RENEWAL
In a Community

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RATIONALE

Jill LeBallister-Dudka and Paul Kelly

The theme for this interdisciplinary unit is, "Renewal in the Community". When we think of renewal we think about making what is old new again. To renew something requires the recognition that we live with a future, but also with a history both in generations and in cycles of the natural world. We plan for renewal, prepare for it, work for it, wait for it, and when needed intervene to keep alive and fresh what is fading which may or may not create a new form.

The essential question in this unit is, "What is our role, as individuals, as members of a community and as consumers of resources, in the cycle of renewal?" Some questions that will drive our inquiry are: How can adolescents understand that human beings, the environment and the community are continuously in need of renewal? When do we, as human beings, need to step back--wait, rest, recuperate, reflect? When do we need to renew our vision and redouble our energy? When do we need to intervene to restore or renew an object of value that has been damaged or cast aside? What do we keep of the old? What do we add that is new? When do we recognize with grace or gratitude the cycles of death, dormancy and renewal that are much bigger than we are and are out of our control?

This theme allows eighth-grade students to create multiple connections to the idea that all things must renew themselves or die. In the natural world, renewal generally happens in cycles but is often interrupted by human intervention with both positive and negative results. Human renewal of the natural world requires working within the confines of natural cycles of renewal. Through experiential and inquiry learning, students will learn how to work within this natural cycle as they are exposed to the idea that human, social and personal renewal requires vision, effort, patience, and resources. Students will develop a greater understanding of the importance of these human and natural renewing cycles. Through multiple lenses, students will explore how they can positively influence or simply coexist with these cycles to ensure a healthy body and spirit, environment and community.

As the service learning component of our unit, students will transform an abandoned lot into a school garden as a living symbol of renewal in their community. This multi-year project provides students with an opportunity to be a link in the cycle of a garden. At the end of the project, they will pass on the fruits of their labor to the next class to continue the nurturing, care, and flourishing of the garden. The garden will become the physical manifestation of renewal in their community and a shining example of their vision, effort, patience and resources.

The renewal of the vacant lot into the school garden is the link between the content areas and the theme. The inquiry and learning that takes place in the content areas will support the development of the garden.

This unit is intimately related to the real needs and resources of any school and community in which it would be implemented. To put "flesh on the bones," we imagined applying this unit in a community similar to Cambridge—urban, diverse, and possessing strong resources. Ten Cambridge public schools currently participate in the CitySprouts program, a parent-led effort that supports the development of schoolyard gardens. CitySprouts funds stipends for five middle

A Schoolyard Garden…

embodies the theme of renewal by …

- giving the lot a new life and purpose
- removing an eyesore from the street
- being a place for rest, thought and play for the community
- providing good food and exercise to aid positive health
- challenging us to learn new skills thereby renewing our minds
- being a place of beauty and by being tangible evidence of student accomplishment thereby renewing our spirits
- by clearing trash, composting food, turning in cover crops, rotating crops, and making a healthy garden habitat for microorganisms and worms and renewing the soil

As we seek to answer our essential question "what is our role in the cycle of renewal?" many additional questions will arise such as…

- How do living things renew themselves, as individuals and as populations?
- How is soil renewed? Water?
- How is Earth's surface renewed?
- What is our vision for renewing this lot, street, and neighborhood?
- How can renewing this lot meet real needs in our school and community?
- What work will we need to do to accomplish our vision?
- How long will this process take?
- What resources will we need? How and where will we get these resources?
- What tasks will others need to accomplish to renew our efforts next year?
- How have people in other places sought to renew their lives and spaces?

school students to maintain each school garden through the summer and learn more about urban gardening. In the wider Boston area, the Boston Natural Areas Network supports community gardens and has begun a pilot program, Students Learning through Urban Gardening (SLUG) to connect community gardens with schools.

Disciplinary Content in the Interdisciplinary Thematic Unit

Besides envisioning a specific community for this unit, we have also outlined a particular set and sequence of activities. If this unit is implemented, these activities may be adjusted for the circumstances and needs of the participating community. Furthermore, as students take greater ownership of the project, they can expand their project in other directions.

In science, our students will examine renewal in the natural world by exploring cycles in harmonic motion, the reasons for seasons, and plant reproduction and heredity. These units will lay a conceptual basis for recognizing that even natural and physical systems that are cyclical depend on new inputs to maintain themselves or grow. In reality, the theme of renewal and cycles is so deeply related to science that it can be related to many more areas of study than those outlined here. As students work in the garden and prepare for their eighth-grade MCAS test, they will have occasion to reflect on such topics as the relationship of the rock cycle, life cycle and water cycle in soil formation, and the energy cycle of photosynthesis and respiration in living things. The ITU could be further unfolded to incorporate habitat restoration, the recycling of materials, the recapture of energy, and the meaning of "renewable" resources. In humanities (social studies and language arts), students will experience the renewal (resurgence) of a culture through the exploration of the Harlem Renaissance. Through theater, poetry, and art, students will reflect upon the historical significance of this time and experience the creations of artists at the forefront of the Harlem Renaissance. In addition, they will create their own masterpieces to display and/or perform during the culminating activity. Lastly, students will write persuasive letters to involve local businesses and even larger corporations to donate resources of all kinds for the development of the garden.

