

Curriculum Units by
Fellows of the
Yale-New Haven Teachers Institute
Guide
2009

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Preface

In March 2009, fifty-six teachers from twenty-seven New Haven Public Schools became Fellows of the Yale-New Haven Teachers Institute to increase their preparation in their subjects and to develop new curricular materials for school courses. Established in 1978, the Institute is a partnership of Yale University and the New Haven Public Schools, designed to strengthen teaching and improve learning of the humanities and the sciences in our community's schools. Through the Institute, Yale faculty members and school teachers join in a collegial relationship. The Institute is also an interschool and interdisciplinary forum for teachers to work together on new curricula.

The Institute has repeatedly received recognition as a pioneering model of university-school collaboration that integrates curriculum development with intellectual renewal for teachers. Between 1998 and 2003 it conducted a National Demonstration Project to show that the approach the Institute had taken for twenty years in New Haven could be tailored to establish similar university-school partnerships under different circumstances in other cities. An evaluation of the Project concluded that new Institutes following the Institute approach could be rapidly established in other communities. Based on the success of that Project, in 2004 the Institute announced the Yale National Initiative to strengthen teaching in public schools, a long-term endeavor to establish exemplary Teachers Institutes in states throughout the country. In 2009 *An Evaluation of Teachers Institute Experiences* established that such Institutes promote precisely the teacher qualities known to improve student achievement and epitomize the crucial characteristics of high-quality teacher professional development. Moreover, Institute participation is strongly correlated with teacher retention. In New Haven, Institute participants were almost twice as likely as non-participants to remain in teaching in a New Haven public school.

Teachers had primary responsibility for identifying the subjects on which the Institute would offer seminars. Between October and December 2008, Institute Representatives canvassed teachers in each New Haven public school to determine the subjects they wanted the Institute to address. The Institute then circulated descriptions of seminars that encompassed teachers' interests. In applying to the Institute, teachers described unit topics on which they proposed to work and the relationship of those topics both to Institute seminars and to courses they teach. Their principals verified that their unit topics were consistent with district academic standards and significant for school curricula and plans, and that they would be assigned courses in which to teach their units in the following school year. Through this process five seminars were organized, corresponding to the principal themes of the Fellows' proposals. Between March and August, Fellows participated in seminar meetings, researched their topics, and attended a series of talks by Yale faculty members.

The curriculum units Fellows wrote are their own; they are presented in five volumes, one for each seminar. A list of the 192 volumes of Institute units published between 1978 and 2009 appears on the following pages. The units contain five elements: objectives, teaching strategies, sample lessons and classroom activities, lists of resources for teachers and students, and an appendix on the academic standards the unit implements. They are intended primarily for the use

of Institute Fellows and their colleagues who teach in New Haven. They are disseminated on Web sites at yale.edu/ynhti and teachers.yale.edu. Teachers who use these units may submit comments at teachers.yale.edu.

This *Guide* to the 2009 units contains introductions by the Yale faculty members who led the seminars, together with synopses written by the authors of the individual units. The Fellows indicate the courses and grade levels for which they developed their units; many of the units also will be useful at other places in the school curriculum. Copies of the units are deposited in all New Haven school libraries. Guides to the units written each year, a topical *Index* of all 1744 units written between 1978 and 2009, and reference lists showing the relationship of many units to school curricula and academic standards are online at yale.edu/ynhti.

The Yale-New Haven Teachers Institute is a permanently endowed unit of Yale University. The 2009 Institute was supported also in part by grants from the Howard Hughes Medical Institute and the National Science Foundation. The New Haven Public Schools, Yale's partner in the Institute, has supported the program annually since its inception. The materials presented here do not necessarily reflect the views of the funding agencies.

James R. Vivian

New Haven
August 2009

I. Writing, Knowing, Seeing

Introduction

How does writing help us know what we see? By considering the theoretical bases of that question, Fellows in this seminar developed curriculum units that explore its practical implications. Because our analysis treated not only the physical act of seeing but also vision as a metaphor for understanding – as in “I see what you mean” – we examined both what looking closely at an object can teach the viewer and how the act of writing fosters comprehension. The ordering of the three terms in the title of the seminar was meant to encourage new ways of conceiving the relation between perception and articulation. Art critic and cultural theorist John Berger famously began his *Ways of Seeing* (1972) with the statement “Seeing comes before words.” Rather than proposing that students see first and write later, however, the curriculum units presented in this volume often acknowledge that writing comes before seeing.

Arguments that make claims for the importance of visual stimuli and the complexity of visual processes would be difficult to refute. We live in a culture increasingly dominated by information and misinformation presented in pictorial forms: the Internet is only the most obvious example of a medium whose flood of constantly changing images now threatens to make genuine comprehension seem impossible. According to psychologists, approximately 80% of what we know about the world comes to us through our eyes. The same experts explain that vision is not a matter of processing full and continuous physical data registered on our retinas; rather, our minds create the illusion that sight provides a detailed and comprehensive report on the external world. Moreover, because seeing also depends on words, sight is an even more complicated mechanism than scientists understand it to be. As Annie Dillard explains in *Pilgrim at Tinker Creek* (1974), “Seeing is of course very much a matter of verbalization. Unless I call my attention to what passes before my eyes, I simply won’t see it. It is, as Ruskin says, ‘not merely unnoticed, but in the full, clear sense of the word, unseen.’” If one does not test what one knows about what one sees by turning it into words, then it is, according to John Ruskin, the nineteenth-century sage whom Dillard quotes, simply “unseen.”

Fellows in this writing seminar explored in particular the relationships between what Dillard calls “seeing” and “verbalization” as they manifest themselves in the kinds of academic writing that involve observation, analysis, and argumentation. Although we read the work of authorities in the disciplines of cognitive science, media studies, and aesthetics, we quickly turned theory into practice, developing several questions that came to guide our work together: How does focusing on vision help our students become better writers? What does looking at an image or an object do for the teacher of writing that cannot be accomplished by examining words alone? The units collected here offer a number of different answers to those questions, resulting in part from the fact that this seminar, in its form and content, resembled both a course about writing and a course about the teaching of writing: constituting themselves as members of a writing workshop, the Fellows put into practice the assumptions and ideas about writing that we discussed. Analyzing their written exercises provided a kind of meta-commentary on the presuppositions and goals of specific assignments; from such discussions there often emerged new ways to craft prompts to be used with students. The success of the efforts of these Fellows

to be both skilled writers and effective teachers is, I think, evident in many of these units: striking insights conveyed in memorable turns of phrase, elegant and apparently effortless organization of complicated arguments, and instances of a thoughtful concern for the interests of their readers – all these qualities frequently characterize these units.

During two particularly enlightening sessions, the participants in this seminar benefited from the generosity of two of Yale's most gifted experts in the area of visual literacy: Barbara Rockenbach, Director of Undergraduate and Library Research Education at Bass Library, and Linda Friedlaender, the Curator of Education at the Yale Center for British Art. Both of them demonstrated in different but complementary ways a lesson of great importance for anyone who teaches visual material: students need to be encouraged to talk freely and expansively about a visual object without being given any information about it that would influence what they might or might not say. Sharing with us a photograph from World War II, Barbara Rockenbach was careful not to identify its subject until we had had a chance to notice and to comment upon many of its intriguing and perplexing details as well as speculate on their possible implications. Similarly, during our visit to the Center for British Art, Linda Friedlaender invited us to sit in front of an impressive full-length portrait and think aloud as a group. Never explaining that we were looking at a commissioned portrait by Sir Joshua Reynolds, she gave us a chance to identify details that made us more and more curious about both the formal qualities and the cultural significance of the painting. Many of the individual projects pursued by the Fellows in this seminar adapt the practices demonstrated by Barbara and Linda, thereby expressing their gratitude to them for sharing with us their knowledge of both visual texts and visual pedagogy.

The curriculum units collected here fall into three distinct, but often overlapping groups. Many specific topics are broached again and again: the role of visualization in reading and writing, the relation between word and image, and the power of visual materials to motivate students to talk and to write in analytically productive ways. Each unit, however, demonstrates the distinctive gifts and interests of its author, and my account here can point out only the most obvious of the diverse strengths that each project possesses.

In the first set of units, each written by a middle-school teacher, Ekaterina Barkhatova and Caitlin Dillon and Deirdre Prisco use the extensive research that they did to inform lessons that translate theory into practice. Offering insightful accounts of vision and language acquisition, Ekaterina develops an inventive plan to help bilingual students strengthen their ability to write academic prose. By using photographs that depict migration and immigration, she offers a unit that is a model of cross-disciplinary study, including the areas of language arts and social studies and, through the phenomenon of marching penguins, the sciences. Caitlin turns to cognitive science to examine how experiences contribute to different kinds of mental models and to theorize about the relation between visualization and verbalization, comprehension and retention. One of her most telling points, drawn from research done by those who developed the teaching method called Visual Thinking Strategies, proves that the skills that students develop when they work with visual materials transfer to and therefore enhance their abilities as readers. Caitlin creates a series of lessons that move logically and productively from visual to verbal and from verbal to visual, using photographs and paintings in a clever and engaging fashion. Deirdre also makes use of the findings of cognitive science as the basis of her account of how to incorporate visual journaling in one's lessons: by exploring the relation between visual experience and the

processes of memory and attention and visualization, she argues persuasively that allowing students to create images is a way of helping them use words. Her unit contains an admirably wide and diverse array of exercises that teachers can adapt for their classes in a range of subjects and at a number of grade levels.

