

Curriculum Units by  
Fellows of the  
Yale-New Haven Teachers Institute  
Guide  
2010

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## *Preface*

In March 2010, forty-eight teachers from twenty 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 2009, 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 four seminars were organized, corresponding to the principal themes of the Fellows' proposals. Between March and July, 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 four volumes, one for each seminar. A list of the 196 volumes of Institute units published between 1978 and 2010 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](http://yale.edu/ynhti) and [teachers.yale.edu](http://teachers.yale.edu). Teachers who use the units may submit comments at [teachers.yale.edu](http://teachers.yale.edu).

This *Guide* to the 2010 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 1784 units written between 1978 and 2010, and reference lists showing the relationship of many units to school curricula and academic standards are online at [yale.edu/ynhti](http://yale.edu/ynhti).

The Yale-New Haven Teachers Institute is a permanently endowed unit of Yale University. The 2010 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 2010

## ***I. Interdisciplinary Approaches to Consumer Culture***

### **Introduction**

Consumer culture surrounds and infuses contemporary American life in ways that make its causes and effects appear blindingly obvious: materialism, status-display, waste, and so on. But as with so many cultural phenomena, the very obviousness or conspicuousness of consumerism in our lives can in fact blind us to the complex play of economic, social, and political forces that have actually shaped our modern “landscape of desire.” Over the past several decades, an extraordinary outpouring of scholarship across the disciplines has inspired, indeed compelled, scholars to revise and deepen their understanding of consumer culture in this country.

As a result, a consumerist way-of-life that was once understood either as the artificial creation of the advertising industry or the organic product of individual dreams and desires in the free marketplace now looks far more complicated than that stark opposition between corporate manipulation and democratic aspiration would suggest. Far more complicated and far more interesting. The seminar that brought the authors of these marvelous curriculum units together was designed to provide some samples – a taster’s menu so to speak – of this new generation of scholarship so as to see whether its insights might be translated into curricular recipes suitable for many different classroom kitchens.

The history of consumer culture is a very long one, stretching back centuries and over thousands of miles of sea-borne trade routes. Our seminar, though, focused on the last three-quarters of a century, from the Depression and World War II onward, when the political and economic architecture of an energy-intensive, highway-dominated, urban/suburban matrix was set into place. Drawing on work by historians, sociologists, ethnographers, economists, cultural studies scholars and a few short-story authors, we explored the impact of consumer culture on generational consciousness, citizenship and civil rights, race and ethnicity, children and family dynamics, and the environment. Since we all knew ourselves as consumers, whatever else we may fancy ourselves, no one felt excluded from the seminar conversation because of his or her specialization. For that reason, I suspect, our conversations were always lively, provocative, and productive – a hint, I believe, of how our students’ own tacit sense of themselves as consumer citizens-in-training can provide a stimulus to discussion in virtually any classroom setting.

The proof of that hypothesis is in the pudding, as they say, so I invite the curious reader to look into the diverse offerings that follow, curriculum units that range from art and music to psychology, civics, statistics, language and culture. What you will find are not only compelling distillations of the ideas and approaches taken up in the seminar but, in keeping with the classroom mastery brought to the table by the Fellows themselves, an extraordinarily imaginative yet entirely practicable array of lesson plans and activities that translate those ideas and approaches into workable, teachable experiences. Unlike cooking, teaching cannot be reduced to the “nuking” of microwaveable knowledge-nuggets; but curriculum units are, in their own way, a form of what intellectual historians call recipe-knowledge. And on that basis, I and the Fellows hope you will find something to your taste.

Jean-Christophe Agnew

## **Synopses of the Curriculum Units**

### **10.01.01**

#### **Government Policy through the Lens of Suburban Development, by Justin M. Boucher**

This unit seeks to teach both the history of the post-war American suburb and the process by which the federal government makes policy decisions. The students will explore the historical forces that led to suburban growth. While the policy-making process is often shrouded in secrecy, the policies that spurred the creation of modern suburbs are surprisingly well documented. Additionally, the consequences of these policies are obvious to most Americans every day. Thus the history of modern suburbs allows teaching of the policy-making process in real terms, while assessing its real consequences. This unit will help students to understand the consumer dimensions to these policies, thereby allowing them to explore the cultural ramifications of policy decisions as well.

Approaching the policy-making process in this way allows students the opportunity to understand and evaluate the decisions that led to their towns, their schools and their lifestyles. The students will come away with a clearer understanding of their government and their own history. As a result, the students can build on their critical thinking skills and content knowledge, allowing them to understand and evaluate the world in which they live.

(Developed for AP Government, grade 12; recommended for U.S. History, Civics, and Government, grades 11 and 12)

### **10.01.02**

#### **Publicidad en Español, by María Cardalliaguet Gómez-Málaga**

This unit is designed as a vehicle to introduce students to the world of advertisement through the cultures and identities of Latin American countries including Argentina, Chile, Mexico and Colombia, as well as Spain, and to the world of visual arts and advertisement.

Developed for a careers-oriented high school, the unit contains a business component, with advertising jargon and vocabulary in Spanish. Students will learn how an advertising agency works, how different departments are configured and some of the duties of advertising staff. Students will practice grammar, reading, writing, listening comprehension and speaking skills.

(Developed for Business Spanish, grade 11; recommended for Business Spanish, grade 11)

### **10.01.03**

#### **Environmental Consumerism, by Larissa Giordano**

The consumption of goods is a fixture of our culture. Only by producing and selling things and services can our modern economy thrive. Yet consumption can cause havoc for the environment. This calculation includes what happens from the conception of a good to its disposal. The

production, processing, and consumption of commodities require the extraction and use of natural resources like wood, ore, fossil fuels, and water. Factories then often create toxic byproducts. This multidisciplinary unit includes lesson plans designed to enhance literacy, history, math and science as it guides students' understanding of what consumerism is, how their lives are affected by it, and consumption as a contributor to environmental decline.

Students will learn that each person can make a difference in sustaining our world by "going green." They will recognize the three R's Reduce, Reuse and Recycle. This unit will create an awareness of the global implication of everyday decisions. Students will be able to identify the differences between needs and wants and how daily choices affect what is available for others. This unit will answer questions like: What is consumer culture? How do my daily decisions affect the future? What changes can I make in my own life to sustain our environment? The students will understand the life cycle of trash, particularly when examining plastic versus paper. Students will look at the production, advertising, packaging, toxicity, and cumulative impact of the environmental damage caused in the process. Students will weigh the benefits and consequences of the product versus the cost of production and environmental impact.

By the end of the unit, students should be able to answer the question, "Does our way of living depend on commodities that are damaging to the Earth to produce?" They will then devise ways to help conserve resources and minimize waste. This unit will examine some consumerism pitfalls and give students the responsibility for taking action to help sustain our environment.

(Developed for Science, Mathematics, and Literacy, grades 3-4; recommended for Science, Mathematics, and Literacy, grades 3-4)

#### **10.01.04**

#### **I'd Like to Teach the World to Buy: Advertising Jingles in America, by Jennie A. Kerney**

We can all hum them, and sometimes we can even remember all the words. However trivial jingles may be, they are successful at getting us to remember a product and even to buy the product. In a world where consumers are bombarded with which soft drink is "in" and the correct fast food to eat, the jingle is often the most memorable part of the commercial and the part most likely to sway consumers.

This unit is designed to help students become aware of how much they are influenced by a commercial with a catchy jingle. They will learn the history of jingles and discover how certain jingles can remain in the brain long after the commercial has been aired. They will read the history of one of the most famous jingles ever written. Students will also have the opportunity to design a product, create a jingle and "pitch" their product to the class. They will be rated for both the visual (the actual product invented) and the aural (the jingle) quality of their commercial.

When this unit has been completed, I expect my students to understand the important role that jingles play in advertising, what making a commercial and jingle involves, and what the future of the advertising jingle might be.