Students will use mathematical skills and reasoning to help support the renewal of the garden plot. They will determine the resources needed for this botanical enterprise, as well as the

numerous plants that will transform the abandoned lot. In addition, the students will design the layout of the garden as well as a greenhouse. Students will experience the work required for running a business by evaluating budgeting decisions when they look at material costs.

In the unified arts, students will create artwork inspired by their knowledge of the Harlem Renaissance and their work in designing, preparing and growing produce in the garden. They will use software applications such as Microsoft Excel, PowerPoint and Word to assist in the development of resources planning, cost estimating, and presentations. In industrial arts/engineering, students will design and build the greenhouse in preparation for a late winter "barn raising." In health class, students will study the renewal of the human body through learning about proper sleep and nutrition.

Engaging and Culminating Activities

As a "kick-off" for the unit, the students will embark on a field trip to The Farm School in Athol, Massachusetts. At the farm, the eighth graders will engage in a variety of activities surrounding their study of the cycle of domesticated plant life. They will begin to create an understanding of the steps needed for creating a fruitful school garden. During the trip, students will form many questions regarding their project, which they will answer as the unit unfolds.

The unit will culminate in a student-lead, outdoor extravaganza at the end of the school year in which the eighth graders will educate incoming eighth graders about the garden and charge them with the care of the garden. During this culminating event, summer garden workers will be recognized, scale garden and greenhouse models shared, student artwork will be displayed as other students perform renewal-inspired poetry/music, and a taste testing of vegetables will take place.

Community Support

During this unit, we will involve local professionals and parents to support the real world application of the skills the students are acquiring. We will bring in farmers and urban gardeners through the CitySprouts program to work with students and architectural students from the Boston Architectural College to assist students with building design, measurement techniques and CAD/CAM software applications. Local residents will be contacted, kept informed, and invited to participate in helping students establish and maintain the garden.

School and Student Profile

The school is an urban, public, K-8 school in a major metropolitan area, with a diverse population, racially, culturally and socio-economically: 32 percent African-American, 23 percent other non-white, and 34 percent free and reduced lunch The school has good funding, strong community support and resources.

- 8th grade
- 2 classes of 17-20 students each
- diverse levels of prior academic achievement

- no LEP students
- 3-5 students with IEPs in each class
- no students with physical disabilities

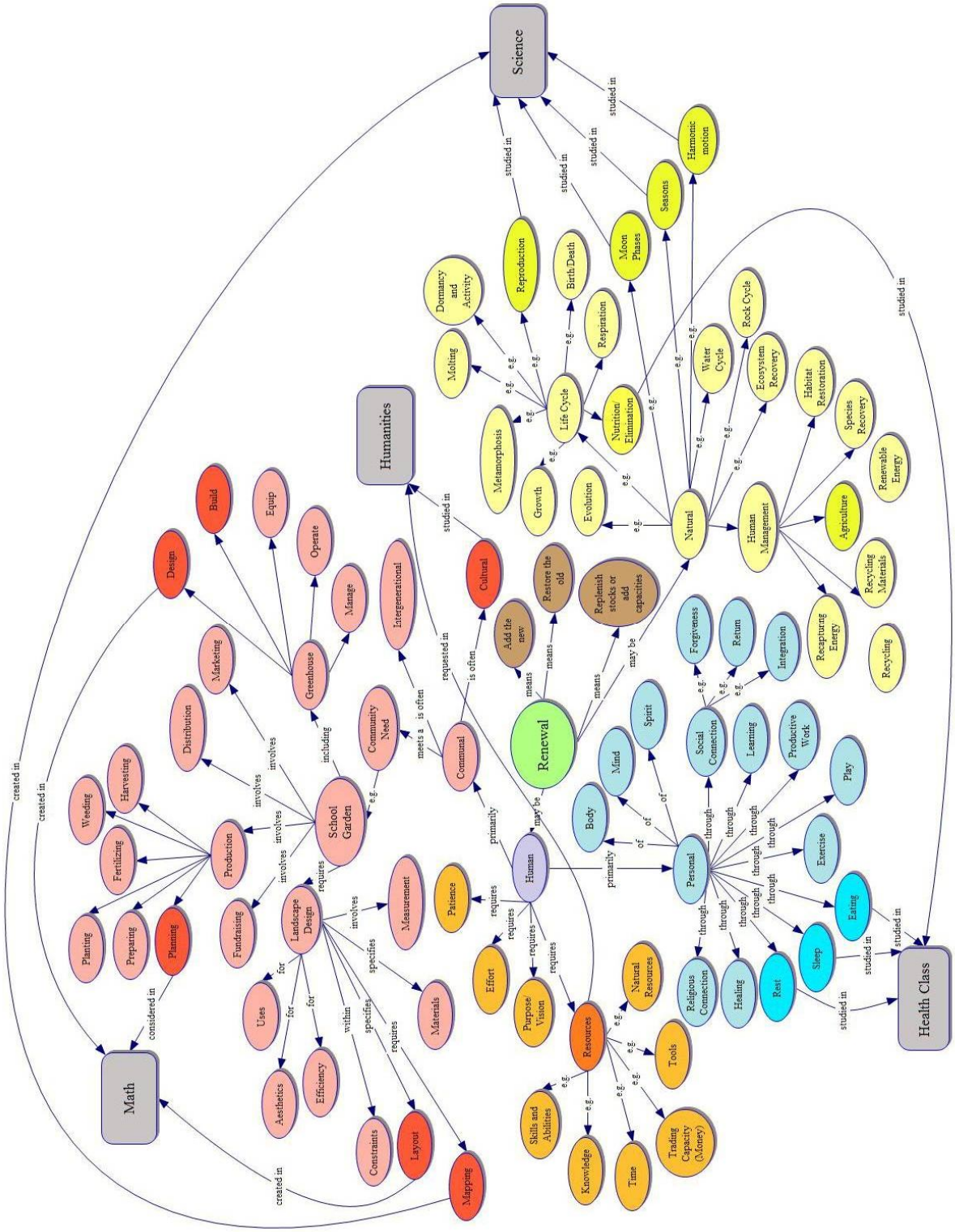
Completed preparations

This unit follows a year of critically important preparation done by teachers and members of the local community.