The units in the next group turn to specific subjects taught at the high-school level. Proposing a unit to be used in his psychology course for eleventh- and twelfth-graders, Justin Boucher offers a particularly convincing way of understanding what happens when a student writes by demonstrating the similarities between the processes of sensation, perception, and cognition and the processes of seeing, knowing, and writing. Explaining that writing is a “form of cognition,” Justin presents a carefully structured series of increasingly demanding exercises; and he bases them on the assumption that students should think about writing with as much self-conscious attentiveness as they are asked to offer the material in their psychology textbooks. In the next two units, Leszek Ward and Melissa Dailey prove that emphasizing the visual qualities of a Shakespeare play, both as enacted on the stage and as communicated on the page, encourages students to think about problems that go well beyond the realms of literature and history. Constructing lessons dealing with *The Tempest* for the eleventh- and twelfth-grade students in his literature classes, Leszek encompasses an admirably wide range of materials, from Renaissance theatre history to portrait painting and contemporary film adaptations. Arguing that literature, in this case in the person of Prospero, has the power to change one’s perspectives and therefore one’s knowledge and understanding, his unit engages such diverse issues as forgiveness, criminality, and cross-cultural misunderstandings. Melissa, in her plans to teach *Hamlet* and *Macbeth*, makes a case for the similarities of the challenges faced by the two tragic heroes of those plays and by her students: in her account, both “the illusory world of the spiritual” that Shakespeare conjures up and “the illusory world of the Internet” pose dangers that students need to be encouraged to consider. The final unit in this group responds, as Melissa’s does, to an article by N. Katherine Hayles, “Hyper and Deep Attention: The Generational Divide in Cognitive Modes.” Hayles proposes that today’s students are “hyper”-attentive learners: because all the various visual technologies available to them have trained them to respond simultaneously and quickly to different sources of stimuli, they have trouble mustering the “deep attention” required for extended, solitary, and quiet acts of reading. By asking how visual images of the kinds of behavior that express love can help her students move from the hyper to the deep, Marialuisa Sapienza demonstrates her understanding not only of two different ways in which students attend to the world but also her awareness of the great variety of skills and experiences that students bring with them to the classroom. Her unit is a model of how to create intellectually coherent but diversified lessons that account for such differences.

The last three units were written by Mary Lou Narowski and Alice Smee and Deborah Boughton, and the first two also respond to Hayles’s theories about hyper and deep attention. Mary Lou proposes to ask students in her seventh-grade language-arts classes a deceptively simple question, What is art? That question becomes the basis for analysis of 9/11 photographs and well-known masterpieces of Western painting; the unit concludes with an exercise in argumentation that asks students to choose and to defend the objects that they want to include in a classroom art gallery. Like Mary Lou, Alice suggests that working with visual materials in middle-school grades can be a way of lessening the stress that students often feel when they are required to write. By starting with the kinds of visual media that are so much a part of her

students' lives, Alice hopes to teach them the importance of visualization as a way of strengthening both their engagement in what they write and their abilities to elaborate on and prove their written assertions. Deborah's unit provides a fitting conclusion to this volume because she explicitly coordinates the goals and practices promoted by Visual Thinking Strategies with the goals and practices of literary analysis. She also makes good use of the resources that Yale has to offer teachers in the New Haven school district and beyond: her lessons on the ambiguities in visual and verbal texts include images from a past exhibition at the Yale Center for British Art, images available to all teachers on the Center's Web site, as well as paintings in its permanent collection.

Finally, a note of gratitude to the members of this seminar: talking with them over a series of weeks and months has allowed me to rethink how I teach writing to college freshmen in ways that I never could have predicted before our sessions began. Impressive examples of dedication, insight, and resourcefulness, these Fellows have encouraged me to revise – to see again from wholly new perspectives – how to use visual images and visual phenomena as catalysts for writing instruction. My students this fall will no doubt be the beneficiaries of the Fellows with whom I have had the pleasure to work – as will be, I predict, anyone who reads the units collected here.

Janice Carlisle

Synopses of the Curriculum Units

09.01.01

I Came, I Saw, I Wrote: An Interdisciplinary Writing Unit for Bilingual Students, by Ekaterina Barkhatova

The possibilities of visual materials are investigated as sources of constructing new meaning in teaching writing to bilingual students in grades five through eight. The content of photographs is united by one theme – migration and immigration – that covers three disciplines: language arts, social studies, and science. The unit assists teachers working with English Language Learners with the teaching of writing – a highly demanding cognitive skill. Along with the main goal – to teach writing about something what one sees in a photograph – the unit aims to enhance students’ oral language and improve their reading skills. Its theoretical part offers extensive research on the subjects of vision and photography. To ensure students have the contextual knowledge necessary to interpret a visual image, writing about a photograph is preceded by reading short texts on migration and immigration in the three content areas. The strategies in this unit are based on the premises that our vision is constructive and that students should be able to construct their own meanings of photographs that they study. Using writing strategies in a three-step process, they will write about their interpretations based on their prior knowledge and on the emotions aroused by an image.

(Developed for English as a Second Language, grades 5-8; recommended for English as a Second Language, grades 5-8)

09.01.02

See It Again for the First Time, by Caitlin M. Dillon

As a seventh-grade Language Arts teacher I face difficulties teaching students to (1) observe details (well), (2) form visualizations that are sufficient for comprehension and retention of images/texts, and (3) demonstrate age-appropriate levels of critical thinking. Research has led cognitive scientists to conclude that when we see an image or read a text, we construct mental representations of the characteristics of the image or the description provided by the text, and use those mental representations to retain characteristics of the image or text in memory. We use the mental representations to make connections, comparisons and inferences, and to draw conclusions. When students are given practice observing details in visual images and are guided toward making inferences about their observations, they develop greater ability to observe images and texts, retain their observations and inferences in memory, and develop critical thinking skills. This unit is intended to help build comprehension and retention skills by enhancing observation and visualization skills, using oral and written responding to visual and written texts (e.g., the painting and the poem entitled *The Midnight Ride of Paul Revere*). It could be taught for two to three weeks or as individual lessons, and is adaptable for students of any level.

(Developed for Language Arts and Writing, grades 6-8; recommended for Language Arts and Social Studies, Middle School and High School grades)

09.01.03

Visually Speaking: Using Visual Journaling to Build Elaboration Skills in Writing, by Deirdre Prisco

Worn out, overused verbs and adjectives fill students' writing. This unit is designed to develop elaboration skills through the use of visual journaling which combines images and text. For many students who have a dread of writing, visual journals can increase the flow of words by providing images. The visual journal is a creation of observations and reflections designed to increase awareness of details in order to build better elaboration skills. Research has shown that strong visual-verbal connections develop better thinking skills, expand vocabulary and improve the quality of writing with elaboration. This unit addresses the needs of all learners with the opportunity for differentiated instruction. The unit promises to be highly motivating to all students, especially those who struggle with writing. It allows students and teachers to move beyond standardized test instruction. Although the unit was created with middle-school students in mind, the unit can be adapted for any grade level. It can be implemented as weekly or monthly supplemental lessons to the language arts curriculum or as a unit autonomously.

(Developed for Language Arts, grade 7; recommended for Language Arts, grades 5-12)

09.01.04

Using the Writing Process to Teach Sensation, Perception and Cognition, by Justin M. Boucher

All writing is based in the knowledge and experiences of the writer. Writers develop their unique perspectives through a lifetime of sensations and perceptions. This interaction is obvious to writers and teachers, but it is seldom the focus of units purporting to teach the writing process. Units on writing frequently focus on the process of composition and its products. This focus on the writing rather than the writer misses an important aspect of the writing process. Writing is a form of cognition. It is a thought process. Thus a great deal could be gained from studying the psychological concepts that result in writing.

This psychological understanding of writing allows teachers to approach writing from a different angle. Specifically, this unit will be based in sensation, perception and cognition with the goal of using focused writing instruction to help students understand both the psychology of writing and the writing process itself. There is a strong link between the three parts of the writing process (seeing, knowing, and writing) and these three psychological concepts. Furthermore, this link is reciprocal, allowing for a deeper understanding of the writing process and subject matter.

(Developed for AP Psychology, grades 11-12; recommended for AP Psychology and Psychology, grades 11-12)

09.01.05

Controlling Sight and Knowledge in *The Tempest*, by Leszek H. Ward

Students are often unaware of the powerful influence “artists” exert on their daily lives and the extent to which their understanding of the world around them is limited by what they see. Studying

The Tempest can help remedy this situation by providing students with a powerful metaphor for the artist in the character of Prospero, who is able to use his magical arts to control and manipulate what other characters in the play see and know. Seeing becomes a metaphor for understanding as students are asked to evaluate how various characters see each other, how the audience sees the play, how Europeans saw indigenous peoples, and how students themselves see criminals in need of forgiveness. In each of these situations students will evaluate the extent to which what is seen determines what is known and learn that our frequently limited perspectives often lead to imperfect understandings. The variety of strategies used to achieve these objectives include journals, reading logs, seminar discussions, artistic analysis, and acting.

(Developed for Shakespeare, grades 11-12; recommended for Literature and English, grades 11-12)

09.01.06

Technology and Shakespeare: Writing, Researching, Knowing, by Melissa A. Dailey

Students will study vision, interpretation and action in the plays *Macbeth* and *Hamlet*. Through textual analysis and writing, students explore the intersection of seeing and knowing. In the current technological age, it is of growing importance that we think critically about what is presented to us via the Internet, the cell phone, and television. My eleventh- and twelfth-grade students utilize these forms of communication daily. I intend to use classic literature to draw a connection between what we see, how we interpret it, and how we react to it. Using *Hamlet* and *Macbeth* as the central texts, the class will evaluate how the characters Hamlet and Macbeth base their actions on visions that may or may not be valid. In the cases of Hamlet and Macbeth, the decisions they make based on what they see have grave results. Through exploration of these characters, students will evaluate how vision can be problematic for them as well. The saturation of technology in these students' lives requires them to evaluate the quality, validity, and at times the safety of what is presented to them. They often act on what they see, and if they do not do so in an analytical and ethical fashion, their actions may be harmful to themselves or others. Examples range from spreading a hurtful, inaccurate rumor to being accused of trafficking child pornography through "sexting." Therefore, this three-week unit helps students become critical viewers when it comes to technology and critical readers when it comes to literature.