(Developed for Music History/Music, grade 6; recommended for Music History/Music and Consumer Culture/Social Studies, grades 6-8)

### **10.01.05**

#### **Consumer Culture, Young Voters, and American Presidential Elections, by Jeremy B. Landa**

Study of the American political election system at the presidential level is an excellent way to help students understand the role that mass and segmented consumption play in politics. Understanding that the average citizen plays a supportive role in a democracy is important; however, it is not all that the young people of the country should recognize about government.

The consumer citizen is a modern phenomenon in America. This unit will take students through an analysis of three major elections, reflecting both visible and invisible changes that have allowed the political model containing consumerism to flourish. By examining the elections of 1936, 1960, and 2008, students gain the opportunity to explore the role that consumer culture and media technology have played in the rise of a new consumer citizen. They should recognize that a citizen has power in elections, not merely by voting, but by critically scrutinizing the consumer's role in the shaping of politics, the politicians, and the ideals and stereotypes that define our leaders. This power is one that should be an obligation rather than an option.

(Developed for Civics, grade 12; recommended for Civics-Election Process, grades 9-12 and U. S. History – 1936, 1960, and 2008 elections, grades 6-12)

### **10.01.06**

#### **Gridiron Consumers: The Billion-Dollar Ascent of Football in America, by John K. Laub**

The National Football League generates well over \$8 billion in revenue annually and has its own cable television network. Why do fans continue to devote so much money and time to supporting and rooting for their favorite football teams? After World War II, two cultural transformations – television and consumerism – intersected to catapult football to the top of the sports industry. This unit offers students an opportunity to appreciate the impact on themselves as consumers of the dynamic involving sports, technology, big business, and the federal government. The NFL has dominated the sports industry during the past fifty years by marketing, branding, programming, and promoting its athletes and the game through shrewd decisions by its owners and commissioners. All lessons are designed and presented in order to examine and answer the following essential question: How have gridiron industrialists, marketing mavericks, competitive coaches, college athletic departments, the federal government and fanatical fans embraced amateur and professional football and kindled a multi-billion-dollar consumer culture in the United States?

(Developed for History Through Film, grade 12; recommended for History Elective and History Through Film, grades 11-12)



### **10.01.07**

#### **Really, ¿Quiero Taco Bell?: A Multicultural Marketing Approach, by Denise M. Massari**

It is the purpose of this unit to explore multicultural ethnic advertising strategies and how marketers' and consumers' cultural literacy affects the creation and interpretation of advertisements.

Students will use the Spanish language as well as prior knowledge and current teaching of customs and practices within the Latino community to analyze advertising in order to answer the essential question, "How does cultural relevance in advertising/marketing manipulate people as consumers to purchase products?" The culminating assessment – create a target audience advertisement – asks students to apply and internalize the marketing strategies examined throughout as each must recognize himself or herself not only as a member of an audience to be targeted but also as a manager targeting an audience.

(Developed for Spanish III, grade 10 or Spanish IV, grade 11; recommended for Spanish and History, grades 9-12)

### **10.01.08**

#### **Is It Trash? Sculpture that Recycles, by Amy Migliore-Dest**

This unit has been created to promote the recycling and reusability of objects to create art. Its roots are in the consequences of consumerism; we are dealing with the waste that results from over-consumption. Students will analyze and categorize this waste, and as they experiment with it, they will discover it as a material to create pieces of art. Students will use a wide variety of artists for inspiration, as well as a wide variety of materials.

Students will look for inspiration through several artists of various genres, including: Louise Nevelson, Joseph Cornell, Betye Saar, Andy Goldsworthy and a Recycle Artist, Clare Graham. These artists all work(ed) in different media and, consequently, convey very different messages through their pieces. They will give students a starting point for their own personal sculptures and allow students to appreciate and understand distinctions among many different types of art.

Students will connect these artists to the recycling movement. The artists we discuss will inspire students to see and design their own sculptures out of recycled materials and/or materials in their natural environment. Students will research recycling practices, as well as strategies for reducing waste and reusing certain items. Students will also write journal entries, which will allow time for reflection on some of the environmental issues discussed in class and their thoughts on some of the artists' work. This unit strives to yield not only sculptures that will send a message promoting recycling, reusing and reducing waste, but also students who will reinforce this message themselves and spread it, throughout the course of their lives.

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

### **10.01.09**

#### **Assembling the Latino Consumer, by Millette Núñez**

As the largest minority group in the country, Latinos might be assumed to be accommodated in the United States simply because of their numbers. However, Mexicans, Puerto Ricans, Cubans, Dominicans, Colombians and so forth historically were less often perceived to fall into a single category, as opposed to the way they may commonly be viewed today. In this unit, students will see how the U.S. census helped to create a homogeneous label for many people of Latin American/Spanish origin or descent and how Spanish-language television networks have assisted in establishing and maintaining those labels. Categorizing Spanish-speakers in this manner combined their purchasing power and allowed Anglo politicians and companies to look at and target people from various national, generational and racial backgrounds as a singular demographic group.

Through analysis of the U.S. census questionnaire, advertisements and various forms of media, students will experience first-hand the impact of Latinos as consumers in America and the influence that their growing presence has had on American culture as a whole. Students will examine an assortment of television commercials, Internet sites and market research data to see how and why advertisers market to the Latino population and will notice that the cultural variations within the group are often ignored. Focusing on such differences will force students to refine their stereotypical views of *Latinidad*.

(Developed for Spanish IB, grade 8; recommended for Spanish 1B, grade 8 and Spanish 1, grade 9)

### **10.01.10**

#### **The Shroud of Choice: A Psychological Look at Consumer Culture, by Robert F. Rhone**

What is consumer psychology? Think about the last time you went into a store, to purchase an item like a bottle of soda. You went right to the place in the store that has the beverages, you chose your favorite brand, and purchased it. This action, simple as it sounds, is loaded with complexities and questions. For example, why did you choose this soda? How could other soda companies persuade you to buy their drink? How does this soda make you feel? These are the kinds of questions that consumer psychology attempts to answer.

The purpose of this unit is to inform students that producers use psychologists' ideas about how humans think and behave to market their products as effectively as they can. Through understanding this idea students can become more informed consumers and make choices that are in their best interest. Of course consumption is necessary in our modern world. We need to buy food if we want to eat, and clothing if we want to be socially accepted. Our general question is: How can we prepare ourselves to make rational decisions when we shop?

(Developed for Psychology, grades 11-12; recommended for Psychology, grades 11-12 and Economics, grades 9-12)

### **10.01.11**

#### **Numeropharma: America’s Powerful Legal Drug Culture and the Math Behind It, by Kathleen Z. Rooney**

The language of statistics has become a ubiquitous part of the modern consumer culture: economic statistics, weather statistics, sports statistics and the omnipresent medical studies. “The study” with its catch phrases “Four out of five doctors recommend...” and “Studies show...” is the voice of a pseudo governmental presence. This voice counsels an attentive consumer public in the belief that a cure for all ills is through buying.

Pharmaceuticals are not merely a multi-million-dollar industry or even a multi-billion-dollar one. This industry dwarfs almost all other industries. It competes with big oil and the (too big to fail) commercial banks to be among the top three overall of the nation’s most profitable industries. The consumer protections implemented throughout the 20<sup>th</sup> century resulted in “Big Pharma.” The FDA not only approves drugs for market but controls the marketing of those approved drugs. This relationship has created a centralized pharmaceutical industry with *de facto* government-approved monopolies.

This unit will introduce students of high-school statistics to the historical and contemporary role of statistics in the biopharmaceutical industry. We will examine sampling methods and experimental design in the context of clinical trials.

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

### **10.01.12**

#### **Fast Food in France: Would You Like Cherry Tomatoes with That? Using Advertisements, Menus, and Web Sites in Middle-School French Classes, by Crecia C. Swaim**

Why can’t *I* get pineapple slices at McDonald’s?  
Why doesn’t KFC sell a *Double Down* sandwich in France?  
Is a *Chicken Shake* as unappetizing as it sounds?