- The school observes an opportunity to renew a vacant lot adjacent to the school. Many parents have expressed concern with the possibility of children getting hurt in the lot. The school sends home a letter and questionnaire to parents requesting input as to whether renewing this lot is important and whether or not they would be willing to actively help in the renewal project.
- The approximate size of the lot is one quarter acre.
- After inquires to Town Hall, we learned that the city owned the lot.
- Through negotiations between the town manager, selectman, school board of trustees and city officials, the school was given permission to use the property for a school garden for at least five years.
- The PTO raised funds for the project throughout the year to cover the upstart costs of the renewal..
- The PTO, Parks and Recreation and Department of Public Works cleared the lot of hazardous material, metals, trash etc.
- This year our thoughts are to plant on a space of 12 x 24 feet, with expansion in future years. The team teachers felt since this was the first year perhaps a smaller planting area would be more manageable. This area can, however, change.

CONCEPT MAP

Paul Kelly



TIME TABLE

Osprey Team

This would be hung in the classroom for students and for the teachers so everyone is aware of what is going on each month. Also, students should have a copy of this on the front page of their portfolio.

MONTH	ACTIVITY
August	▪ Send parent letter ▪ Send student letter
September	▪ Send home field trip permission slips ▪ Begin composting ▪ Research plants and associated suitable growing conditions ▪ See site and take soil samples and test
October	▪ Field trip – take soil samples at Farm School ▪ Survey students regarding crop preferences ▪ Prepare the field for the winter
November	▪ Decide on crops ▪ Students develop timetable, action plan and assign responsibilities for implementation of garden plan ▪ Write letters to obtain resources through community donations of money, time and skills. ▪ Teams are created for each plant &/or flower so that teams become experts on growing that particular plant. ▪ Design greenhouse ▪ Design layout of gardens
December	▪ Continue the greenhouse design ▪ Continue the garden design
January	▪ Pre-fab the pieces of the green house
February	▪ Construct green house outside – "barn raising" ▪ Plant winter crops
March	▪ Make sure the field is ready for planting ▪ Begin planting
April	▪ Continue planting ▪ Study Harlem Renaissance
May	▪ Create artwork & performance pieces for culminating event. ▪ Students compile all their work into their portfolio ▪ Check student progress on presentation.

June	▪ Culminating event ▪ Hand over the garden to the 7th grade
July	▪ Garden maintained by CitySprouts team and neighbors
August	▪ Garden maintained by CitySprouts team and neighbors

HABITS OF MIND & STUDY SKILLS

Dorin Shams, with contributions from Paul Kelly and Jill LeBallister-Dudka

Throughout this unit of study the following habits of mind will be engaged:

Persistence – What does it mean to be persistent? Does persistence mean you try the same approach again and again? Or, do you make adjustments to your current method and then try again? Persistence is important, but this attitude should not be an exercise in futility. We will explain what persistent means, give real world examples, and model the behavior. Students will be guided to ask questions such as:

- What information do I have?
- What information do I need?
- What materials are available?
- How much time do I have?
- Who can I work with?
- Where can I get help if I am still not sure?
- What changes do I make to the process or my approach?

The garden is a long-term undertaking which will pose many challenges and only bring fruits over time.

Applying past knowledge to new situations – think about what you know about the problem, then try to see if you can make connections with prior knowledge and the problem at hand. How did you solve that problem? Can you apply the same techniques?

Being attentive and gathering data through all senses and thinking interdependently – students need to learn to use all their senses when gathering information. They need to try visualizing, writing, smelling, etc and then combine that information with other content and prior knowledge to see if all the information makes sense. Students need to observe data and details and be able to remember that information in a meaningful organized way. Students need to understand how they see information.

Listening with understanding and empathy– students need to learn and practice being respectful when someone is trying to explain a thought. They need to pay attention, look at the person speaking, be patient, let the individual finish his sentence, and then ask questions.

Thinking fluently and flexibly – Usually, more than one way of solving a problem exists and oftentimes, more than one solution to a problem exists. Be creative in finding your solutions and use a variety of resources if necessary. In any large undertaking, there will be changes and adjustments along the way. Students will need to generate (and regenerate) many and varied ideas. Applying the renewal theme in different areas will require that students generate many and varied ideas of how renewal works.

Taking Risks – Students and teachers will be doing things they have not done before. Nor all elements may succeed as hoped. Risk is necessary when solving problems, creating solutions,

and inventing. Students will also learn that the level of risk must be reasonable and not excessive.

Searching for Patterns - How does renewal describe a pattern that emerges in different forms in different subjects, investigations, and undertakings? What type of relationships do we see in shapes, data, cycles and art?

Using models and metaphors; thinking by analogy - Renewal is itself a kind of model, metaphor, or analogy for many different processes.