(Developed for English 3, grade 11, and AP English, grade 12; recommended for English 3, grade 11, and English 4, grade 12)

09.01.07

Love: The Art of Seeing, Knowing and Writing Today and in the Past, by Marialuisa Sapienza

Love is a feeling or an emotion, but it can also be positive attitudes and behaviors. Our retina will never construct the image of love because it is not a physical object. However, being in love leads to behavioral changes we can see and describe. The unit starts with the following essential questions: "What do I see? What do I notice? Is this love?" It includes a visual section that primarily teaches students to see details, interpret them, infer, analyze the context, and discuss what an artist/author wants to communicate with a visual image. A second section focuses on

critical thinking and takes into consideration the following essays: “Seeing” by Annie Dillard, “I Want a Wife” by Judy Brady, “The Breakups That Got Under My Skin” by Kerry Cohen published in *The New York Times*, and the novel *Great Expectations* by Charles Dickens. The objective is to enhance students’ ability to see details, pay close attention to context, think, close-read, analyze, discuss, synthesize, and evaluate themes. The unit requires various writing activities and concludes with a documented essay or, for those students who have special needs, a simple documented visual presentation.

(Developed for College English and AP English Literature, levels 3-4; recommended for College English, AP English Literature and Composition, and AP English Language and Composition, levels 3-4)

09.01.08

Using Art to Encourage Effective Speaking and Writing Skills with ESL Students, by Mary Lou L. Narowski

This unit is designed to bring my middle-school bilingual/ESL students to the place where the clarity of thought they possess as Spanish thinkers and speakers can be expressed in effective written English form. Pedagogically, my students will have opportunities to see, hear, read, speak, and write in a safe, stress-free environment exploring the question, “What is art?” Art will provide creative ways to respond using language, creative skills, and critical thinking. Starting with the exploration of photographs of the 9/11 tragedy, students will become familiar with the elements and principles of design through oral and written verbal exercises. Then, using these skills, students will apply them to opening up an art gallery in the classroom after defending a chosen piece of art, again using oral and written activities. Because the emphasis will be placed on the piece of art and not language as it is typically taught, students will feel a sense of freedom. Writing will not necessarily be under the microscope; students’ ideas about the piece will be. Students will explore the artist’s life, thus seeking answers through a biographic search using computer technology. These opportunities will better their chances at success with fluency and proficiency.

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

09.01.09

Persuasive Writing: Beyond the Three Reasons, by Alice R. Smee

Starting in seventh grade, students are required to write persuasive essays for both district and state tests. In order to guarantee a successful score on these tests, students have been taught a *no-fail*, five-paragraph formula for writing a persuasive essay. This unit incorporates visual stimuli, such as television, Internet, video, etc. into the lessons to help students connect images and text, and it uses them as tools in visualization and elaboration. One of the main goals of this unit is to have students write a persuasive piece using visualization and descriptive writing while still meeting district and state standards. The unit helps students to formulate a persuasive piece that allows them to write beyond the *no-fail* formula and without using “my reason is...”

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

09.01.10

Seeing between the Lines: Teaching Students to Interpret Visual and Verbal Text, by Deborah L. Boughton

On the scoring rubric for the Response to Literature section of the Connecticut Academic Performance Test (CAPT) the word *perceptive* appears three times, always to describe exemplary performance. To demonstrate excellence, our students are expected to develop *perceptive* interpretations, make *perceptive* connections and defend *perceptive* judgments about literature. By the time students reach high school, we expect them to be more adept at independently probing and analyzing text. While we want them to ground their thinking in the text, we expect them to see beyond it to its cultural and historical context, the character's motivations and conflicts and the author's probable intent. For some students, especially those that still struggle to decode what the text literally says, grasping the text's deeper meaning can be frustrating and discouraging. The aim of this unit is to demystify the process of interpretation by making the act of critical thinking more visible to students. Using *Visual Thinking Strategies* (VTS), an instructional model developed by cognitive psychologist Abigail Housen and museum educator Philip Yenawine, as a point of departure, this unit reinforces core skills of inquiry: making observations and inferences, defending claims with evidence from the text, and entering into an academic conversation.

(Developed for English Language Arts, grade 10; recommended for English Language Arts, grades 9-12)

II. *The Modern World in Literature and the Arts*

Introduction

Literature and the visual arts offer outstanding opportunities to teach students about the modern world. Modern art and literature are known for their rejection of traditional conventions for representing the world and constructing works of art. The modern world opened up new ways of representing reality that would be appropriate to a period of constant change, when people were migrating from the country to the city, and across national borders. Modern writers and artists were often keenly aware of living in a world that was utterly different from that of their parents, whether because of new religious and scientific beliefs, industrialization, changing attitudes to sex and gender, or transformative political events. Many modern writers and artists produced their works in an effort to display what was distinctively modern about the times in which they were living.

This seminar explored these experiments, which sometimes involved getting rid of traditional structures (like rhyme or meter in poetry, or perspective in painting) and often involved a focus on the special role of the observer.

Participants in the seminar discussed classic works of twentieth-century literature and art from around the world that address the unique problems of modern life. Many of the stories discussed in the seminar were written in the first person, offering accounts of what it is like to experience the rapid changes of modern life. The works were selected because they were likely to be of interest to teachers and also to middle- and high-school students; many of the themes could also be incorporated in elementary-school classrooms.

The unit on Europe explored some of the major modernist literature that transformed literary methods of representing the world, including Franz Kafka's story "The Metamorphosis," and poems by William Butler Yeats and Federico García Lorca. The unit on Africa discussed Chinua Achebe's novel *Things Fall Apart* and Albert Camus's "The Guest," both concerned with the colonial encounter in Africa. The longest unit, on the Americas, explored the history of migrations in the Western hemisphere in stories by William Faulkner, Richard Wright, Gabriel García Márquez, and Leslie Marmon Silko and poetry by Langston Hughes. Under the guidance of curators Jessica Sack and Kate Ezra, we visited the Yale University Art Gallery and explored paintings and sculpture from Europe, Africa, and the Americas.

The Fellows, 12 teachers in the New Haven public schools, teach subjects ranging from first grade to Advanced Placement, including middle-school language arts, social studies, and special education, and high-school Spanish, English, and Art. The units are presented according to subject matter and grade level.

Visual Arts

At opposite ends of the spectrum of K-12 education, two of our units explore modern art. In "A Pop Portrait of the Artist as 'the Young Person That I Am,'" Christine Elmore introduces first-grade students to the Pop Art of Andy Warhol. Starting from Warhol's premise that "in the

future, everyone will be famous for fifteen minutes,” she gives her first-graders their first fifteen minutes of fame by having each of them produce a self-portrait in Pop Art style. The unit combines art with reading, writing, history, and drama (in the form of a brief play about Andy Warhol). It also touches on related art movements such as the Abstract Expressionism of Jackson Pollock. The unit can easily be adapted for students in higher grades. Sara Thomas’s unit on “Futurism: Capturing Modern Technology” designed for advanced courses in high-school art, uses students’ interest in emerging technologies to explore some of the leading movements of twentieth-century art. Focusing on futurism and its debt to the techniques of photography and cinema, she proposes first a historical survey of futurist art and then a series of classroom activities for allowing students to make use of current technologies, such as digital photography, while also developing traditional artistic skills such as brush control. Her unit makes use of resources available in the Yale University Art Gallery.

Spanish and French

Three Spanish teachers participated in the seminar and explored a range of Spanish-language works in their units. These are generally appropriate for students at the level of Spanish III or IV. In “Advanced Spanish Taught through the Short Stories of Quiroga,” Laura Tarpill draws on the grisly and macabre works of the Uruguayan writer Horacio Quiroga to entice students into reading Spanish literary works. In “La Generación del 27,” María Cardalliaguet Gómez-Málaga challenges advanced students by introducing them to works of Federico García Lorca and Rafael Alberti, as well as to the art of their contemporaries such as Luis Buñuel and Salvador Dalí. This approach also allows students to learn about the broader cultural context of Spain in the period leading up to the Spanish Civil War. In “Cuentos de Eva Luna: Magical Realism in Latin American Literature,” Valbona Karanxha, who teaches at Spanish I and II level, proposes an introduction to the works of Isabel Allende and Gabriel García Márquez in English translation. Studying these works in English will permit beginning Spanish students to develop cultural understanding of Latin America.

Like the high school Spanish teachers, Crecia C. Swaim attempts to balance language learning with cultural literacy and confidence-building in “Poetry and Differentiated Instruction in the Middle-School French Classroom.” Her approach focuses on having students learn and memorize short poems while they are at an elementary stage of learning French. This approach allows students to develop confidence in their own ability to learn and pronounce French. Even if some students do not understand the poems when they begin to memorize them, they gradually develop confidence and understanding.

Middle-School Language Arts and Social Science

Three other units focus on middle-school language arts, social science, and English to Speakers of Other Languages. Multicultural experience is a crucial concern in the middle-school classroom, especially in a city as diverse as New Haven. In “Modern Literature and the Arts Seen through the Experience of American Immigrants,” Julia Biagiarelli introduces eighth-grade language arts students to the writings of five writers from immigrant families: Gary Soto, Laurence Yep, Julia Alvarez, Amy Tan, and Roberto Felix Salazar. These writers, representing a diverse range of ethnic groups, tap into the long history of migration to the United States. The

unit begins with the historical background to U. S. immigration from the late nineteenth century to the present (including the resistance to immigration) and then focuses on the most recent immigrant groups, showing both the continuities in their experiences and the unique experiences of various groups. Susan Holahan addresses a similar set of issues for a group of middle-school students in English to Speakers of Other Languages. Since a high proportion of such students are native Spanish-speakers, she focuses in “Observing the Modern World: What Do Writers See? What Do I See about Myself?,” on short excerpts from works by Hispanic writers whose works have been translated into English, including Pablo Neruda, Octavio Paz, Jorge Ibarguengoitia, and Laura Esquivel, as well as one Hispanic writer in English, Sandra Cisneros. The special challenge here is to involve English Language Learners in reading by drawing on works that may have particular cultural resonance for them, but with which they are probably not familiar. In “A Comparative Literary View of U.S. History, 1820-1900,” Hoyt G. Sorrells brings some of the literary concerns of the seminar to bear on historical sources. He inquires into the ways that American history textbooks have described 19th-century policies such as the Monroe Doctrine and the policy of Manifest Destiny and related historical developments involving settlement of the west and re-settlement of native populations. His unit, designed for middle-school social studies classes, has students conduct independent “I-search” research projects to explore representations of such events as the Trail of Tears and the U.S.-Mexican War through documents written by participants from different sides of these conflicts, such as accounts of the Battle of Little Bighorn by native leaders and accounts of the U.S.-Mexican war from the perspective of Mexican historians and political leaders.