These are a few of the questions that came to my mind as I browsed Web sites of French fast-food restaurants. Everyone loves food, and if they don’t love a particular food item, they certainly enjoy telling the world how much they dislike it. Language students seem to derive even more pleasure from this act of declaring personal preference since they get to do it in another language; for some reason, they can’t get enough of that! It is not only human nature but also very much in the nature of teens and preteens to be drawn to the familiar, so I knew that creating a unit around well-known American fast-food chains that have become popular in France would be a winning combination, a virtual value-meal, if you will, for my middle-school French students.

This unit will introduce students to American and French fast-food restaurants in order to engage students in the process of discovering the variety of similarities *and* differences among French and American fast-food offerings and advertising, in addition to learning vocabulary and

seeing real-world examples of things like the different punctuation with which numbers are written in France and the euro system of currency. We will explore McDonald's and Kentucky Fried Chicken, two American fast-food restaurant chains, as well as the European chain Quick, to gather different perspectives on the fast-food scene in France.

(Developed for French, grade 6; recommended for French, grade 6 (second year beginner))

## II. *The Art of Reading People: Character, Expression, Interpretation*

### Introduction

We can contact millions of people across the globe, yet we increasingly connect with even our most intimate friends and family via instant messaging, virtual visits, and fleeting meetings that are rescheduled a half dozen times, then punctuated when they do occur by pings and beeps and multitasking. . . . We are nurturing a culture of social diffusion, intellectual fragmentation, sensory detachment. In this new world, something is amiss. And that something is attention.

Maggie Jackson, *Distracted: The Erosion of Attention and the Coming Dark Age* (2009)

People who appear within imaginative writing – whether in novels, short stories, or plays – are generally referred to as “characters”; and young readers learn to recognize “character” as a key element of many literary works, one which requires careful observation and various forms of analysis. Our seminar reapproached the familiar topic of the study of literary character partly by exploring connections between that study and the concepts of the “person,” “personality,” social “image,” and “inner self” that we use to navigate our understanding of people – and of ourselves – in daily life. What kinds of techniques or information do we use to “read” the people around us? What kinds of signals do we rely on to shape *their* readings of ourselves? How do our methods of interpreting people whom we know slightly or very well in our own lives compare with the methods we use to interpret characters in novels or stories or plays?

Our seminar was composed of teachers of reading, language arts, visual art, middle school and high school English, creative writing, critical writing, and the advanced study of literature. Collectively, we work with students from the elementary school grades through middle school and freshman English to A. P. English literature, college, and graduate study. Though our students range widely in age and in levels of academic skill, we found that, as teachers, we share an urgent concern to heighten our students’ abilities to make observations, to draw inferences, and to reflect on their understandings of other people, as well to articulate their own inner lives and sense of self. Repeatedly, we exclaimed at the rapidly-changing contexts in which our students engage in communication, and wondered: how have our practices of understanding ourselves and others been altered by the new mediums of expression brought by the digital age? Together, we asked what varied forms of *attention* could be adequate to the great human interpretive questions posed by our encounters with other people – whether characters in fictional narratives; speakers in lyric poems or in plays; flesh and blood individuals met face to face; or people known primarily or only to us through technologically mediated or virtual means.

Early in the twentieth century, the critic L. C. Knights warned readers and critics away from the misguided enterprise of analysing literary characters as though they were historical persons, whose life events and inner characters are full of determinate features beyond what any account might specify or imply. The question in the title of Knights’ essay – “How Many Children Had Lady Macbeth?” – made his point by being impossible to answer. In investigating connections across different arenas for the expression, depiction, and interpretation of character, we have

remained mindful of this admonition about the naïvete of discussing a literary character as though he or she were a person in the world. While recognizing the essential difference between a character who exists only in a literary text and one existing in the world, we have ventured to trace connections and important distinctions between the remarkable processes by which human beings interpret and respond, respectively, to real and to represented characters. Of course, we frequently encounter “real” people via representations of one or another kind. Encouraged by recent developments in literary study that draw on the burgeoning field of cognitive studies, we have taken seriously the complex and often intuitive or unconscious processes by which, in everyday life, we posit, imagine, and draw inferences about the inner lives of other human beings. We made reference to those processes and skills, often highly developed in our students, as we considered how we might develop the skills of student-readers in making inferences about and interpreting characters in literary texts.

Literary critics such as Lisa Zunshine offer fresh perspectives on our interpretation of literary characters by connecting that activity to what cognitive scientists call “Theory of Mind”: the average person’s exercise of limited but essential “mind-reading” abilities, as he or she explains the behavior, words, facial expressions, and body language of others in terms of underlying states of mind. We began our series of readings with selections from detective and mystery stories by A. Conan Doyle, Edgar Allan Poe, and Edward P. Jones, in which characters must draw inferences about others’ intentions and actions as they attempt to assign responsibility for an enigmatic crime, even as the reader strives to interpret the motives of the characters about whom she reads. We next brought our questions of how character is directly and indirectly made manifest to other genres, including dramatic monologues by Robert Browning, Sharon Olds, and Langston Hughes as well as Shakespeare’s *The Tempest* – where control of others’ interpretation of their own identities and pasts is crucial to the relations of power within the play.

The depth of common assumptions about “mind-reading” as a universal human response is revealed by our bafflement at some autistic people’s difficulty mastering such normative skills; variations in individuals’ cognitive processing of cues about others’ feelings and thoughts help us see the complex processes of inference that we generally take for granted. Narrated by a highly intelligent, autistic teenager, Mark Haddon’s *The Curious Incident of the Dog in the Night-time* brought together our seminar’s interests in narrative “voice” and point of view, mystery and detective plots, and the range in individuals’ readiness to interpret the facial expressions and indirect verbal expressions of others. We read this fictional work alongside the factual autobiographical account of an extraordinarily gifted, autistic person, Temple Grandin. Moving finally to one of the classics of English fiction, Jane Austen’s *Emma*, we observed the perils that even (especially?) a highly-socially-attuned person is subject to in hypothesizing about others’ feelings, intentions, and states of mind. Throughout, we aimed in our seminar meetings to reap the benefits of mindful attention to the words, tones, and physical presence of other human beings, as we puzzled over, argued about, and shared revelations in person about both the texts we read and our own teaching experiences.

The rich and various group of curriculum units that emerged from our work together takes up different facets of the interconnected set of questions that we considered in seminar, bringing them to readings written in several genres and addressed to readers of various ages. With units designed respectively for second-graders, third-graders, and sixth-graders, Melissa McCarty,

Waltrina Kirkland-Mullins, and Katharine Magdon Liphardt all strive to develop in their students the skills of observation and inference required to interpret the inner lives of characters in literary texts – whether Marc Brown’s popular picture books about Arthur; lyric poems by Ogden Nash, Eloise Greenfield, Langston Hughes, and Arnold Adoff; or Gordon Korman’s multi-genre chapter book, *No More Dead Dogs*. Working with elementary age students, both Melissa McCarty and Katharine Magdon Liphardt draw attention to the distinction between character *traits* and character *feelings* – allowing young readers to conceptualize a dynamic experience of feelings that does not fix a person’s character categorically.

The units designed by Sandra K. Friday, Mary Lou Narowski, and Marialuisa Sapienza ask middle-school and high-school students to develop a variety of more sophisticated, specialized skills of readerly inference and interpretation. Friday’s unit emphasizes the particular power of “close reading” as a technique for entering into the inner life of another, especially as difficult feelings are only partially and indirectly expressed. Narowski adds a comparative dimension to her students’ study, examining different media as a way to think about the “clues” to character variously offered by dialogue, images, tones of voice, and physical expressions. While McCarty’s second-graders will examine the *Arthur* stories in picture-book form, in read-aloud recordings, and in videos, Narowski’s eighth-graders will embark on a probing comparison and evaluation of the realization of character in the book *The Outsiders* and in its movie adaptation. Sapienza’s unit models a high level of literary analysis for her high school students, guiding them to examine structure, setting, images, and symbols as nuanced forms of character revelation both in Shakespeare’s drama and in Hardy’s fiction.