Develop and use a plan of action – When you come across a math problem or a problem in daily life, make a mental or written list of ways to solve the problem. Define the problem, research the problem thoroughly, observe the problem from multiple angles, and devise an action plan supported by an alternative solution. If the first solution does not work, try another solution. Remember to stick to deadlines and solicit help if necessary. Personally check your results or ask another person for feedback to make sure your answers appear logical.

Cooperating and collaborating and competing – In order for students to successful continue to renew the vacant lot and turn it into a productive school garden successful collaboration and cooperation must take place. Students will compete in the sense that the most appropriate design of the garden plan and greenhouse will be chosen. They will also compete against other natural forces such as weeds and insects.

Simplifying questions and problems – Students will clarify their questions by thinking more clearly about why they are asking the questions.

Study Skills

- Self-evaluation
- Thinking about thinking (metacognition)
- Organization of classroom material
- Goal setting and Planning
- Seeking information
- Keeping records
- Rehearsing and memorizing
- Asking peers for help
- Asking teachers for help
- Asking adults for help
- Reviewing material for special projects
- Striving for accuracy
- Remaining open to continuous learning

ENGAGING ACTIVITY

Osprey Team

The engaging activity that kicks off our ITU will be a field trip to The Farm School. Situated in Athol, MA, the Farm School provides direct, hands-on learning experiences for adults and students to educate them in farming techniques, lifestyle and advocacy**.** This field trip connects directly to our theme of renewal and will help drive the development of our service-learning project – the school garden. Our goal for this trip is to solicit excitement from the students regarding all the possibilities open to them as they contemplate their school garden. We hope that the vibrant experience of participating in daily farm life, far from the occasionally utilitarian existence of city life, will begin to spark a litany of questions and curiosities.

Prior to the field trip, students will take a sample of the soil in the garden and perform an analysis of the soil. In addition, we will send a soil sample to The Farm School for them to do an analysis. After the classroom analysis is complete, we will gather in groups to brainstorm objectives and questions in preparation for the field trip.

Possible field trip objectives:

- Learn about soil types, soil health, components of soil and how human, animal and natural intervention impacts the renewal of the soils health.
- Learn about how to cycle crops in a garden to maximize the health of the garden.
- Learn how to organically and naturally manage pest infestation.
- Learn how to plan, nourish and harvest vegetables, herbs and flowers.
- Learn how to propagate cuttings, save seeds and hybridize plants.

Possible inquiry questions during and following The Farm School visit:

- Harvest renews our stores of food, but comes at the death of the plant. Why?
- What must farmers and gardeners do to keep the cycle of planting and harvest going? What concrete tasks does one need to accomplish? What vision, effort, patience, and resources are needed?
- The Farm School is part of a movement to renew agriculture and an agricultural way of life in at a time in U.S. history when fewer and fewer people live and work on farms. Why would someone want to do this? How can it be done?
- What does it mean to us that we don't live on a farm or grow food?
- What would happen to our way of life if we didn't have farms throughout our country? What would happen if we had more farms?
- Can a person live off of his or her own garden for an entire year? How much does a garden produce?

When we return from The Farm School, students will brainstorm possible visions for the school garden. They then will develop a garden resource list, time table, action items and create a preliminary list of responsibilities assigned to specific students. The final assignments will be made once the student crop survey is completed. They will also create a list of inquiries which will help guide science instruction.

ITU PROJECTS

Osprey Team

- The design and construction of a greenhouse
  - design will take place during math and industrial/engineering block time
  - construction will take place during industrial/engineering block time
- Development of scale drawings and models of the greenhouse and garden designs
  - Scale measurements and calculations will take place during math time
  - Creation of the scaled drawings and models will take place during art and technology block time
- Design and construction, for installation in the garden, of practical, artistic, or curious devices that use or symbolize the repeated transformation of potential energy into kinetic energy, and vice versa. Examples are as diverse as a swing, an Aeolian harp, a water tank, and a sprung or weighted gate closer.
  - Cooperation between science and art or industrial arts classes
- Maps of garden plot showing changing areas of sun and shade, and angle of sunlight, at different times of day and year.
  - Science
- Design, construction, and installation of sun dials.
  - Science, in cooperation with art and/or industrial arts
- Demonstration bed showing the varieties of brassicas created by selective breeding.
  - Science
- Survey of student population to determine the produce, herbs and flowers to be grown.
  - Research can be done during after school hours, technology and math block time
  - Collection of data will occur during lunch
  - Analysis of data and drawing of conclusions will occur during math block
- Development of presentations by product teams to 7th graders and then to parents during garden party.
  - Pieces of this presentation will be done during technology, math, science, language arts and art.
- Creation of artwork, poetry and performance pieces stemming from students study of the Harlem Renaissance
  - These projects will be completed during humanities, art, industrial engineering, and music blocks
- Poems and songs exploring students' personal connection to renewal
  - This activity will take place during humanities

Possible additional ITU projects or projects for the following year

- Sell flowers for special person (mother, father, grandparent, or guardian) day (?)
  - Cutting and preparation for flower sale will be done during common block time and after school
- Design, write and print a garden cook book for sale at the culminating event.
  - Writing will take place during language arts
  - Design of cover and production will take place during art and common block time
- Creation of garden business plans
  - This will be done during math and language arts block times

HUMANITIES UNIT

Joyce Ting

Rationale

In the humanities, the students' exploration of renewal will be broken into two sections. The first section will last for about two weeks consisting of research and communication with local businesses concluding in the students writing a series of persuasive letters personalized for each business. The idea is that students will form relationships with community businesses to involve the resources, skills and time of people outside of the school community. During the second portion of the unit, students will study the Great Migration of African Americans from the South to the North/Midwest and the flourishing of the arts during and following the Harlem Renaissance. Their study of this time period will center on a series of paintings by Jacob Lawrence entitled *The Great Migration*, the significance of the Apollo Theater, and the poetry of Langston Hughes. Beginning in mid-April, this second portion will last about three weeks and lead into the month of June, in which students will create original art, performance-pieces, and poetry informed by their study of the Harlem Renaissance and inspired by their reflections upon renewal throughout this entire ITU project.