High-School English

Finally, three of the units, written by high school English teachers, focus on aspects of modern North American literary history and interpretation. In her unit for college prep sophomores, “What Lies Beneath: A Strategy for Introducing Literary Symbolism,” Sandy Friday introduces a crucial problem for advanced literary interpretation. Beginning with relatively simple fables and allegories, such as Aesop’s Fables and the allegorical stories of Dr. Seuss, she gradually introduces students to the problem of interpreting literary symbols. She concludes the unit with a discussion of William Faulkner’s 1942 story “The Bear,” a story full of complex symbolism that describes a boy’s rite of passage. Students in this unit will learn how to analyze stories and also how to write their own stories making use of various forms of symbolism. In “And the Beat Goes On: American Art and Literature from 1950 to Present,” Matthew S. Monahan explores a group of writers who remain of enduring interest for teenagers today, the Beats. Rebelling against what they perceived as an era of conformity and suburbanization, such writers as Jack Kerouac, Allen Ginsberg, and LeRoi Jones (also known as Amiri Baraka) helped to create the counter-culture that would flower in the 1960’s and influence both politics and popular culture up to the present day. Monahan suggests that these writers can appeal to students today because of their central theme of rebellion; the challenge here is how to select works appropriate for the 11th-grade classroom when many of the writers wrote about drugs, sex, and other problematic topics. Monahan has selected a group of poems and stories that give a fair sense of the tone of these writers while still being appropriate for classroom discussion. Shannon Ortíz explores the experiences of Puerto Ricans both on the island of Puerto Rico and on the U.S. mainland in “Puerto Rico: Americanization, Assimilation and Diaspora through Literature, Film, and Music.” The unit, designed for advanced high school students of English, draws on literature by Piri

Thomas, Esmeralda Santiago, and others while encouraging students both to keep a journal on their reading and to create a multidisciplinary artistic project at the end of the unit. Although the unit focuses on one particular group in U.S. society, the experiences it explores are relevant also to other immigrant and minority groups.

Acknowledgments

We are grateful for the involvement of Kate Ezra and Jessica Sack of the Yale University Art Gallery, who guided us on visits to the European, African, and American collections. Our exploration of literary representations of modern experience was greatly enriched by considering parallels in the visual arts.

Pericles Lewis

Synopses of the Curriculum Units

09.02.01

A Pop Portrait of the Artist as ‘the Young Person That I Am,’ by Christine A. Elmore

Young people are especially fascinated by the various kinds of representations of modern life that we find in Pop Art imagery. Pop artists’ delightful use of color and, often, brief texts, and their genius for turning the most common images into art captivate the attention in the same way that advertising and tele-media imagery do.

In this interdisciplinary unit I plan to help my students develop an understanding of art as a highly adaptable vehicle for self-expression through the exploration of and experimentation with the many styles and the more elementary techniques employed by the well-known Pop artist, Andy Warhol. Although it is designed for first-graders, I am confident that it can be adapted for older students.

This unit is divided into four sections. In Section One students will learn about the Pop Art Movement in which Andy Warhol was a leading figure. We will look at art created by Pop artists as well as by Abstract Expressionists. In Section Two students will learn about the life of Andy Warhol using children’s books and a Readers Theater play about his life. In Section Three students will explore the use of both line and color in art. In Section Four students will try their hand at creating a number of artworks, imitating some of Andy Warhol’s techniques.

(Developed for Language Arts, grade 1; recommended for Language Arts, grades 1-6)

09.02.02

Futurism: Capturing Modern Technology, by Sara E. Thomas

Even through my lifetime of three short decades I have seen drastic changes in technology. When I was a kid we had a computer with 64MB of memory, far less than even a memory stick today would hold. ATM cards have practically replaced checks; GPS allows instant access to maps and directions. Cell phones, texting and chat functions keep us in touch. Myspace and Facebook offer constant updates about the lives of peers, family members and friends. Digital cameras and webcams invite information to be recorded and uploaded immediately. Students are extremely familiar with this technology and couldn’t imagine their lives without it! Other technology is being created to make the world a cleaner place, like solar power and hybrid cars. Futurist artists working in the 1910s were exploring how to capture the new technology of their decade on canvas with paint, though their new technology was motion pictures, still-frame photography and the industrial revolution. I would like to challenge my students to capture the new technology of their generation while exploring how it has changed their everyday lives.

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l My objectives for this unit have two distinct categories: technical and conceptual. On the technical side I would like students to analyze a subject as a whole and determine which basic shapes to break the subject down into. On the technical side, I would also like them to be able to

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draw and paint those shapes correctly, and to add volume to them using tints and shades. Lastly, I would like them to be able to capture motion using gesture drawing. On the conceptual side I would like students to be able to understand why an artist might want to represent a subject in a more simplified manner. I would also like them to think about how they might show movement related to today's technology. I am hoping to reach this objective by having students actually go through the process of creating a futurist painting, and to discuss how the abstracted work is different than simply a snapshot of the subject. We will discuss what further information an abstracted painting gives the viewer and why.

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

09.02.03

La Generación Del 27, by Maria Cardalliaguet Gómez-Málaga

The unit *La Generación del 27* is designed to introduce history, poetry, theater and art in my classroom in a meaningful way. It explores the social and cultural context of Spain in the 1920s in order to understand the rise of a "La Generación del 27," a poetry movement in which ideology and aesthetics reached out to other literary genres, such as prose or theater or even other non-literary circles including cinema, art or music.

In this unit, students will learn about the Spanish Generation of 1927 in order to be able to read, analyze, interpret and understand poems written by Federico García Lorca and Rafael Alberti as well as to recognize and understand the historical events that led to the Spanish Civil War. The unit is recommended for Spanish students with at least an intermediate level of fluency since it is going to be conducted in Spanish.

(Developed for Spanish, grades 11-12; recommended for Spanish, grades 11-12)

09.02.04

Advanced Spanish Taught through the Short Stories of Quiroga, by Laura M. Tarpill

Horacio Quiroga is sometimes called the Poe of South America. He was born in Uruguay and spent much of his life in the frontier land of Argentina. The author's life was marred by tragedy after tragedy, which is reflected in his stories, many of which are centered around death, mental instability, and the struggle between man and nature. High-school students are drawn to Quiroga's tales, possibly because of the stories' morbid nature. The unit objective is for upper-level Spanish students to learn about Latin American culture and regionalisms along with Spanish grammar and vocabulary through the study of the tales *La gallina degollada*, *El almahadón de plumas*, and *El hombre muerto*. They will work separately and together while using writing, speaking, listening, reading and artistic methods to extract meaning from each story. They will be assessed for understanding of *La gallina degollada* and *El almahadón de plumas* along the way. Their culminating activity will allow them to write their own ending to the story *El hombre muerto* with help from the teacher.

(Developed for Spanish IV, grades 10-12; recommended for High School Spanish IV, grades 10-12)

09.02.05**Cuentos de Eva Luna: Magical Realism in Latin American Literature, by Valbona Karanxha**

This unit is designed for middle-school teaching of Spanish literature, art, culture and civilization. It correlates with the national standards of teaching a foreign language because it expands from literature to other disciplines. The unit starts as an overview of the literary movement of Magical Realism. I have tried to analyze its origins, developments and representation in the Latin American literature. The unit evolves around the study of “Two Words” written by Isabel Allende and ends with a comparison of storytelling techniques between Allende and García Márquez as two of the most successful novelists of Magical Realism in Latin America. In designing this unit, I kept in mind that my students are young readers and like fantastical stories and visuals; therefore I introduce information such as Magical Realist art from Hispanic artists.

Since the main focus of the unit is a representation of the political and social struggles of most of the Latin American countries, it will give the students the opportunity to learn how some of the countries still struggle for survival and democracy.

(Developed for Spanish, grade 8; recommended for Spanish, grade 8)

09.02.06**Poetry and Differentiated Instruction in the Middle-School French Classroom, by Crecia C. Swaim**

How do you meet the diverse learning needs of every student in your middle-school world languages classroom? How do you ensure that the newer or struggling student is able to comprehend, participate, and communicate, while the more seasoned or able student is also adequately challenged? How do you place vocabulary in a context that students will remember in a visceral sense, so that they will be able to automatically retrieve it when needed? I propose the use of poetry, in particular the reading, memorization, and recitation of poetry, as an invaluable method to accomplish these tasks in such a way that students will both enjoy what they are doing and experience a sense of confidence and success at being able to memorize pieces of French poetry.

In this unit I will provide a framework for incorporating poetry in the middle-grades language classroom to support differentiated language learning, allowing each child to progress at his or her own pace. I will include general techniques and practices that can be used across the board, as well as demonstrate how I apply them in slightly different ways in grades five through eight.

(Developed for French, grades 5-8; recommended for French, Middle School grades 5-8)

09.02.07

Modern Literature and the Arts, Seen through the Experience of American Immigrants, by Julia M. Biagiarelli

The purpose of this unit is, through reading and writing reflections of selected pieces of modern literature written by authors who are immigrants or come from immigrant families or are closely connected to immigrant communities, to expose students to the experiences of immigrants to the United States. The aim is to bring students closer to an understanding of and connection to people of various ethnic groups.

The unit includes background information that outlines a brief history of immigration to the United States by various groups including those from Asia, Europe, and Latin America. Included are brief biographies of the authors whose work will be studied -- Amy Tan, Laurence Yep, Gary Soto and Julia Alvarez -- and a review of the pieces of literature that will be read.

Sample lessons are outlined for reading and reflecting on these pieces, researching immigrant culture and writing in response to mentor texts. Students will give presentations to demonstrate their learning. This can be done through oral presentation backed up by an artistic or visual presentation such as skits, songs, dances, posters or other work that shows creativity and understanding of the texts studied.