Several units combine this focus on inference and critical thinking about character with a carefully-scaffolded approach to students’ reflection on and creative expression of their own characters. Sean Griffin’s unit uses Walter Dean Myers’ multi-genre novel, *Monster*, to encourage students to explore multiple ways to formulate their own experiences and tentative sense of identity. In her unit for the fourth-grade art classroom, Melody Gallagher introduces three strikingly different ways to depict character visually – Hanoch Piven’s assemblage portraits, Kara Walker’s silhouettes, and Cindy Sherman’s photographs – to allow students both to develop their abilities to discuss artworks critically and to make use of these different methods of visual representation to portray themselves and classmates. Judith J. Katz and Timothy Grady both teach creative writing: poetry and fiction-writing, respectively. Katz’s unit addresses the essential human experience of mortality and of loss, drawing on the “mentoring” offered by literary models to give students means to memorialize those real-life characters they have known who are no longer in this world – as well as to feel their ways to an understanding of the impact of such losses on their own lives. Grady takes the analysis of literary depiction and construction of character into the creative act: his students will move through a sequence of carefully-designed steps to explore that “magic” by which an author compels us to “believe” in a fictional individual.

Simon Edgett in a sense turns this interest around: his unit offers students opportunities to explore how the lived experiences of individual authors, as in the dramatic life stories of Mary and Percy Bysshe Shelley, might enter into the imaginative works of literature they create. Like Edgett’s unit, Tina Marie Manus’s unit raises students’ level of critical self-awareness and sophistication by asking them to “try on” a range of literary-critical methods – and ultimately to

consider how their own aesthetic and critical preferences contribute to a portrait of their intellectual selves.

Finally, Elizabeth Johnson's unit on "Creating Character: Performance, Analysis, and Social Development Using *Romeo and Juliet*," makes explicit the conviction that underlies another key aspect of the design of all these units: a conviction that not only through the analytical practice of reflection on literary character and its consequences, but also through the social practice of group work in the classroom, disciplined, sustained attention to others' opinions and performances, and constructive collaboration, students may gain important knowledge about their own characters and about their impact on others' inner lives. As Johnson emphasizes, our teaching seeks to foster social and emotional development, even as it sets high goals for the intellectual development of our students of every achievement level and age.

Jill Campbell



## Synopses of the Curriculum Units

### 10.02.01

#### **The Shelleys: Author and Character, Reality and Fiction, by Simon C. Edgett**

In this curriculum unit, students will explore the lives of Percy Bysshe Shelley and Mary Wollstonecraft Shelley, major forces in the Romantic Period in English literature. By exploring the two writers' personal lives and experiences, students will gain a deeper understanding and appreciation of the impact of their writing. Percy Shelley's life is evident in the themes and imagery of his poetry. Many of Mary Shelley's experiences mold characters and themes of her novels. Students will apply what they glean from their biographical study to several of the authors' works (poetical and fictional) to develop thorough analyses which take into account the historical and personal forces at work in their writings.

While this unit focuses specifically on the Shelleys and their writings, it has potential to be adapted to other authors. I have selected the Shelleys because of their dramatic lives and the impact they have on students in my classroom. Helping students see as individuals those writers they are exposed to will create an arena for deeper connection to their writings and help mold our students as lifelong learners and readers.

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

### 10.02.02

#### **Ellen Foster: A Character Study from the Inside Out, by Sandra K. Friday**

One of the five Habits of Mind that we focus on at New Haven Academy is "Who is speaking?" My unit, based on the novel *Ellen Foster* by Kaye Gibbons, addresses how the narrator, a twelve-year-old girl, Ellen, expresses her emotions and inner make-up through the clarity and candor of her voice, her perspective, her prejudices, her innocence, and the challenges she faces as an orphan trying to make a place for herself, in an often indifferent and sometimes hostile world, the rural South of the 1970s.

The central tool that my students will use for *close reading* the character of Ellen is the technique known as Marking and Discussing a Passage. Through this technique students will collaborate to create a composite of Ellen as she narrates the story of the past two harrowing years of her young life. My unit focuses on several threads that run through Ellen's narrative, beginning with the first sentence in which she confides, "When I was little I would think up ways to kill my daddy." Two strong threads are her desperate need to escape her destructively dysfunctional family, and her equally desperate need to search out a home where she feels safe. Another thread that makes the fabric of her story poignant is her journey out of racial prejudice.

While the essence of her character remains intact, Ellen also undergoes changes as she takes on the challenges a runaway orphan must face. Exploring Ellen's character is an ideal practice for my tenth-grade students who will take the Connecticut Academic Performance Test (CAPT), and will be asked to read a story in the test and use their skills to answer the question: "How does

the main character change from the beginning of the story to the end, and what do you think causes this change?"

(Developed for High School English, grade 10; recommended for High School English, grades 9-12)

### **10.02.03**

#### **A Picture Is Worth a Thousand Words: Creating Expressive Character Portraits in Art Based on the Work of Hanoch Piven, Kara Walker, and Cindy Sherman, by Melody S. Gallagher**

Why do we teach? We teach in hope that students may become critical thinkers of the world. This unit is designed for visual art students to utilize techniques of character analysis as the basis for creating their artworks while developing their ability to think critically about art. It has been designed for fourth-grade art students; however, it can easily be adapted for higher grade levels. Students will create three distinct characters in their own artworks by learning about the techniques used in the work of three contemporary artists: Hanoch Piven, Kara Walker, and Cindy Sherman. They will be experiment with three forms of art: assemblage collage, silhouette paper cuttings, and photography. Within each lesson students will develop their skills of art criticism and character analysis in oral discussions and through written responses to strengthen their critical thinking skills.

(Developed for Art, grade 4; recommended for Art, grades Elementary 4-5, Middle and High School grades)

### **10.02.04**

#### **Forging Life: Characterization through Prose, by Timothy A. Grady**

Students spend years reading and analyzing fictional texts for character, but they spend almost no time on the act of how to create character in fictional prose. This unit is designed to help students learn how to create fictional characters "on the page," i.e., in prose fiction of their own making. The unit focuses on several specific characterization methods, on prose styles (and their effects), and on the patterns in which those methods and styles are used to represent the character as a whole. In other words, the unit centers on how to create bits of character in individual lines, as well as how all those bits (and lines) go together to create the overall character. The unit's overall goal is to help students construct characters better in the fiction they write, rather than just becoming adept at analyzing others' works (though those two goals are not mutually exclusive); as such, the unit's chief method of instruction is through the students' creative exploration of characters they create.

(Developed for Psychology of Story/Creative Writing, grades 11-12; recommended for English and Creative Writing, grades 9-12)

### **10.02.05**

#### **Reading Characters, Reading Ourselves: Reflecting with *Monster*'s Steve Harmon, by Sean T. Griffin**

Focusing on Walter Dean Myers' novel *Monster* and several poems that will accompany the novel, this unit will attempt to help students uncover things about themselves as they make discoveries about Myers' protagonist, Steve Harmon. Students will see the parallels between life and literature as we move between the characters of *Monster* and the students' lives.

Students' comfort with sharing and writing will increase as we explore several types of writing in the unit. Journal writing will provide an important writing connection to the novel and to students' own experiences. Students will also explore poetry writing, memoir, letter, and essay writing. Students will become more comfortable with class discussions and sharing as we move through the unit, emphasizing the importance of respecting each other's ideas. Finally, the understanding and analysis that students put into literary characters can be applied to their own lives and displayed in an artistic format. Through a series of writing exercises, students will apply the lessons learned through literature to their own lives and ultimately express their understanding through artwork as they create three dimensional self-portraits that reveal more than a simple surface depiction of themselves.