Focusing on U.S. history is fairly common for the eighth grade, both in public and private schools. Prior to the second portion of this unit, students will explore the cause and effects of the Civil War and the Reconstruction period following the war. Thus, the eighth graders will approach their study of the Great Migration and the Harlem Renaissance with prior knowledge regarding the sentiments held by the majority the Southern, white population. This knowledge will propel the students' understanding of the pushes experienced by African Americans to migrate to the North/Midwest combined with the pulls influencing African Americans to start anew in non-Southern areas of the United States. Through observing Lawrence's paintings, the students will form a concrete social and psychological vision of the experience of the migration.

Students will draw on their knowledge of these pushes and pulls to "set the stage" for the factors that spawned the Harlem Renaissance. They will discuss the frustrations, inspirations, and motivations that formed the driving force behind this celebration of African American theater, art, music, and literature. They will interact with these creations through listening to performers who debuted at the Apollo Theater. They will also explore the poetry of Langston Hughes. After studying the themes in Hughes' poetry, students will create original poetry focused on the experience of this interdisciplinary unit. Possible themes could be taking pride in one's own skills and background, renewal as expressed in nature, and personal experiences of renewal.

Tied in with the Unified Arts aspect of this project, students will create a series of paintings/drawings expressing their personal experiences during this project. A short description of each student and their connection to the art will accompany each creation. In music, students will further explore the musical contributions of artists such as Duke Ellington, Louis Armstrong, Bessie Smith, and Billie Holiday. As a part of the culminating activity, students can perform the music of these artists, write original music revolving around themes of renewal and/or transform their original poetry into song form. Students can collaborate with one another for the performances, as well as perform solo.

Standards

English Language Arts

9.5: Relate a literary work to artifacts, artistic creations, or historical sites of the period of its setting.
10.4: Identify and analyze the characteristics of various genres *(poetry, fiction, nonfiction, short story, dramatic literature)* as forms chosen by an author to accomplish a purpose.
11.4: Analyze and evaluate similar themes across a variety of selections, distinguishing theme from topic
13.21: Recognize use of arguments for and against an issue.
13.22: Identify evidence used to support an argument.
13.23: Distinguish between the concepts of theme in a literary work and author's purpose in an expository text.
13.24: Analyze the logic and use of evidence in an author's argument
14.4: Respond to and analyze the effects of sound, form, figurative language, and graphics in order to uncover meaning in poetry
15.5: Identify and analyze imagery and figurative language.
15.6: Identify and analyze how an author's use of words creates tone and mood.
19.15: Write poems using poetic techniques, figurative language, and graphic elements.
19.18: Write formal letters to correspondents such as authors, newspapers, businesses, or government officials.
20.4: Select and use appropriate rhetorical techniques for a variety of purposes, such as to convince or entertain the reader.
21.6: Revise writing to improve organization and diction after checking the logic underlying the order of ideas, the precision of vocabulary used, and the economy of writing.
21.7: Improve word choice by using a variety of references.
22.8: Use knowledge of types of sentences, correct mechanics, correct usage, sentence structure, and standard English spelling when writing and editing.
24.4: Apply steps for obtaining information from a variety of sources, organizing information, documenting sources, and presenting research in individual projects:

History

Concepts and Skills:
1. Apply the skills of prekindergarten through grade seven.
2. Distinguish between long-term and short-term cause and effect relationships. (H, G, C, E)
3. Show connections, causal and otherwise, between particular historical events and ideas and larger social, economic, and political trends and developments. (H, G, C, E)
4. Interpret the past within its own historical context rather than in terms of present-day norms and values. (H, E, C)
5. Distinguish intended from unintended consequences. (H, E, C)
6. Distinguish historical fact from opinion. (H, E, C)

USII.26 Describe the accomplishments of the civil rights movement. (H, E)

Habits of Mind

1. Persistence -communicating with different sorts of people for the persuasive letters, creating original art/performance pieces/poetry.
2. Listening with Empathy & Understanding - discussion.
3. Thinking Flexibly - what if not enough money is donated? What other sorts of resources can students pull from?
4. Applying Past Knowledge - apply knowledge of Civil War/Reconstruction to study of Harlem Renaissance.
5. Thinking and Communicating with Clarity & Precision - with peers and business owners
6. Creating, Imagining, & Innovating - original pieces.
7. Thinking Interdependently - collaborating with peers on culminating activity and bouncing ideas off of each other for letter writing.

Activities

Activity One – Persuasive Letters

Description:
The idea is that each student will research and become familiar with one business in order to "tailor" a specific letter to that business. Whereas some businesses might donate an obvious resource like money, other businesses may decide to offer physical resources, time, and skills. Students will communicate with businesses via phone calls or personal visits before writing the letters. This way, students will know who to address their letters to and can theorize ways in which the business might offer resources to the project.