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

09.02.08

Observing the Modern World: What Do Writers See? What Do I See about Myself?, by Susan Holahan

This language arts curriculum unit is to be taught over a four-week period, with two classes per week taught by an ESOL teacher and the remaining class sessions taught by the regular language arts teacher. Specifically intended for seventh-graders, the unit could be for eighth- or ninth-graders with supplemental readings. The unit begins with several poems by Pablo Neruda, and Octavio Paz and continues with folktales from several Latin American countries and an essay by Laura Esquivel. The unit concludes with Sandra Cisneros's *The House on Mango Street*. The objective of the unit is to introduce the predominantly Hispanic student population in this class to modern Latin American literature. The students will be asked to think about what the *author* intends us to "see" in his/her writing; the students will also be asked what *they* are learning to observe. Students will write in each class, learn the biography and geographical background of the authors and present a final project.

(Developed for Language Arts/ESL, grade 7; recommended for Language Arts/ESL, grades 7-8)

09.02.09

A Comparative Literary View of U.S. History, 1820-1900, by Hoyt G. Sorrells

This unit consists of a three-week block of ancillary instructions for eighth-grade Social Studies students, providing them an opportunity to design a research project of their choice. Students will create I-Search proposals, conduct the research that will either answer their questions or require

them to redirect their research and write an I-Search paper or Personalized Research Paper. An I-Search project allows students to create a research project from the initial question through the final presentation of the I-Search paper. The I-Search is based on the K-W-L reading strategy, a method of helping students to comprehend written material. Prior to reading students indicate what they know about the topic they are about to read. They indicate what they want to learn. Finally, students indicate what they actually learn. The students will start with a topic of considerable interest to themselves. Students will list what they already know about the topic. The students will then list three or four questions for which they want to find answers. The object of the I-Search project is for students to develop a goal; investigate a topic or issue; use their own voice; take into consideration an audience – usually their classmates – and present their findings.

In this unit, students will build their background knowledge of the westward expansion of the United States during the 19th century by completing class and homework assignments on the materials contained in their textbook, *American History*. At the conclusion of those assignments, students will conduct an I-Search, write an I-Search paper and present their findings to their peers. They may employ computer slide shows or other visual presentations. The areas of study are comparisons of accounts from various sources that describe the same historical event surrounding the westward expansion of the United States across the North American continent, for example, the Trail of Tears. Students must utilize “I” to tell the stories of their searches. The most important purpose is for students to develop effective methods of communicating.

(Developed for American History, grade 8; recommended for American History, grade 8)

09.02.10

What Lies Beneath: A Strategy for Introducing Literary Symbolism, by Sandra K. Friday

When my college prep. sophomores discuss a story we have read and *what it means*, including the literary symbols, I have noticed that often they are not discussing the same story. They are not clear on the sequence of events or what causes what. They do not have a solid understanding of the agents (characters), and their actions, and how these actions affect others, of significant objects in the story, or the prominence of the setting. Since literary symbolism can be fairly sophisticated, it seemed to me that a strategy, or strategies, for introducing it would be an appropriate unit topic.

Beginning with fables, parables, and Dr. Seuss’s allegories, the students will complete graphic organizers and storyboards to gain clarity about the sequence of events, and what causes what among the characters, their actions, significant objects, such as the green stars on the bellies of Sneetches, and the setting. Once they have an understanding of the stories with the help of these organizers, followed by class discussions, they will take it to the next level, and again with graphic organizers, they will brainstorm scenarios that are *represented* by the literary symbols in the stories. Progressing from the fable *The Moth and the Star* by James Thurber to *The Bear* by William Faulkner, not only will students learn to identify and interpret literary symbols, they will have the opportunity to write and share their own fables, parables, and allegories.

(Developed for Literature 2 and English, grade 10; recommended for High School English and Literature 2, grade 10)

09.02.11

And the Beat Goes On: American Art and Literature from 1950 to Present, by Matthew S. Monahan

This unit explores the work of the small group of American modernist writers collectively known as the Beat Generation. Although members of this group’s writing styles varied greatly, they shared a common vision; they recognized the problems facing modern Americans and believed that the solutions were to be found in the creation of a uniquely American art and literature.

Students participating in the implementation of this unit will be able to do the following: work individually and cooperatively in defining the terms *Beat*, American Dream and other related terms and read and appreciate works by the Beat Generation’s core members (Kerouac, Ginsberg, Burroughs and Corso), as well as the works of its precursor, Thomas Wolfe, and one of its ancillary members, LeRoi Jones AKA Amiri Baraka. Additionally students will analyze both literary elements (e.g. onomatopoeia, allusion, personification, etc.) contained in and the historical significance of these works and develop theories that relate these works of prose and poetry to their own lives and to the current American sociopolitical landscape. The culminating project is a multi-genre paper (a written or multi-media presentation that incorporates a common theme across a number of genres and or styles). This student work relates most closely to that of William S. Burroughs whose “cut-ups” incorporated common themes in non-linear prose.

(Developed for English, grade 11; recommended for English, grades 10-12)

09.02.12

Puerto Rico: Americanization, Assimilation and Diaspora through Literature, Film, and Music, by Shannon L. Ortiz

This unit was created for Honors Junior English and Advanced Placement English Language courses. It is designed to teach the students about the complex relationship between the United States and Puerto Rico and how it shapes Puerto Rican literature. The unit is broken up into three sections. Section one focuses on the Americanization of Puerto Rico. Section two examines the effects of assimilation of Puerto Ricans in the United States. Section three focuses on the effects of diaspora and how Puerto Ricans maintain or lose their identity in the United States.

For section one, students will begin by learning the historical background of the U.S. occupation of Puerto Rico. Then they will read excerpts from Esmeralda Santiago’s memoir *When I Was Puerto Rican* and examine her perception of Americans.

For section two, students will read short stories by Piri Thomas and analyze the effects of assimilating into mainstream American society. Students will also watch the film, “Every Child is Born a Poet,” a documentary that chronicles Piri’s life growing up in the 1940s and ‘50s.

For part three, students will read “How to Eat a Guava” by Esmeralda Santiago. Students will identify the effects of diaspora by her inability to buy a guava in the United States. Additionally, students will read Tato Laviera’s poem “nuyorican” in which he reflects on feeling rejected after

visiting Puerto Rico. Students will also watch the documentary “Yo Soy Boricua, Pa Que Tu Lo Sepas” and analyze how Puerto Rico and the United States influence how director Rosie Perez identifies herself.

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

III. *Science and Engineering in the Kitchen*

Introduction

Every child is a natural scientist. Every kitchen is a laboratory in disguise. Our seminar explored these ideas to develop approaches for teaching science to students in elementary and middle school.

The units we developed are far-reaching and fun. As a group, we placed special emphasis on the development of hands-on classroom activities using materials and tools found in the kitchen.

Some of our units are focused on the science of food. How is candy made? How do micro-organisms help us make food?

Some units are focused on teaching basic scientific principles using examples from the kitchen. What is the scientific method? What are solids and liquids and why are some materials hard to classify? What are the differences between igneous and sedimentary rock?

Other units take a broader view and use food and cooking as a means to introduce students to new cultures and careers.

Along the way, our discussions were supported by Harold McGee's delightful text *On Food and Cooking: The Science and Lore of the Kitchen*.

Eric R. Dufresne

Synopses of the Curriculum Units

09.03.01

Catering Middle-School Science: Monomers, Polymers, and Macromolecules, by Karen A. Beitler

The primary question and deciding factor about whether an event is fun or not in middle school revolves around what is on the menu. This unit uses food to teach about the transition from small molecules to the complex molecules that make cells and ultimately organisms. Seventh-grade science takes students from the chemistry of the atom through the progression of ever-larger compounds to living organisms, genetics and human systems-chemistry and biology. Eighth-grade curriculum takes the student from simple physics through the solar system, inside the earth and introduces physics, astronomy, earth science and natural disasters. Our school's focus is environmental science which is integrated into all curriculums. This unit attempts to bring the two curriculums together and apply the ideas of monomers to polymers to macromolecules to things students can recognize in their everyday lives. Using standard reagents students recognize the macromolecules in foods, and then build molecular structures that make up those foods. Students are encouraged to formulate their own tests and ask probing questions about how the world is constructed. Through recognition of the connection between the inorganic and organic, students will gain a better understanding of their connection to the earth which will then, hopefully, foster stewardship of the environment.

(Developed for Science, grades 7-8; recommended for Science, grades 7-10)

09.03.02

Cooking Up the Scientific Method, by Carol P. Boynton

This curriculum unit for first- and second-graders is designed to reach the developing scientists through a very common experience – eating the food we prepare! The focus will be learning and practicing the scientific method, a strategy that young students will need for their future science classes and experiences. The instruction will begin with some introductory lessons on the basic units of measure and some hands-on experiences and then moves into learning the steps of the scientific method. The students will practice these steps with recipes for trail mix, granola bars, fruit salad, scrambled eggs and other foods they enjoy. Cooking is perfect for these young learners! For students of this age, seeing is believing and touching is knowing and understanding.

Science should be fun and interesting and should offer experiences that get students thinking critically. Using the scientific method is a fundamental way for this to happen. By performing experiments and analyzing the data, students are learning to become creative thinkers. Understanding how to define a problem, observe situations, take notes, synthesize the results, and come to a logical conclusion based on objective results will help students not only as scientists, but as learners in all areas.

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

09.03.03

A Taste of Korea: A Chemistry-Geography Adventure!, by Waltrina D. Kirkland-Mullins

What do preparing kimchi, rice, and green tea have to do with science and the study of an Asian country? Through engaging, interactive activities, young learners will discover the scientific, cultural, and historic answer to this question. This unit explores aspects of Korean culture along with scientific elements that go into the creation of three of the country's traditional foods: kimchi, rice, and tea. Students will create these three foods, discovering food preservation via fermentation and the chemistry of creating perfect cups of sticky rice and green tea. Targeted at students ages seven through nine, this unit can be modified to accommodate upper elementary grades. The unit can be implemented within a 12-to-16-week time frame or expanded to accommodate the entire school year.

Non-fictional and fictional children's book selections, interactive Web sites, visits with local Korean merchants and restaurateurs, and more constitute an engaging language arts complement. A team-effort "We-Search" research project is included to promote greater understanding of Korean culture coupled with reinforcing social development and student work ethic skills. Have your young learners join in the adventure!