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

### **10.02.06**

#### **Creating Character: Performance, Analysis, and Social Development Using *Romeo and Juliet*, by Elizabeth A. Johnson**

This unit uses *Romeo and Juliet* to develop social and emotional skills as well as literary skills and improvisation techniques in high school students. Students will examine characters in the play based on their goals, motivations, obstacles, and actions. Then, students will perform scenes from *Romeo and Juliet* and critique their role as audience members. Finally, students will keep a week-long journal of their own goals, motivations, obstacles, and actions. From this they will evaluate their own decisions and see how their actions affect themselves and others. Students will get concrete ways to express themselves physically and emotionally while learning literary and life skills that translate into life outside our classrooms.

(Developed for Freshman English, grade 9; recommended for Standard English Course, grade 9 and Theatre course, grades 9-12)

### **10.02.07**

#### **The Things We Carry: Understanding Grief and Loss through a Memorial Ceremony, the Elegy, and the List Poem, by Judith J. Katz**

This unit is devoted to an issue that I find is critically missing from our students' education: how to deal with grief. The day I began writing this unit, a crisis committee was called in our urban high school because there had been a shoot-out over the weekend in which three teenagers were

injured and one died. None was a student at my school, but all had close friends there. Students were crying, afraid to stay in school and afraid to go home.

I am hard-pressed to find a class in which more than 25 percent of the students have not experienced violence, death, or significant loss first- or secondhand this year alone. How do students, children, and the adults they look to for guidance and stability learn to incorporate such experiences into their lives? I think there is something to be learned from the process of grieving that requires language to examine, interpret, express, and in the end to decide what things you will let go of and what things you will carry away from grieving. I don't think writing is the cure, but I do think that reading and writing can change the way we see ourselves and each other.

(Developed for Creative Writing, grade 10; recommended for Creative Writing, grade 10)

### **10.02.08**

#### **Poetry Alive! Grabbing Young Readers via the Lyrical Voice, by Waltrina D. Kirkland-Mullins**

Bringing literature to life across genres is crucial at the elementary level. By sparking interest in written art forms at this formative age, we can help children grasp that the written word is the spoken word penned in creative ways. By intentionally tapping into children's audio-visual, kinesthetic, and tactile learning styles, we can set the tone for a love of language among young learners to last a lifetime. An effective way to achieve this end is through the use of poetry. It is for these reasons that I created this unit.

Aligned with Connecticut educational standards, the unit explores select poems by Edward Lear, Eloise Greenfield, Langston Hughes, and Arnold Adoff. Through the poetic voices of these authors, children across ability levels will be immersed in creative expression using such literary devices as simile, metaphor, onomatopoeia, and more. Story content as it applies to each poem is accentuated with a focus on the first or third person character(s)/narrator(s). Mime and role play, coupled with collaborative interactive writing activities, serve as engaging teaching tools through which students will make meaningful text-to-self-to-world connections. Equally important, students work together on a collaborative basis, making Poetry Alive! a language arts/social development experience!

(Developed for Language Arts/Social Development, grade 3; recommended for Language Arts/The Arts/Social Development, grades 3-5)

### **10.02.09**

#### **Literary Analysis: Understanding of Character through the Elements of Literature and the World Around Us, by Katharine M. Liphardt**

This six-week unit is intended to help launch genre-based, peer-supported learning groups in September/October. At this point in the school year, students will need the organized scaffolding of the teacher to prepare them to be able to work in cooperative learning groups for the remainder of the year. These cooperative learning groups are an essential component of New

Haven's reading curriculum. They will also benefit the students across the curriculum as well as through multiple genres of reading and writing. The skills and strategies introduced through this unit will allow the students to hone their critical reading skills, and the unit will serve as the foundation for the remainder of their reading instruction.

In this unit, students will begin to read literature more critically and make inferences that come from both the stated and implied features of the texts they read. Through various activities and texts, students will explore the use of multiple strategies that will enable them to interact with the text more deeply.

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

### **10.02.10**

#### **I Like What I Like, Because I Like It! An Epistemological Approach to Literary Analysis and Interpretation, by Tina M. Manus**

This eight-week unit focuses on giving students the academic language to accurately identify and describe their aesthetic preferences, while discovering new ways of looking at texts and experimenting with various analytical lenses. The unit uses "Circe's Palace," from the *Tanglewood Tales* by Nathaniel Hawthorne, as the major in-class text. Supplementary sources are included to plan for different learning styles and to increase levels of student engagement. Students are challenged to view the story through applying Reader Response, Moral/Philosophical, Mimetic, and Feminist methods of critical analysis.

The plan of instruction allows for both "Modeled Instruction/Guided Practice" and "Independent Practice." There are opportunities for self-assessment, peer assessment and "Writers' Workshop." The unit easily aligns with each marking period's essential question for the New Haven Public Schools' language arts curriculum. At the conclusion of the study of an analytical lens, students are asked to write a 250-word response in the style of that particular lens. The culminating project asks students to write a 500-word essay describing their personal aesthetic as they have come to understand it through participation in the learning activities.

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

### **10.02.11**

#### **Character Investigations, by Melissa B. McCarty**

My unit is geared towards second-graders who are learning comprehension strategies during the reading block. This unit could be altered for first grade as well as third, fourth and fifth. I will be using *Arthur* stories by Marc Brown to model and scaffold the lessons. The students will be able to infer/figure out how the character is feeling in regards to scenarios in the story. The students will use their prior knowledge and connect that with what is happening in the story to draw their conclusions.

My students have had difficulty in the past learning how to infer and how to get in touch with their thinking. I ultimately want them to be able to explain and communicate how they know the

character is feeling a certain way. The students will be grouped based on their learning styles and either use different *Arthur* books, books on tape, or films. The groups will be separated by reading level according to the DRA2 reading assessment, as well as learning styles; i.e. visual learner, auditory, and/or tactile. When the groups are separated, they will be able to identify how the character is feeling as well as be able to explain how they know. Each group will have a writing slip to fill out and will draw pictures of Arthur exhibiting different feelings. *Arthur* stories are good for teaching this skill because kids at this age can identify, and identify with, the characters in the story. Arthur the character is a student in an elementary school who faces problems that most kids face in school and at home. He has friends and family who could be labeled as “stereotypical,” which helps with the connections.

(Developed for Reading Block, grade 2; recommended for Elementary-school curriculum, grades 1-4)

### **10.02.12**

#### **Better Read than Viewed? Contrasting the Novel and Film, by Mary Lou L. Narowski**

Using the Paideia educational philosophy as the overall process, this unit seeks to address the question, “Which has more merit, the novel or its film version?” Drawing upon the novel *The Outsiders* by S. E. Hinton and the film of the same name directed by Francis Ford Coppola, my students will observe character, write a film script scene, and compose a comparative essay as a way of answering this essential question. Exploring the Konstantin Stanislavski’s Method Acting concept, my students will first critically observe three people in their lives, studying their appearances, behaviors, moods, and attitudes. They will apply this understanding to character as they read the novel. Using a series of graphic organizers, students will map different aspects of character, readying them for the viewing of the film. From there, groups of students will choose a scene from the novel and write a filmscript of that scene using skills they acquired while reading *Monster*. Next they will actually watch the movie recording identical information to be used in their comparative essay. Finally they will discuss the components of a comparative essay, and using all the information they gather throughout the process, write an essay deciding which has more merit, the novel or the film.

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

### **10.02.13**

#### **Macbeth and Tess of the d’Urbervilles: Intriguing Individuals Revealed through Structure, Setting, Imagery, and Symbols, by Marialuisa Sapienza**

Lisa Zunshine, a literary critic, argues that “fiction engages, teases, and pushes to its tentative limits our mind-reading capacity.” Her conclusion relates to “recent findings of cognitive psychologists into literary studies” that “explain behavior in terms of underlying states of mind – or mind-reading ability.” Hence, this unit focuses on the students’/readers’ ability to understand and explain a character’s behavior, thoughts, feelings, and desires through a close consideration of all the details that are conveyed by several different aspects of the text: its structure, its description of setting, its imagery, and its symbols. The unit starts with the following essential

questions: “Who is this character/person? What does he/she think? What are his/her feelings? How do you know?” In order to achieve this objective, the students start by reading a real person through specific external cues like facial expressions, tone of voice, clothing, hair style, environment, and/or interests. This is followed by the second section that explores two specific texts, *Macbeth* and *Tess of the D’Urbervilles*, with particular emphasis on the above mentioned literary conventions. The unit concludes with the writing of an essay focused on the characterization of Macbeth and Tess of the D’Urbervilles.