Objectives:

1. Students will develop interpersonal skills through researching and communicating with one local business to brainstorm ways in which the business could donate resources in the form of monetary contributions, time and/or skills.
2. Students will study different kinds of persuasive speech - fact, value, and policy based arguments.
3. Students will apply their knowledge of persuasive speech to writing through informative and concise letters to local businesses to support the project.
4. Students will practice peer revising, as well as teacher-generated revising.

Materials: List and contact information for local businesses, computer/laptops, envelopes/paper

Procedures:

Day 1 & 2: Each student will study a list of local businesses to select and research a local business to learn more about.

Day 3: Before writing the letters, we will take a field trip to the street where most of the businesses are located. The students will then break up into pairs to visit specific businesses to learn about the businesses and to communicate with owners/managers about the vision for their project.

Day 4-6: Students will learn about and practice different forms of persuasive writing
Day 7-8: Each student will write a concise, informative and inspiring letters to a local business. Students will have teacher conferences and peer feedback in order to make reflective and necessary revisions to their letters.
Day 9: The students will take another field trip to personally deliver and thank businesses for taking the time to learn about their school.

Assessment:

1. Did students take the necessary steps in researching and forming relationships with local businesses?
2. Do students understand multiple forms of persuasive speech as evidenced by their letters to local businesses?

Activity Two – Jacob Lawrence's set of paintings entitled *The Great Migration*

Description:

Students will study the Great Migration through the reading of primary resource articles from that time, Visual Thinking Strategies from Jacob Lawrence's *The Great Migration* and group/self-reflection of their experiences in creating the school garden. Their study of the Great Migration through art, followed by personal reflection will transition into the students' study of the Harlem Renaissance and creating their own works of art.

Objectives:

1. Students will study the historical migration of African Americans from the South to the North/Midwest utilizing a series of paintings by Jacob Lawrence entitled *The Great Migration*
2. Students will practice Visual Thinking Strategies through teacher-facilitated and self-facilitated observations of Lawrence's paintings
3. Students will discuss reasons for the Great Migration as well as challenges faced by migrants once situated in their new communities

Materials: images of Jacob Lawrence paintings, tape to fixate paintings on the wall for a "gallery" viewing, informative articles (primary sources) describing the attitudes/experiences of African Americans and non-African Americans during the Reconstruction/Great Migration era

Procedures:

Day 1: Students will break into groups to read and discuss different articles describing the attitudes and experiences of people during the Reconstruction, leading to the Great Migration. Students will then join mixed groups, each group including a representative of a different article to describe their group's article and share their group's thoughts.
Day 2: Teacher will facilitate Visual Thinking Strategies with the entire class as an introduction of Lawrence's paintings. When facilitating Visual Thinking Strategies, only three questions are used, "What do you see?" "What do you see that makes you say that?" and "What more can you find?" Throughout the exercise, the facilitator remains neutral to student responses and simply paraphrases each response, encouraging students to widen

the range of responses through the three questions. Following VTS, the teacher will introduce the artist and debrief about the VTS. By this time of the year, students will have become comfortable with VTS and be able to act as facilitators. They will then form groups of four for student-facilitated walking tours in a "gallery" of Lawrence's paintings designed by the teacher. As they tour, students will record personal and peer observations on a worksheet regarding artistic style, expression, informative aspects, etc in the paintings.

Day 3: Students will join mixed groups to share different reactions to the paintings. Next, the class will debrief together and will draw on prior knowledge from the articles to make connections from the paintings to the Great Migration. The teacher will use the paintings as an introduction to the Harlem Renaissance. She will introduce the students to their "gallery" project in which students will create a gallery of art (paintings, sketches, sculpture, etc) inspired by their experience of building the garden.

Day 4: Students will independently answer a series of reflective questions in writing, followed by group reflection on the experience of creating the garden.

Assessment

1. Were students able to process the various perspectives from the time of the Great Migration as presented by the articles and discuss these perspectives?
2. Were students able to articulate the views from the article they each read to students who read different articles?
3. Were students able facilitate student-lead Visual Thinking Strategies focused on Jacob Lawrence's paintings in the self-guided walking tour of the gallery?

Activity Three – Harlem Renaissance

Objectives:

1. Students will be introduced to the Harlem Renaissance through Marino Amoruso's documentary *Harlem Renaissance*.
2. Students will study the Harlem Renaissance as represented by the poetry of Langston Hughes.
3. Students will write their own poetry imitating the style of Langston Hughes, but as inspired by their own lives and the experience of creating the school garden.
4. Students will also perform poetry by Langston Hughes as part of the experience of discovering the power of his poetry and the styles he utilized.

Materials: poems by Langston Hughes, *Harlem Renaissance* documentary, DVD player, jazz/blues CDs

Procedures:

Day 1 & 2: Students will watch the Harlem Renaissance documentary while completing a worksheet structured to observe the various people, ideas, events, and music used in the film

Day 3: Class will begin with the music of some modern-day artists who were introduced at the Apollo Theater, an epicenter of creativity during the Harlem Renaissance. Students will share observations and knowledge gained from the documentary. (Their observations

will be followed-up in music class, through which they will do a more in-depth study of the musicians of that time eventually leading to student-created original music.) In class, students will generate discussion based on prior knowledge on the events leading-up to the Harlem Renaissance and the reasons for this movement. The class will read *Let America be America Again* followed by observations of the themes represented and tying the themes of the poem into Hughes' own beliefs and passions.