(Developed for Science, Social Studies, and Language Arts, grade 3; recommended for Science, Social Studies, and Language Arts, grades 3-5)

09.03.04

Sweet Twinkie, Density and Sugar Chomping Yeast: A Look at Physical and Chemical Reactions in the Kitchen, by Roisin A. Macdonald

Every day we take part in numerous chemical reactions; you might ask what do Twinkies have to do with it? How does making Monkey Bread fit into the seventh-grade science curriculum? My unit is intended to lead seventh-grade students through an exploration of the physical and chemical properties of matter, more specifically baked treats.

The unit is initiated with a discussion of how chemistry is an important part of all our lives. Initial connections are made by having students discuss what their morning was like and how chemistry played an important role. Before considering the intended food subject area, we first activate prior knowledge of molecules and how they move dependent upon the state of matter (class activity: Movin' Molecules). Second, students will explore the concept of density using a Twinkie. An introduction to chemical and physical properties follows with the concluding portion of the lesson illustrating how mixing/melting ingredients are examples of physical changes while baking those mixed ingredients culminates a chemical change. Lastly, students will see the fermentation process of yeast feeding upon sugar water producing carbon dioxide and alcohol as waste products.

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

09.03.05

Sweet Science: How Sugar Molecules Are Manipulated in Candy Making, by Roberta A. Mazzucco

Imagine making marshmallows, lollipops, caramels, fudge and taffy with your students. This unit will give children an exciting experience with candy making, while teaching them a fundamental principle – that heat has extraordinary effects on sugar molecules, and how that bit of knowledge has led to the world business of candy. It was written for a third-grade class but is appropriate for grades 2 through 5. The unit begins with some background history on sugar and how it found its way into all parts of the world. It then mentions the discovery of sugar beet, and the growth of slavery in the Americas as a result of the growing sugar industry. The unit presents some facts about the structure of the sugar molecule and how it responds to being heated in a water solution. The different cooking stages of candy are reviewed and some recipes that have been tried out are presented. The unit seeks to explore how each temperature of sugar aligns itself to a certain type of candy. Other suggested activities include the construction of a timeline of candy history and research projects for the students. There are also links to useful Web sites and a bibliography.

(Developed for grade 4; recommended for Science, grades 2-5)

09.03.06

It's Alive! Using Microorganisms in Cooking, by Pedro Mendia-Landa

Are all microorganisms harmful? Which are some of the beneficial microorganisms that are used in cooking? What are the differences between starters and yeast? What are some modern alternatives to yeast and how do they work? Which are some of the common bacteria that are used in cooking? How can the use of bacteria and yeast in cooking aid the classroom teacher to introduce some basic principles and ideas about chemistry? These are some of the central questions that this curricular unit begins to answer and attempts to clarify.

In this unit, we explore some basic physical, chemical, and engineering principles as we explore the way that microorganisms (yeast and bacteria) aid us in preparing some simple foods such as pancakes, flat breads, or ginger ale. Students will proceed through a series of hands-on activities that will allow studying the elements of the scientific method, and in the process, the design of a science fair project.

A list of student, teacher, and electronic resources, evaluation rubrics, extension activities and standards is provided for the implementation of the unit.

(Developed for Integrated Science, Language Arts, and Social Studies, grade 7; recommended for Science, grades 5-7)

09.03.07

Young Engineers: Understanding Engineering through Cooking, by Erica M. Mentone

As educators, we need to expose children to a variety of careers throughout their school experience; engineering demands character traits and skills that teachers are always trying to develop in students. Industrial engineers are problem-solvers, data- analyzers, decision-makers

leaders, logical thinkers, researchers, and risk-takers. Throughout this unit, students will work together to develop and optimize a process for making chocolate-chip cookies. This unit, developed for second graders, can be adapted for students in grades one through five. This unit teaches students about the career of engineering, while capitalizing on their strengths in an engaging hands-on unit. I have incorporated learning experiences that will expose students to the career of engineering while developing valuable skills.

This unit includes background knowledge for teachers about engineering, a scope and sequence, a bibliography with resources for teachers and students, and hands-on experiments meant to expose the children to engineering and the scientific process.

(Developed for Interdisciplinary, grade 3; recommended for Interdisciplinary Science, Mathematics, and Writing, grades 2-4)

09.03.08

Chocolate Chipping Away at the Rock Cycle, by Amy L. Piccirillo

Rocks aren't the most exciting topic for middle school students, but this 4-6 week unit is an exciting, edible way to encourage students to learn about them. In this unit students will learn the three main groups of rocks and the rock cycle and also be able to show how energy within the Earth is transferred within the rock cycle. Students will also be able to explain how internal energy of the Earth causes matter to cycle through the magma and the solid earth.

To introduce students to rocks and the rock cycle the teacher will present information about the layers of the Earth and plate tectonics. Next, students will be organized into small groups to research basic information about rocks. There will be a variety of igneous, sedimentary, and metamorphic rocks that they can choose from and research. They will also learn what makes up their rock and where we can find these other minerals that comprise these rocks. Eighth-graders connect to factual information better when they can relate to it in a personal way, so they will be encouraged to find out how these rocks or minerals that makes up their rocks they use or see in their everyday lives. Students will become familiar with each group of rocks and, while doing hands-on activities, will be able to explain how each is changed through the rock cycle.

(Developed for Earth Science, grade 8; recommended for Middle School Earth Science, grades 5-8)

09.03.09

Cook Me Up Some Equations, by Scott P. Raffone

Do you know the right ratio of ingredients to make the perfect marinara sauce? Does an Italian cook put salt in water to raise the temperature of water?

I have taken an inquisitive approach to teach high-school math through cooking. We will use ratios and proportions to make a traditional Italian marinara sauce. We will use the Cartesian plane to discover linear expressions and make predictions on some of the results of boiling water. We will find different volumes using homemade dough. Any teacher that has the ability to use

heating elements can take advantage of this lesson to provide students with an opportunity to learn mathematics and life skills that they can use for the rest of their life. My research involves a brief history of lines and planar figures with attention to three-dimensional figures and volume.

(Developed for Algebra Lab, grade 9; recommended for Pre-Algebra and Algebra I, grade 9)

09.03.10

Fluid Thinking about Liquids and Solids, by Stephanie J. Sheehan

Would you like your students to get excited about science? Would you like them to understand and use the scientific method and create delicious foods in your classroom? This unit is for you! Students will learn about states of matter as they make mayonnaise, chocolate sauce, and gelatinous fruit mold, as well as bread, right in your classroom. These activities will develop critical thinking skills, make the science curriculum more exciting for students, and encourage students to make connections between school science and real life.

The unit will consist of two main sections. The first section will provide various opportunities for students to sort and observe various properties of solids, then to do the same for liquids. The second section will provide hands-on experiments to challenge some of the generalizations they may have made during the first section. The experiments will help students to understand how liquids and solids react under certain circumstances. They will understand how energy affects matter and they will begin to understand how the movement of molecules affects the materials we see, touch and eat. The unit includes an annotated list of second-grade reading material for students to learn from and respond to.

(Developed for Science, grade 1; recommended for Science, grade 2)

09.03.11

Edible Transformations, by Melissa Talarczyk

Imagine ice cream, chocolate and gelatin teaching your students about science. This two-and-a-half-week unit designed for students in kindergarten to second grade allows you to do just that. Students will discover how transformations or changes occur in the kitchen. Students will discover how flour and baking soda react as they are mixed with a variety of liquids. They will observe the changes that occur as a liquid, colored sugar water, freezes, melts and evaporates. Students will see demonstrations of the three phases of a matter, leading into discussion of the water cycle or weather patterns. Students will make and compare two types of gelatin. To discover how temperature transforms solids and liquids, the students will follow a recipe to make ice cream and chocolate sauce. Finally, they will observe the growth of a seed as it transforms and becomes something completely different, a radish. This unit is a great way to teach hands-on science activities using food while incorporating writing and math. Students will be able to write about the changes they observe using their five senses, the steps to each mixture, following directions and counting how much of each ingredient is added.

(Developed for Science and Writing, grade K; recommended for Science and Writing, grades K-2)

09.03.12

Mixing It Up!, by Huwerl Thornton, Jr.

How would your students like to make gelatin and whipped cream? This unit deals with different types of mixtures. There are a wide variety of mixtures in science. This unit will use food to explore and learn about some of those mixtures. The primary mixtures this unit will focus on are solutions, gels, and foams. This unit will also encompass emulsions and suspensions. The students will make KOOL-AID® to represent solutions. They will also make JELL-O® gelatin to represent gels. The students will also make whipped cream from heavy cream to represent foams. We will use the whipped cream as a topping for the JELL-O® gelatin. The unit will allow students to practice following directions by reading recipes and following the instructions. We will talk about what is happening when KOOL-AID® and sugar are mixed with water. This strategy will also apply to JELL-O® gelatin as well as to what happens when we boil the water, and what happens when we hand-whip heavy cream. This unit will be interdisciplinary in nature in that it will cover science and math, as well as reading. This unit will take approximately two weeks and is targeted for second through sixth grade.

(Developed for Science, Mathematics, and Reading, grade 3; recommended for Science, Mathematics, and Reading, grades 2-6)

IV. How We Learn about the Brain

Introduction

We are all curious about the workings of our brain and we are aware that much is known about its function. Yet many of us have little idea how the nervous system is studied. This seminar examined a variety of approaches to the study of the brain. The overall aim was to expose Fellows and their students to some of the details of the science that has revealed how the brain works.

Much of what we know about our own brains is derived from the study of the brains and sensory organs of other animals. Why do birds see so much better than humans? Why does the elephant hear so well? We can also study the brain and senses by investigating how disease, injury and drugs alter their functions. Stroke, brain injury, alcoholism, Parkinson's Disease, Alzheimer's Disease, Huntington's Disease, poor nutrition and drugs -- both prescribed and illicit -- alter the way we sense, think and behave. We can study the structure and function of the normal human brain through a variety of diagnostic procedures. These include recording of brain electrical activity by EEG, or through electrical potentials evoked by flash stimulation of the eye and by tone stimulation of the ear. Modern imaging methods like the MRI and CAT scan have allowed volume measurements of specific regions of the brain. More recent advances have permitted visualization of functional activity of the brain.