(Developed for College English 3 and 4, grades 11-12 and AP English Literature and Composition, grade 12; recommended for College English 3 and 4, grades 11-12 and AP English Literature and Composition, grade 12)

### **III. Geomicrobiology: *How Microbes Shape Our Planet***

#### **Introduction**

Microorganisms play many essential roles in the function and evolution of Earth systems, even being responsible for the oxygen in Earth's atmosphere and for much of the natural gas used to heat homes and fuel vehicles. Geomicrobiology explores the diverse habitats, metabolisms and functions of microorganisms that occur primarily outside of human and animal hosts. This includes microbes that thrive in the most extreme environments on Earth such as boiling volcanic hot springs, deep-sea vents, acid mine drainage, radioactive waste sites and in the deep underground, where sunlight does not serve as a primary source of energy. Geomicrobiology is a highly interdisciplinary field that encompasses geology, geochemistry, molecular biology and microbiology – all applied to the study of interactions between microorganisms and Earth systems over the full range of geologic time and spatial scales.

A student's first introduction to the microbial world is often within the context of microbes as germs or parasites that cause disease or other harm with their only beneficial role being that of the decomposers of organic matter in predominantly terrestrial ecosystems. Not only do these narrow definitions of microbial form, function and habitat leave out the wide array of roles that microbes play in shaping the planet, but they also fail to inform on the greatest source of biological diversity on Earth – microbial diversity, a great deal of which lies outside of the terrestrial realm and even beneath the ocean floor.

Of the three domains of life, two comprise exclusively single-celled and microscopic organisms – the Bacteria and the Archaea, which collectively make up a significant amount of Earth's total biomass, yet receive very little attention in K-12 science courses. The overarching goal of this seminar was to expand science curriculum content on microorganisms and geomicrobiological processes by providing new information, and to also reinforce teachers' comprehension of fundamental concepts and relevant background knowledge of chemistry, geology, microbiology and biochemistry.

Larger and multicellular organisms are often described in terms of their physical appearance and behaviors, whereas the single-celled prokaryotes (bacteria and archaea) are described in terms of their metabolic and biochemical diversity. Exploration of microbial diversity thus requires knowledge of basic chemistry and metabolism central to all cells and especially the concepts of electrons, electron flow, and reduction-oxidation (redox) reactions.

Regardless of the grade level at which unit content is taught, it is highly beneficial for instructors to have a firm grasp of the underlying fundamental chemical/biochemical processes that govern metabolism and are common to all living organisms. Such fundamental background information was included in the seminar with the goal of enriching the teaching of specific unit content on geomicrobiology as well as enhancing the teaching of related science curricula. Units by Carol Boynton and Deborah James include detailed background sections reviewing fundamental concepts in chemistry, energy flow and metabolic diversity. Haifa Abdel-Jalil



emphasizes the physiological features of bacteria such as cell morphology, motility and reproduction as well as the many impacts of microbes on society.

One of the greatest challenges to teaching about microorganisms and microbial processes at the K-12 level, especially in the earlier grades, can be the lack of microscopes in the classroom needed to observe microbes and make them “real” for the students. Thus, hands-on activities included in several of the units (K-6 especially) emphasize macroscopic manifestations of microbial activity such as microbial mat communities (Deborah James, Melissa Talarczyk), root nodules and bioluminescence (Julia Biagiarelli), and the impact of microbial cycling of nutrients on other organisms as well as on humans (all units). Units by Charlene Woodland and Julia Biagiarelli include activities involving the detection of microbial activity through means other than direct visual observation of cells, such as the sense of smell and chemical detection of microbial metabolic byproducts.

Units emphasize both the helpful and harmful roles that microbes play in their interactions with other organisms and humans, with Melissa Talarczyk and Julia Biagiarelli focusing on the local marine habitat of Long Island Sound. The unit by Charlene Woodland considers the presence of microorganisms and their interactions with the Earth from its very beginnings.

Several of the units cover similar and common topics such as photosynthesis and the carbon, nitrogen (e.g., Boynton, Biagiarelli, Woodland) and sulfur (James, Woodland) cycles, but from different perspectives and at different depths appropriate to each grade level. This approach provides reinforcement of the more technical aspects and fundamental chemical concepts included in the seminar, so that, for example, a middle- or high-school instructor could benefit from the units written for K-2 students and vice versa.

Ruth E. Blake

## **Synopses of the Curriculum Units**

### **10.03.01**

#### **The Wonders of Bacteria, by Haifa Abdel-Jalil**

The purpose of this unit is to introduce students to the invisible world of bacteria. Bacteria play a significant role in our lives and in natural ecosystems; yet we cannot see this with our naked eyes. Through this unit, students will develop a deeper understanding for the classification of bacteria, practice some lab techniques that will improve their experimental design skills, and use a microscope to explore the amazing world of bacteria.

The background information sheds light on the differences among prokaryotes including shape, chemical structure of the cell wall, reproduction, and styles of movement of prokaryotes in their environment. However, no characteristic of prokaryotes can illustrate their diversity more than the methods they use to obtain energy. This diversity can have a direct impact on our lives either by producing organic carbon, formation of iron deposits, producing oxygen in the biosphere or recycling organic matter in nature. The unit will also explain how bacteria can cause diseases – and reasons why some bacteria are becoming resistant to antibiotics.

The unit includes many hands-on activities that allow students to draw the shape of bacteria, and teaches them about exponential growth. It also includes a Gram-staining technique, and an antibiotic sensitivity lab. In addition, students will complete a research project about the role of bacteria in science, society and technology. They will make a brochure and will be evaluated using a rubric.

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

### **10.03.02**

#### **How Microbes Help Ecosystems, by Julia Biagiarelli**

The purpose of this unit is, through direct experience with various microbes, to introduce middle-school students to microbiology. Students will be participating in lab activities, recording observations and notes in an interactive notebook, and researching basic concepts of microbiology to gain a better understanding of the world around them, especially those living organisms that are not visible without microscopes.

The unit includes background information about: basic microbiology, bacteria, archaea, ecosystems, nutrient cycles of water, carbon, nitrogen and oxygen, useful microorganisms, relationships between living organisms, and the microbes that live in Long Island Sound. Sample lessons and activities are designed for active participation by students, using their five senses, where applicable, to discover the world of microorganisms. Use of the interactive notebook is recommended to enhance students' understanding of the concepts presented.

(Developed for General Science, grade 6; recommended for General Science and Life Science, grades 5-8)

### **10.03.03**

#### **Life Underground, by Carol Boynton**

Microbes are everywhere. There are more of them on a person's hand than there are people on the entire planet! Microbes are in the air we breathe, the ground we walk on, the food we eat; they're even inside us! We couldn't digest food without them, plants couldn't grow, garbage wouldn't decay, and there would be a lot less oxygen to breathe. In fact, without these invisible companions, our planet wouldn't survive as we know it!

Five activities will provide a platform for teaching this unit on microbial life to students from first to fourth grade. The students will grow plants from a variety of seeds, develop an aquatic habitat and build a terrarium, create and maintain an underground worm environment and an ant colony or farm. As scientists, the students will make observations and learn about organisms, including microorganisms, through inquiry and hands-on experiences and participation in these examples of life. Science journals will allow students to track and report scientific findings while observing these five environments and to express different ways the organisms sustain life. How they are breathing and eating will be an obvious connection to human life as well. Included is a fundamentals section that can be useful to science teachers at all grade levels.