Day 4-7: Students will work in groups imitate the group-centered process of reading a poem, dissecting the poem's themes and then performing the creatively performing the poem as a group (memorized). Students will reflect upon some more technical pieces of Hughes' style of poetry (rhythm, vocabulary, themes, spacing, etc) based on their experiences of the performed poems. The teacher will play spiritual, blues, or jazz songs from that time and ask students to observe the rhythms they hear. (Students will have been introduced to the jazz style in music class, thus they will have the skills necessary to make informed observations) The music will be used to introduce the "jazz style" of Langston Hughes' poetry. Following the music, students will read their poems in groups with the song to make rhythmical connections from the music to the poems. In music class, students will choose songs to analyze and pair their poems with. Students will ultimately perform their Langston Hughes poems paired with a jazz piece.

Day 8-10: Students will brainstorm and list all the themes and technical styles exhibited by Langston Hughes. They will then create original poems inspired by themes from Hughes that they personally connect with and the style of his poetry. As with persuasive letters, students will give peer feedback, serving as an audience for one another as they reflect upon and revise their poems. The poems will eventually be performed during the culminating event, without music, or accompanied by or set to music.

Assessment:

1. Do students understand the reasons, concerns, and events leading up to the Harlem Renaissance?
2. Do students understand the themes and jazz style of poetry used by Langston Hughes as evidence by their group performances and original poems?

SCIENCE AND RENEWAL

Paul Kelly

Rationale

The theme of renewal is closely interwoven with science through one of science's "big ideas": natural and physical *cycles*. These may be mechanical energy cycles, the cycle of seasons, or life-cycles. For example, a pendulum cycles between kinetic and potential energy; the tilt of earth's axis and earth's revolution around the sun creates the cycle of seasons; and living things go through the cycle of birth, growth, reproduction, death and decay. We can say that the pendulum's potential energy is renewed with each swing (and with the added impulse of a periodic push), that lengthening days and more direct sunlight renew growth, and that each generation renews the species. People live within, play with, count on, exploit, and are subject to these cycles of renewal. These cycles are the undergirding "stuff" of people's relationship with the natural world and their own bodies across cultures. Hence, renewal can be explored in science investigations throughout the year and in all branches of the sciences, and can be used to open up the larger cultural issues and economic management issues of humankind's relationship with the natural world.

In this ITU, science investigations are designed to yield understandings and products that relate to the schoolyard garden. Students may build a garden swing, track the changing distribution of sunlight in the garden over days and months, and do plant breeding experiments that will illuminate how garden plants were developed. The energy cycle of the garden swing will be used as an analogy for the energy cycles of plants and the chemical energy cycles of the human body that are renewed when we eat food. Each project will contribute to the development of the garden as a place of renewal.

As students develop products, they will learn about technologies and the engineering design process as well. Science will coordinate with Industrial Arts as students design and plan the garden layout, the selection of vegetables and flowers, the greenhouse, and even composting and integrated pest management systems. The design process itself is a cycle, renewed and changed as designs are improved in response to testing and feedback.

On a broad level, we will reflect on ways in which natural cycles are not simply repeating circles, but "spirals" that return to similar, but not exactly the same, conditions. Over time, these spirals create changes in species and ecosystems, the composition of the atmosphere, weather patterns, the distance of the moon from earth, and distribution and composition of continental crust. Through interacting feedback loops, natural cycles do bring truly new things into existence.

Students will then consider the dynamics of human interaction with natural cycles—an inescapable part of our economic activity, whether that is hunting and gathering, agriculture, or industry. Human beings create new things at a rapid rate, but are still dependent on natural cycles of renewal and must work with them or imitate them.

Throughout the year, there will be other opportunities to relate science learning to the garden. Soil tests will apply knowledge of elements and compounds. In designing and building the green house, students will work with the forces of compression and tension. As they decide whether to

garden organically or use chemical fertilizers and pesticides, they will have to evaluate the interaction of human products with natural cycles and human health, just as towns, states, and nations must do when regulating economic activity.

It is important to note that the garden is a multi-year project and the possible connections among the garden, renewal, and science and engineering are numerous. Therefore, the projects described here are simply the initial entries in a menu of possibilities that teacher and students may choose or develop each year.

Students will work in cooperative groups, and as a team-wide cooperative with separate work groups, to conduct investigations and build products. Students will have a role in choosing specific projects and investigations, especially as these branch off from, or further develop, base investigations. For instance, students might choose to develop sundials as they measure changing patterns of sunlight in the garden.

Relation Between Theme and Curriculum

As in the Cambridge Public Schools, we will assume a curricular sequence in which physical, earth and space, and life science topics are addressed each year. The eighth grade curriculum covers the following units in order: motion and energy (fall); astronomy (winter); and heredity, genetics, reproduction and evolution (spring).

Content in each unit may be related to the theme of renewal, or cycles of change.