This seminar was intended for teachers of biology and anatomy at all levels, as well as teachers of social or environmental studies, psychology, and art. The units cover a wide range of topics, from the embryonic human brain to the hearing of the elephant. Teaching science and technology to students in the elementary grades, Nick Perrone examines the receptor organs and brains of the sea turtle, elephant and eagle. These animals have remarkable sensory capacities that far exceed man's. Andrea Bailey's unit is intended for the primary grades; she examines the role of nutrition in the growth of the brain and in learning. Ruth Chaffee introduces high-school students, in a special education curriculum, to the structure and function of the brain. The unit emphasizes behaviors that will enhance or degrade thinking. Jennifer Esty's unit is written for her class of pregnant high-school students. The unit follows the development of the brain before and after birth, with the importance of proper maternal nutrition and postnatal sensory stimulation discussed. Larissa Giordano explores the effect of drugs on the brain. Given specific, age-appropriate explanations, her third-grade students will be better poised to make sound decisions. Darla Martinez has written a unit to introduce kindergarten students to the five senses. Sam Jones uses examples from the structure and function of the brain to teach high-school mathematics. Topics include comparing the reaction times of mouse and giraffe and analysis of the frequency of musical tones.

William B. Stewart

Synopses of the Curriculum Units

09.04.01

How the Heightened Senses of the Sea Turtle, Elephant, and Eagle Are Evident in the Brain, by Nicholas R. Perrone

What is the relationship between form and function in an animal's brain? Specifically, I believe different species of animals rely more heavily on one particular sense; with each heightened sense, specialized areas of the brain must control them: the female Green Sea Turtle uses magnetism to lay her eggs in the same beach where she hatched; the African Elephant has the amazing ability to create and hear infrasonic sounds too low for humans to hear; and the Bald Eagle uses its acute sense of sight to spot prey from hundreds of feet in the air. Each of these animals has an amazing ability directly caused by a heightened sense. The behaviors of these animals suggest that a major part of their brain must control that sense. Furthermore, if an animal has a heightened sense of smell, I expect that the area of the brain that controls smell, the olfactory lobe, will be larger in size or more developed with respect to the other, less dominant areas. I expect that by the end of the unit, students will be able to answer the initial question.

(Developed for Computer Technology, grades 3-6; recommended for Computer Technology, grades 3-6, and Science and Biology, grades 3-12)

09.04.02

Food for Thought, by Andrea N. Bailey

It is important that students understand that good food choices are essential for the growth and development of their bodies. This unit will allow students to feel knowledgeable enough to make smart and healthy food choices that will affect their development and the function of their brains.

A brief scientific explanation of the structure of the brain will be introduced through pictorial representations and reading materials. We shall also discuss "The Six Categories of Nutrients" and how they are used by our body. Finally, the students will be able to work "hands on" and discuss the components of the Food Pyramid and meal planning. This unit is designed to help teachers integrate Science and Health within their own classroom by providing the necessary background knowledge about the brain, its nutritional needs and how its functions affect our bodies. This unit is aimed at nurturing critical thinkers and problem solvers.

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

09.04.03

How the Brain Learns, by Ruth K. Chaffee

Over the course of four weeks, this unit will introduce high-school students to the basic components of the brain, the process of learning, and variables and strategies that can increase or decrease learning success. This unit is specifically designed for students in a special education resource room but has a number of activities and ideas that could be easily adapted and expanded for the regular education setting. Employing digital texts, such as interactive Shockwave web

programs and video clips to illustrate brain functions and abnormalities, will allow students to connect to the information through different intelligences. Among other topics, students will explore the effects of sleep, eating breakfast, omega-3 fatty acids, alcohol, and drugs on cognitive and learning abilities. Embedded within the unit are skill-building exercises from the core curriculum and CAPT preparation, such as assessing lab reports, identifying the hypothesis, independent variable, and controls, interpreting graphic representations, creating and analyzing graphs, and interdisciplinary writing. Through this unit students should gain not only a greater understanding of how the brain works, but also a greater appreciation for all its abilities.

(Developed for Special Education Resource, High School grades; recommended for Special Education Resource, Biology, Anatomy, and Physiology, grades 9-12)

09.04.04

How We Learn about the Brain: Teaching the Infant Brain, by Jennifer B. Esty

The unit is structured to follow the development of the brain and nervous system of a child from just after conception through about age five. This time period covers most of the more interesting developments in brain structure and function. The timeline allows for an organized way to study a very complex set of structures. It is intended for high-school anatomy and physiology students although aspects of it could certainly be used to teach anatomy and physiology to younger students. Because the unit covers the time period before birth, it will necessarily include some aspect of embryology. However, the unit continues with brain development in neonatal infants through a child's entry into kindergarten. As a result, it also includes information on the development of the senses as well as the development of skills, such as motor, social, language and math skills, that children need to succeed in school.

The unit also includes several ideas for classroom implementation. These lesson suggestions include a project for the students to create a book designed to teach young children the skills they are ready to learn at a particular age. This is a project that might translate well to younger grades if it is simplified for them.

(Recommended for Anatomy and Physiology, grades 11-12, and Parenting, all grades)

09.04.05

Brain Buzz: Effects of Caffeine, Nicotine, Alcohol and Drugs on Learning by Larissa Giordano

This unit will give students the ability to take responsibility for their own learning and well being at a critical time in their lives. It will teach students why they should "Just Say No!" when faced with peer pressure. Students will understand why their parents tell them to stay away from stimulants like caffeine, drugs, alcohol and nicotine. Understanding the "why" often is what will sway students to make positive choices. Students will understand the why based on what they learn about the brain and how these substances affect brain function. Students will therefore formulate a better understanding of how the brain works as well as what stimulants may affect their learning negatively. Students will also learn about addiction and how it attacks a brain like a disease. Students will get to know the functions of the brain and how they can take

responsibility for keeping it healthy in order to be better learners, promote healthy lifestyles and make informed decisions. Students will conduct a series of activities including mapping the geography of the brain and taking an inside peek at the inner workings of the human brain. Students will keep a daily log of their activities from which they will then have to find out what part of their brain controls those actions. This unit will allow students a better understanding of the chronic effects of stimulant use on learning and memory. The students will watch an animation of neurotransmission. The students will study the effects of stimulants on the brain and how they disrupt natural brain chemistry.

Students will focus on keeping the brain healthy through a balanced diet, exercise, maintaining a positive attitude and getting adequate sleep. They will plan “brain healthy” menus based on what is learned about a balanced diet complete with fruits, vegetables, antioxidants, vitamins and minerals. As a result, students will make smarter decisions because they learned that the brain is the control center of their body, directly affected by their actions.

(Developed for Elementary School Science and Social Skills, grade 3; recommended for Elementary School Science and Social Skills, grade 3)

09.04.06

Come to Your Senses, by Darla Martinez

This unit is designed to help students learn about their bodies and how they use their senses to take in information. It is intended to generate interest and excitement by encouraging students to use their five senses to explore the world around them. It will give students the understanding that their five senses work together to allow their body to function properly. This unit will demonstrate these ideas through hands-on activities.

The students will be able to meet the following objectives: recognize and name their five senses; record data; compare and analyze data; communicate findings through illustrations, graphs, and/or verbally, use the five senses to discover properties of objects in the environment, name a body part used for each sense; compare objects using only one sense; classify objects using only one sense; become aware of various physical impairments; describe how the five senses work together; describe ways to show proper care of eyes, ears, skin and nose; practice safety procedures relevant to the five senses; and describe how each sense works.

(Developed for Elementary School Curriculum Area, grade K; recommended for Early Childhood and Elementary School Curriculum Areas, grades PreK-1)

09.04.07

Using Mathematics to Understand the Brain and Describing the Brain to Understand Mathematics, by Sam H. Jones

Mathematics is a powerful tool for solving problems in the world around us. Using very abstract models we are able to describe and predict the sometimes very complex behaviors of people, markets, diseases and physical objects. It is often difficult for students of mathematics to grasp some of these abstract concepts without concrete examples. In particular, it can be a challenge to

motivate students without showing some relevance to their own lives. I would like to capitalize on the students' natural curiosity about their own brains to motivate them to learn mathematics.

In particular, this unit will be used to teach students of the family of functions by using examples and data about the brain. These examples include comparing the reaction time of a giraffe and a mouse. What is the relation between the number of neurons and brain diameter? How much louder is a jet taking off than a vacuum cleaner? Why do some musical notes sound pleasant while others do not? Relevant mathematical models, and their representations, will be used in answering these questions.

(Developed for Algebra II, grades 9-11, and Pre-Calculus, grades 10-12; recommended for Algebra II, grades 9-11, and Pre-Calculus, grades 10-12)

V. Evolutionary Medicine

Introduction

Evolutionary biology involves studying genetic changes within populations over time, and resolving relatedness among species. Although evolution is central to the understanding of biology and the history of life on Earth, one problem with teaching evolutionary biology is that students often fail to grasp its applied significance. Evolutionary medicine is the application of evolutionary thinking to gain valuable insights and new perspectives into human health and disease, demonstrating that knowledge of evolution vitally impacts our everyday lives.

The overall aim of this seminar was to explore ways to teach students about aspects of evolutionary medicine, emphasizing that this interdisciplinary science helps explain the origins of many medical conditions, including obesity, diabetes, asthma, heart disease, allergies and aging. Also, the seminar stressed that evolutionary medicine informs why humans often suffer from infectious diseases ranging from benign to deadly, and how illnesses such as smallpox, malaria, AIDS and the flu have profoundly influenced human evolution, societal interactions, and major historical events. The seminar incorporated instruction and discussions of readings on evolutionary medicine, some hands-on laboratory experiments, and tours of museum exhibits relating to evolutionary biology and the impact of this science on art and culture. The seminar was intended for teachers of science, mathematics and social studies at all grade levels.