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

### **10.03.04**

#### **Ecosystems Beneath the Surface, by Deborah James**

The purpose of this unit is to provide information about unfamiliar organisms to fellow teachers of science of ecosystems. There are ecosystems that do not rely on a "predator-prey" relationship, but rather a community of organisms existing on metabolic byproducts and chemicals released by other organisms. Not all food chains begin from the energy source of the sun directly; some receive the sun's energy indirectly, or not at all. All of this information opens up the dynamic world of geomicrobiology. Teachers will then, in turn, use this information to create meaningful activities for their students through hands-on experimentation in the classroom.

The unit includes background information on how microorganisms convert various forms of energy into ATP in order to create biomass. This energy conversion or electron flow is essential to all living things, and although there will be differences in the energy/electron donors and acceptors of aerobic versus anaerobic organisms, the ultimate requirement for the survival of all organisms is that electrons must flow for ATP to be created and for energy to be used by cells.

Sample lessons are outlined as hands-on classroom activities that include growing microbial mats, and the important role that each layer in the mat plays for the survival of the whole community. There are interactive lessons that students will engage in via the Internet from NASA's Web site, with a computer slide presentation the culminating activity. Students will also participate by playing the three cycle game: oxygen, carbon dioxide, and sulfur. All students will keep an interactive science journal which will focus on what they learn, questions that arise, and a summary of the lesson, followed by homework that is meaningful to the lesson. New

vocabulary words will be maintained in a creative fashion through the use of foldable matchbooks to help with retention of meaning.

(Developed for Ecosystems, grade 6; recommended for Science Curriculum on Ecosystems, grade 6)

### **10.03.05**

#### **Microbes in Long Island Sound, by Melissa Talarczyk**

Imagine a world of microscopic creatures swimming and living around us. This unit allows you to teach your students about the world of bacteria. Students will discover how plants living in Long Island Sound are positively and adversely affected by the microbes living within the water. Students will also learn how bacteria or germs can both help and harm humans. They will make observations as bacteria are grown in the classroom, focusing on how the amount of light the bacteria receive help them to grow more quickly. They will discover what the bacteria need in order to survive and flourish in the Sound. Students will learn about the process of weathering and erosion of rocks and how they provide the plants and animals in the oceans and lakes with nutrients. Students will learn the role that the water cycle plays in the contamination of oceans and lakes. Finally, they will also learn how they are responsible for some of the pollution in the Sound and how they can help to keep the Sound clean.

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

### **10.03.06**

#### **Microbial Influence on Earth's Systems, by Charlene Woodland**

The purpose of this unit is to examine the influences microbes have on Earth's systems. For identification purposes and more detailed study Earth is broken down into four spheres: atmosphere, hydrosphere, lithosphere, and biosphere. As separate as these spheres sound, they work together to create the planet that we inhabit.

The unit includes background information on Earth's origin, microbes, and biogeochemical cycles. An outline of Earth's origin is discussed from the time of the Big Bang to the accretion of the planet. From that point the unit fast forwards to about 3.8 billion years ago, the documented time of the first microbes. It discusses how microbes changed the atmosphere into one that was oxygen rich and able to support eukaryotes. A classification scheme for prokaryotes is discussed, focusing on metabolism and outlining the major groups of bacteria and archaea. Following the background information on Earth and microbes is a section on the carbon, nitrogen and phosphorus cycles and the influence that microbes have over these systems.

Sample lessons are included. Each lesson has been created to reinforce the concepts of matter cycling and Earth's integrated systems. The focus of each lesson is to investigate, analyze and communicate findings in writing.

(Recommended for Physical Chemistry, grade 9; and Environmental Science and Advanced Placement Environmental Science, grades 11 and 12)

## **IV. Renewable Energy**

### **Introduction**

With concerns about the impact on the environment of our current use of fossil fuels and our national energy security, renewable energy is in the news on a daily basis. Many students have seen Al Gore's movie "An Inconvenient Truth" and are familiar with some of the issues relating to energy use, but they may not know much about the science related to renewable energy. The aim for this seminar was to discuss the science related to current sources of energy and potential future sources of energy, with a focus on renewable energy. We can learn much about sustainable energy use by studying natural processes. Nature has solved the renewable energy problem through the process of photosynthesis that is carried out by green plants. Plants are amazing chemical factories and provide a working example of renewable solar energy conversion, but this is often not appreciated. By understanding how plants carry out the processes of solar energy utilization, we can obtain some answers to the question of how we can harvest solar energy by using processes of artificial photosynthesis.

My own interest in science stems from my hands-on experiences as a child. Therefore, many demonstrations were included in this seminar – at least one demonstration, and frequently two or three, in each seminar meeting. These demonstrations were chosen so that they could actively involve the students and at the same time illustrate the scientific principles related to renewable energy.

The books, by David Walker entitled *Energy, Plants and Man* and by David J. C. MacKay entitled *Sustainable Energy – without the Hot Air*, were used as the primary texts for the seminar. A special issue of *Scientific American* on "Energy's Future Beyond Carbon" (September 2006) served as a supplementary "text." The beginning of the seminar focused on energy, light and photosynthesis. The seminar began with a discussion of how plants use light to convert carbon dioxide and water into sugar and oxygen gas. This was followed by discussions on the nature of light and the fundamental steps by which light is absorbed by plants and converted into chemical energy. Demonstrations of the colors in light using diffraction glasses and a spectrophotometer aided these discussions. Plant pigments were discussed next, together with demonstrations on light absorption/emission by pigments extracted from plants and algae, and on pigment separation by using paper chromatography. The process of carbon fixation was discussed and an attempt was made to "photographically" illustrate this process by making starch pictures on geranium leaves (although this demonstration was not as successful as I had hoped). Next, we delved into various forms of energy, including hydroelectric, biofuels, wind, geothermal, solar and nuclear. A highlight of the seminar was the production of biodiesel fuel from cooking oil that culminated in the combustion of biodiesel fuel in an oil furnace burner. The seminar also included a discussion of energy use in the future that included progress in development of systems for artificial photosynthesis and fuel cells. The timeliness of these discussions was brought home by the BP oil spill in the Gulf of Mexico, which was ongoing during the seminar and provided a fertile topic for discussion.

The curriculum units developed from this seminar are suitable for elementary to middle-school to high-school students. In all of the units, the science content is integrated with language

arts, mathematics and social studies to provide a balanced program that meets the literacy requirements of the school system. The Fellows have prepared extensive lists of materials that can be used in the classroom or as supplementary resources. These materials include books that the students can read, textbooks that the teachers can use, demonstration sourcebooks, suppliers of equipment and many addresses of sites on the World Wide Web. Several of the Fellows developed units around a theme or activity related to solar energy, including an innovative mathematics unit on the use of solar heat to create convection currents for solar energy conversion in solar chimneys. Other units are related to projections of sources of energy for the future and the responsible use of current sources of energy to lower our carbon footprint, as well as the impact of our energy use on the planet Earth. The units include a number of excellent activities that will engage the students' interest and teach them about renewable energy.

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

Gary W. Brudvig

## Synopses of the Curriculum Units

### 10.04.01

#### **Searching For Tomorrow's Energy, by Andrea N. Bailey**

This unit will give the students the ability to use demonstrations to better understand the chemistry, physics, and economics of various energy alternatives. The unit will allow students to connect to science in their daily lives when they are beginning to question their lives in general. This unit will allow students to feel comfortable with the processes of scientific investigation. Students will design, conduct, communicate about, and evaluate investigations of renewable energy.

This unit will help students consider which energy source will be most effective for the economy and the environment in the future. At the completion of the unit, students will be able to distinguish between potential and kinetic energy, identify and describe different forms of energy, and demonstrate an understanding of renewable and nonrenewable sources of energy. These topics can be integrated directly through math, science, and technology. Students will further appreciate why it's important to conserve energy – because it directly affects their own daily lives while serving a larger purpose.

