make informed decisions because you're able to look at both sides of an issue. This lofty goal is one that I hope to achieve using this unit.

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

2008.07.08
Many Neighborhoods -- One Community: Learning Chemistry through the History of the Hunters Point Naval Station, by Sally Meneely

The purpose of this unit for me is to motivate students to practice thinking scientifically about things they already care deeply about: their safety in their homes and communities in relation to knowledge they gain about elements and compounds. The topic for this unit will be the historic use and current status of the Hunters Point Naval Station in San Francisco and its ongoing effects on local air and water quality, as well as its impact on potential future use of the area. My goal in bringing this topic to my classroom is to relate it to our study of characteristic properties of elements and compounds to events and conditions in the world, specifically my students' world. To understand and interact safely with any urban land area, its historic uses should be known. The fact that those historic uses involve toxins and may very likely be negatively impacting the health of many people, should be known by not only the adjacent neighborhood, everyone in the San Francisco community has the responsibility to become aware of such hazards.

2008.07.09
The Effect of Vehicular Emissions on Human Health, by Ronni Rossman

Air pollution can be caused by the release of small particles into the air or by noxious gases being released into the atmosphere, whether by natural or fabricated sources. These gases include methane, carbon monoxide, sulfur dioxide, nitrogen oxide, or chemical vapors. The gases can also lead to a chain-reaction event that includes acid rain, smog, and the greenhouse effect. If left unchecked, the chemical aspect of air pollution could become the largest contributor to premature death in the world, higher than the rate of cancer, AIDS, automobile accidents, or any other cause of unnatural or premature death. Most people make the assumption that the greatest single cause of air pollution is the big factories that dot our landscape, especially in our big cities, however, the greatest single contributor to the pollution problem facing not only the United States but also the entire world is automobile emissions which come mainly from cars and other types of automobiles, as well as off-road vehicles. In 2006, the United States was responsible for 21.3% of all cars registered in the world, with a total of 135,047,000 cars. It was also responsible for 42.7% of all the trucks registered in the world, with 108,975,000 trucks registered This curriculum explores, in depth, a number of the specific pollutants and their resulting health issues released from on- and off-road vehicles, and is designed for use in the mainstream high school classroom.

Developed for Life Science, Grade 7; recommended for Biology I and II and Chemistry, grades 9-12, Health Sciences and Environmental Science, grades 8-12)

2008.07.10
Environmental Health Issues Meet Algebra, by Nancy Rudolph

The last time you grabbed an apple, rinsed it off and took a bite, did you think about pesticide residues on it? If your food was not labeled "Organic" it came to you with pesticide(s) added. In this unit, I want my students to learn about potential health risks from common pesticide products in order to make informed decisions about their use and consider "green" alternatives. In the process of learning about health risks from pesticides, I will interject mathematics. Students will use government-published data to consider their potential level of exposure to pesticides from multiple sources: ingestion (food or water), inhalation (breathing), and dermal (skin contact). A critical math skill necessary for these calculations is converting units; therefore, the overriding mathematic theme of this unit will be Dimensional Analysis, sometimes referred to as the Factor-Label Method. This unit, as written, can be used for math students in middle or high school; however, the data sources referenced in this unit can also be applied to Statistics, Algebra 2, and even Pre-Calculus math courses. The unit also makes connections to English and Science with suggested reading activities and practice interpreting tables and graphs.

(Developed for Intermediate Algebra and Pre-Calculus, grades 11-12; recommended for Math, grades 7-12, and Science, Physical Science, Chemistry, Physics, and Environmental Science, grades 9-12)

2008.07.11
Effects of Plastics on Top Predators' Health, by Francisca Sorensen

Most reports indicate that nearly 100 billion pounds of plastic are produced in the United States each year. They are found in everything from the packaging of food and beverages to furniture, toys; medical devices, building products, electrical wiring and vehicles. Mention is made to their durability and effects on the environment as well as the consequences that two of the compounds found in plastics: Diethylhexylphtalate (DEHP) and bisphenol A (BPA) have on normal endocrine systems in different species of animals. A number of animal case studies are presented here along with the substantiating findings that point to the deleterious effects that the aforementioned compounds have had on them. This short analysis is designed to create awareness in teachers in the hope that the information will reach their students and their parents. Perhaps together we will be able to assist in finding ways to combat the growing threat to the earth's biota.

(Developed for Science and Social Studies, grade 2; recommended for Science and Social Studies, grades 2-5)