The resulting units were diverse, reflecting the varied interests and backgrounds of the Fellows. Joseph Corsetti examines the historical controversies and ethical issues relating to eugenics: selective breeding in humans. Fallon Daniels looks at evolutionary biology through the lens of infectious diseases, emphasizing how human evolution can be better understood by studying the microbes that make us sick. Todney Harris focuses on the Columbian Exchange, and the historical impact caused by movement of pathogens between the Old World to the New World. Paul Jones shows that evolution may be taught from the perspective of genetic changes in virus populations, a useful tool for convincing reluctant students that evolution exists and is a matter of life and death. John Laub's unit is on the role of twentieth-century government in protecting public health against the spread of deadly infectious diseases, and allows students to debate policy in this area. Kathleen Rooney uses a mathematics unit to show how math functions are useful for translating data into models, especially in the case of Lyme disease and West Nile fever. Nancy Schmitt's unit warns students that human health may be adversely affected by increased levels of toxic pollutants, similar to the alarming declines evident in frog and other amphibian populations. Hermine Smikle's unit connects biology with mathematics, showing that math concepts can be usefully demonstrated by examining growth and spread of disease microbes. Kenneth Spinka's unit seeks to prepare students for math and physics by exploring mathematical probabilities in evolutionary medicine, especially the generation of fractals.

Paul E. Turner

Synopses of the Curriculum Units

09.05.01

Genetic Testing: Modern-Day Eugenics?, by Joseph A. Corsetti

“Eugenics is the science which deals with all the influences that improve and develop the inborn qualities of a race,” argued Sir Francis Galton in an editorial published in *Nature* in May 1904. The brief article is not a scientific study, but it serves as a succinct treatise of Galton’s work and his motivations. Eugenicists called for the improvement of the human race through better breeding.

This unit has three main areas of focus. First, it examines the social conditions that existed in the late 19th century that allowed the Eugenics Movement to emerge and flourish. Second, the unit explores how the Eugenics movement influenced other social constructs of the period, including methods of controlling the less desirable. The third part of the unit addresses the way eugenic science creeps into our present-day life. This mainly takes the shape of examining the use of prenatal genetic testing and its impact. The unit considers the social, ethical, and moral issues associated with genuine hereditary diseases, and the best way to address these valid and genuine concerns.

(Developed for U. S. History 2, grade 11; recommended for U. S. History 2, grade 11)

09.05.02

Human Population’s Response to Re-emerging and Emerging Infectious Diseases, by Fallon Lorraine Daniels

This unit discusses: What is an infectious disease? How do infectious diseases impact humans? Why is evolutionary biology important in the treatment of infectious diseases?

The unit covers transmission, replication process of bacteria and viruses, genetic variability, human immunity defense and evolutionary defense mechanisms, and medical treatment. The unit will be useful in comparing bacteria and viruses, demonstrating the importance of evolution, displaying the relationships between humans and microbes, and illustrating the importance of genetic variability.

Students will be engaged in a hands-on approach to learning through student-driven discussions, laboratories, debates, and independent research projects. The strategies for teaching this unit must coincide with the 5 E’s of learning: Engage, Explore, Explain, Elaborate, and Evaluate. The unit also seeks to teach science by incorporating other subjects such as history, reading and literacy, and math.

(Developed for Biology, grade 10; recommended for Biology, Evolution, and Infectious Disease, grade 10)

09.05.03

Introduction to the Diseases of Smallpox, Measles and Influenza and the Effects on the Indigenous Populations on the Continent of North America, by Todney Harris

The purpose of the unit is to teach the students at Jepson Magnet School the long-term effects of the Columbian Exchange on the continent of North America. Students will have the opportunity to learn about the causal relationships between the Age of Exploration and the unfortunate set of circumstances that led to the reduction of indigenous Native American populations. Students will also have the opportunity to identify the diseases that were transmitted from the Europeans to the Native American populations. In addition, students will learn the difference between a virus and a bacterial illness and how each is formed. Lastly, students will be able to identify when a disease becomes an epidemic and what the human responses are to such an occurrence.

(Developed for U. S. History, grade 8; recommended for U. S. History, grade 8, and Geography and Cultures, grade 7)

09.05.04

Evolution of the Virus: Teaching Macroevolution through Microevolution, by Paul M. Jones

This unit is for high-school biology students; its main objective is to teach evolution, using viruses and pathogens as the model. As many students are reluctant to accept human evolution given their religious beliefs, this unit focuses on evolution and natural selection while using viruses as the main example of an organism undergoing change. By using viruses as the target organism, this unit attempts to disarm reluctant learners by showing evolution happening over the short term as a demonstration for how more complex organisms evolved over time. Student lessons focus on various viral structures, geologic time scale, and a hands-on activity to enforce the mechanism of natural selection on micro-organisms. The overview offers a synopsis of evolution and virology concepts.

(Developed for Biology, grades 9-11; recommended for Biology, grades 9-11)

09.05.05

A Minuscule Adversary: Combating Epidemics and Infectious Diseases in America, by John K. Laub

Infectious diseases have occurred without warning throughout history, and millions of people have lost their lives because of these epidemics and pandemics. As the nineteenth century came to a close, scientists, with assistance from government funding and private philanthropy in Europe and America, had begun to investigate viruses and bacteria and conducted scientific research in order to better help society combat disease. This unit will explore the various efforts made by social institutions to combat epidemics and infectious diseases during the twentieth century. It will also require students to answer several essential questions, analyze primary sources to illustrate how Americans, the federal government and religious leaders reacted to epidemics in the United States. The unit is centered on the following essential question: How have the federal government and individuals confronted the possibility of infectious diseases

devastating their culture and population? Throughout the lessons of the unit, students will employ critical thinking to synthesize historical events with current events in order to make educated decisions affecting all people. Students will debate the role of the federal government, public health officials and the scientific community in studying infectious diseases and preventing their spread. At the conclusion of the unit, students will write an essay answering the following essential question: Is the United States health care system equipped and capable of combating an infectious disease and protecting its citizens' lives?

(Developed for History through Film, grade 12; recommended for Biology and Science, grade 10, and Elective Social Studies, grade 12)

09.05.06

West Nile Virus and Lyme Disease: Making Sense of the Numbers, by Kathleen Z. Rooney

This is a cross-discipline mathematics unit, designed for students in Algebra 2 or beyond. It incorporates functions with statistics to illuminate the useful nature of functions in translating data into models. It is application-driven. The unit's areas of focus are two emerging diseases: West Nile fever and Lyme disease. Both have important links to New Haven. We will examine the history and epidemiology of the diseases and use evolutionary principles as well as primary source data to lead us to questions and predictions, best modeled through math.

Math can help us study the process of evolving diseases. The engine of evolution is random mutation, mimicked by probability. The pressure of environment leads to success or failure of a mutation. Statistics helps us look at variation and possibilities and find patterns. Through our study of data and statistical analysis, we may find patterns created by that data. Writing a function that emulates the data we have collected is a powerful tool, known as modeling. When we discover correlations between variables such as environmental influences and populations, we can explore these relationships through linear functions. Modeling, combined with evolutionary prediction and analysis can help us to understand and reduce the risk of diseases.

(Developed for FST, grade 12; recommended for Mathematics, grades 9-12)

09.05.07

Endocrine Disruptors in Our Drinking Water: Should We Be Concerned?, by Nancy J. Schmitt

Scientific studies of water sources, streams and rivers have shown there is a measurable quantity of hormones and other pollutants in the water. Our water systems may be contaminated by medicines, antibiotics, birth control pills, vitamins, and menopausal drugs we take to feel healthier, and get better faster. As we use these items, some inevitably get into our water supply and may be impacting our food and water sources. This may be a factor in the evolution of humans and animals. How fast is this happening? Can it be quantified? Should we be concerned?

A growing body of scientific research indicates that many man-made industrial chemicals and pesticides may interfere with the normal functioning of human and wildlife endocrine systems. These endocrine, or hormone, disruptors may cause a variety of problems with development,

behavior, and reproduction. Deformed and feminized fish and frogs may be the result of contaminants in the water. This unit will discuss some of the current issues facing our water supply. The lesson plans are a collection of real-life math problems using the challenges facing our water supply as context.

(Developed for Algebra I, grade 9; recommended for Algebra I, grade 9, and Algebra II, grade 11)

09.05.08

Using Mathematics to Explain the Spread of Diseases, by Hermine E. Smikle

This curriculum unit aims to provide students with background knowledge for the study of mathematical content that can be applied to the biological sciences, and attempts to connect relevant topics from the high-school mathematics content to the concepts in microbiology that affect real-life situations.

The curriculum unit is written in three sections. The first section states the rationale and the objectives of the unit. The second section provides the background information necessary for the study of the mathematical content. The topics include viruses, growth of bacteria, emerging diseases, cholera, malaria, and immunity. The third section shows the connection of the biological concepts and mathematics. The mathematical concepts include: exponential growth and decay, rate of change, and Poisson distribution. The replication of bacteria can be explained by the doubling time, and the growth of bacteria can be explained by the exponential function. The logistic model is used to solve problems based on the spread of diseases. The Poisson distribution will be used to find the probability of the number of bacteria grown in a test situation. Of great importance is the connection of the unit to the state and school district's curriculum. According to the NCTM mathematics standards, mathematics instruction should encourage students to use mathematical models to analyze change in both real and abstract contexts, and to make connections to real-life experiences.

(Developed for AP Calculus, grades 11-12; recommended Mathematics, grade 11-12)

09.05.09

Math Morphing Proximate and Evolutionary Mechanisms, by Kenneth William Spinka

While 12 February 2009 marks the 200th anniversary of the birth of Charles Darwin, his 1859 book *On the Origin of Species* that established evolutionary descent with modification as the dominant scientific explanation of diversification in nature also celebrated its 150th anniversary in 2009. The revolutionary thinking of this publication provoked controversy but never explored implications for the evolution of medicine until biologists recognized the significance for understanding the evolution of pathogens in the germ theory of disease, and an organism's need to defend against them.

This curriculum unit will enhance preparation for courses in the areas of math and physics by exploring the predictors and mathematical probabilities of evolutionary medicine, identifying graph-associated and data-driven patterns, generating fractals from evolutionary processes

formerly ignored by medicine and the proximate mechanical causes linked with hard sciences. After discussing the symptoms, signs, and causes that manifest in single, materialistic, anatomical or structural changes within the body such as in genes and their products, this curriculum unit presents historical and evolutionary perspectives on diseases. The unit includes lesson plans integrating math and science.

(Developed for Math, grades 9-12, and Physics, grade 12; recommended for Math, grades 9-12, and Physics, grade 12)