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

### 10.04.02

#### **The Mathematics of Convection: Nature's Model for Energy Production, by Timothy J. Chiaverini**

This unit is developed for students learning algebra 1 or geometry concepts and covers approximately two weeks of instruction. During this unit, students will discover the answers to basic, yet scientifically critical questions such as: Why does warm air rise? Why does a two-ton boat float while a one-ounce rock sinks? What are the properties of water in liquid, gas or solid form? How does a hot air balloon fly? The unit will advance students' understanding of convection and its potential uses in renewable energy models. Convection currents can be powered by solar energy. One model that uses solar energy to create convection currents is the solar chimney, which is discussed in detail in the unit.

The unit takes an experimental, real-world approach and develops mathematical models. The unit makes valuable connections between science and mathematics. Students learn about buoyancy, density, temperature and volume, and explore real-world relationships between temperature and volume. Students make predictions and draw conclusions about scientific experiments using symbolic, linear, graphical and quadratic mathematical models. Through this process, they discover critical scientific concepts and use mathematics to make conjectures and develop evidence to support their conclusions.

(Developed for Algebra I, Geometry, grades 9-10; recommended for Pre-Algebra, Algebra 1, and Geometry, grades 7-10)

### **10.04.03**

#### **Energy and Me: What Is My Responsibility? by Cheri D. Guerra**

The central idea of this unit is “The choices we make every day about how we use energy impact our environment and our lives.” In this six-week unit, I will begin with the concept of energy. The students will brainstorm about what energy is, why it’s important to us, and where it comes from. From that point, I will demonstrate the different types of energy, the sources of energy, and the effects each has on the environment. I will structure my lessons by teaching about fossil fuels first and then carbon-free powers. Upon completion of instruction on fossil fuels, I will use a map to demonstrate where our reserves are, and initiate discussion on our reliance to other countries and what problems that can cause. Similarly, in concluding the lessons on carbon-free powers, I will use maps to show what countries are using these sources. Throughout the unit we will work on a large comparison matrix to compare all energy sources, including the pros and the cons of each. We will also discuss what countries or areas are doing a better job at using clean energy. This should get the students thinking about our role as a nation and what we could or should do to help.

(Developed for Elementary Science, grade 5; recommended for Elementary Science (includes activities in reading, math, and writing), grade 5)

### **10.04.04**

#### **Renewable Energy in Connecticut – Softening Our Footprint through Sustainable Energy Use, by Paul M. Jones**

This unit is written for the instructor of introductory high-school science, to teach the state and national standards concerning energy use and different sources’ effects on the environment. The prose has background information, including the risks and benefits and criteria for their success in a given region, of the more prominent types of renewable energy to prepare the instructor for this unit. The teacher resources section directs the teacher to further information for his or her home region, and student resources include lists of suggested readings and current Web sites appropriate for student research. The unit concludes with ideas for suggested lessons/assessments and rubrics to accompany them.

(Developed for Phy/Chem, grades 9-10; recommended for Physics/Chemistry, grades 9-10)

### **10.04.05**

#### **Eco-Kids: How Students Can Help Save the World, by Roberta A. Mazzucco**

How much carbon do you produce on a daily basis, and how could you reduce that amount in order to help reduce global warming? This is one of the activities that students will do as part of this unit. It was written for use in a fourth-grade classroom but can be extended for use in grades two through six. The unit has a two-fold objective. The first is to educate students about the need for the development of renewable energy sources for the future. This includes wind, hydropower, biomass, nuclear, hydrogen, and solar. An activity or experiment for each of these sources is included for students to do. The unit also recognizes that the nonrenewable sources of energy we now rely on are in limited supply. These include oil, coal, and natural gas. The unit calls on



students to research ways to conserve the supply of these energy sources. Students will utilize the Web to calculate their carbon footprint and discover how they can reduce the amount of carbon in their daily lives. Students will present their findings at an energy fair in which they will educate other students, teachers, and their own families about the energy crisis. The unit provides an annotated list of books for teachers and students. There is also a list of Web resources. The unit also references the local and state curriculum standards that are covered.

(Developed for Science, grade 4; recommended for Science, grades 2-6)

#### **10.04.06**

#### **Environmental Agents of Mathematics: Mathematicians for Change, by William Lawrence McKinney**

This unit focuses on the creation and understanding of data collection and scatter plots. Many textbooks concentrate on plotting points and developing linear regressions based on best-fit models. While this unit intends to accomplish these skills, it will also revolve around the notions of bias and influence to discuss how data can be manipulated to prompt specific reactions and alter public opinion. More specifically, this unit will focus on how data and scatter plots can affect public opinion on significant political debates such as environmental protection and energy resources. This unit focuses primarily on the consumption of fossil fuels and looks at different perspectives on the energy crisis. In the end, students will pull together their mathematical knowledge and their energy knowledge to create a public service announcement that accurately informs the public of real energy issues that are mathematically supported.

Students will learn to plot points, create scatter plots, identify types of correlation, and extrapolate and interpolate values.

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

#### **10.04.07**

#### **Current Sources of Energy to Maintain a Sustainable Future, by Laura Nannoum**

This unit is designed to explain what energy is, the different sources we use to harness energy, and how energy choices relate to students. It will give students the opportunity to evaluate and draw on their own conclusions. Students will have the opportunity to internalize their effect on the world when they overuse electricity. Students first need to understand where electricity comes from. They will experiment with energy and be able to describe energy in one sentence. In order to understand the availability of energy sources, students will compare renewable resources with nonrenewable resources. Once background knowledge is developed, students will begin learning about wind power, solar power, hydropower, and fossil fuels. They will demonstrate understanding of how energy is transported to their home and how they are able to use it. Students will research and evaluate the cost, effect on the environment, and availability of wind power, solar power, hydro power, and fossil fuels. They will come to their own realization about which energy source makes the most financial and environmental sense to power our world and will create a diagram of how it will be transported to homes in their neighborhood. As a result of

this unit, students will understand the energy source their home currently uses, and will recognize the importance of finding alternative sources and conserving electricity.

(Developed for Science, grade 4; recommended for Math, Science, Language Arts, Technology, grades 3-5)

#### **10.04.08**

#### **Exploring Renewable Energy through Graphs and Statistics, by Ashley R. Singer**

This unit is intended for Pre-Algebra students. The main objective is to teach students how to make bar graphs, histograms, line graphs, scatter plots and find measures of central tendency. Students will also gain some background knowledge on renewable energy and what environmental impact they may have on the world. The final project will have students reflecting on their daily habits, making a plan and finally graphically representing their projected habits, based on the plan.

(Developed for Pre-Algebra, grades 9-10; recommended for Pre-Algebra, grades 9-10)

#### **10.04.09**

#### **Exponential Attributes of Renewable Energy: From Nanopossibilities to Solar Power, by Kenneth William Spinka**

Renewable energies challenge the sciences for strategic solutions to both energy generation and energy application. This curriculum unit introduces and integrates renewable energy as a sample study subject for the mathematics curriculum and physics curriculum of high-school grade levels within the New Haven Public Schools. Selected goals and objectives are cited in the appended lesson plans that will enable students to respond to a series of associated assessments.

Consequently, students experiment with alternate solar energy models that compare and contrast the risk-benefit analyses of collecting, storing, distributing, and applying solar energy to create self-sustaining energy plans for environmental equilibrium, hydrocarbon reductions, and real-time energy problem solving. The attributes of solar collector materials and time-lapsed performance patterns harvesting solar energy, storing solar energy, and calculating solar angles, comprise the data that will be popular with math students. Exploring alternative materials implicit to material science, performance specifications for managing and converting the Sun's photons, and the future designs of both active and passive systems, comprise the data that will be most popular with science students. Pedagogical approaches to nanomaterials and nanotechnologies are also presented, demonstrating more flexible, more stable, and higher performing solar energy generator-candidates to power our planet with lower costs, smaller dimensions, and a more predictable future.

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