- Oscillation is a major phenomenon in motion that involves cyclical transformation of potential to kinetic energy. Bouncing balls, pendulums, springs, sound waves, and even roller coasters are all examples of oscillation. To maintain them, periodic inputs of renewed energy are required, as when a basketball player dribbles the ball, the weight in a grandfather clock is raised, or a child is pushed on a garden swing.
- Earth's cycle of seasons, which we experience in the middle latitudes, is caused by the tilt of earth's axis combined with its rotation and revolution around the sun. The moon's rotation and revolution around the earth, combined with the earth/moon system's revolution around the sun, creates the cycle of phases of the moon.
- Genetics traces the inheritance of traits, genes, and DNA through the generations, that is, through the cycle of birth, growth, reproduction and death. The sun's energy provides the continuously renewed energy input that drives this cycle.
- The season of spring, new moons, and new generations have long been symbols and human experiences of renewal. The oscillation of strings on music instruments will contribute to the culminating celebration of the school garden at the end of the year.

Eight graders are also preparing for the science MCAS test, which covers all science curriculum frameworks for grades 6-8. As we work on the garden, students will be reminded of the dependence of living things on the rock cycle, water cycle, air currents, and seasonal cycles of energy distribution. They will note the place of soil formation in the rock cycle, water cycle, and the growth and decay of living things; energy recycling through producers, consumers, and decomposers; the cycle of photosynthesis and respiration; cycles of dormancy and activity, birth

and death. They will apply what they have learned in previous years about the basic needs of all living things to maintaining a healthy garden that is renewed each year.

Pendulums, Clocks, and Energy Cycles

Massachusetts Learning Standard

Physical Science (6-8): Forms of Energy

13. Differentiate between potential and kinetic energy. Identify situations where kinetic energy is transformed into potential energy and vice versa.

Curricular Resources

Cambridge Physics Outlet. (1996). *Harmonic motion and the pendulum: Teacher's guide. Levels A, B, C.* (Rev. 2.0). Woburn, MA: Author.

Cambridge Physics Outlet. Pendulum apparatus.

Objectives

Concepts.

- Prior concepts
  - Energy is the ability to do work or accelerate another object.
  - Kinetic energy is energy an object has due to its motion.
  - Potential energy is energy an object has due to its position.
  - Kinetic energy may be transformed into potential energy when an object moves to a position in which it is subject to a restoring force.
  - Restoring forces may be of several kinds: gravitational, elastic, electromagnetic, etc.
  - Potential energy may be transformed into kinetic energy when no other forces counterbalance the restoring force.
- Target Concepts
  - Oscillating systems have cycles of "back and forth" motion. They also experience energy cycles in which kinetic energy is transformed into potential energy and vice versa.
  - To maintain full energy and amplitude in an oscillating system, new energy inputs are needed.

Process and study skills.

- Mess about (with pendulum apparatus): explore, make initial observations, manipulate objects, play with materials.
- Design and conduct a scientific investigation (into the variables controlling pendulum periods).
- Identify and control variables (*e.g.*, pendulum weight, amplitude, and length).
- Use appropriate tools and techniques to gather, analyze, and interpret data (*e.g.*, gate timers, pendulum apparatus).

- Think critically and logically to relate evidence (about effects of changes in each of the three variables) and explanations (e.g., that since greater amplitude brings greater speed, greater distance is largely counterbalanced).
- Use mathematics in all aspects of scientific inquiry (*e.g.*, averaging amplitudes, graphing results).
- Apply understandings of physical properties and behaviors to design and build products.

Habits of mind.

- Finding and keeping focus.
- Simplifying questions and problems.
- Being attentive.
- Forming hunches.
- Designing tests and experimenting.
- Using models and metaphors; thinking by analogy.
- Cooperating and collaborating.
- Persevering and having self-discipline.

Performance. Students will be able to…

- Design and conduct a series of experiments to determine the major variable governing the period of a pendulum.
- Explain, based on evidence and reasoning, the relative influence of pendulum weight, amplitude, and length on a pendulum's period.
- Use pendulum apparatus and gate timers to obtain accurate results.
- Record experimental data, organize data in tables, graph data, and discern trends.
- Apply experimental results to design and build a pendulum that can measure one minute of elapsed time.
- Design, build, and operate a useful or artistic product for the schoolyard garden that employs oscillating motion or other transformations between kinetic and potential energy.
- Explain how new energy inputs are needed to maintain the amplitude of an oscillating pendulum.

Garden Projects

A number of useful, artistic or curious oscillating devices could be built for the garden, including swings, sculptures based on pendulums and masses dependent on springs, and Aeolian harps. Projects that are not true oscillators, but which operate by some conversion between potential and kinetic energy, include a water tank and a sprung or weighted gate closer. In either of these, potential energy is stored (as the tank is filled or the gate is opened) and converted to kinetic energy (as water flows out or the gate is released); potential energy is renewed as the tank is refilled or the gate opened again. Devices of different levels of complexity can be built, depending on students' ambitions and pleasure in the task.

A tire swing would be an eminently simple project and enormous fun, although liability and safety regulations on swings in public spaces might make it impractical for the garden. Nevertheless, a swing is a wonderful model of cyclical renewal. Its harmonic motion produces

repeating cycles, while pumping or pushing provides the renewed energy input to overcome damping and keep the cycle from decaying.

Driving Question and Curricular Context

This pendulum unit within the fall Motion and Energy trimester might be guided through a driving question such as, “Is energy renewable? If so, how?” Oscillating systems such as pendulums appear, in part, to renew themselves, yet they also degrade, slowly or quickly, depending on the degree of damping in the system.

Investigating kinetic and potential energy cycles follows earlier investigations of relative position and motion, including speed, velocity, and acceleration. Using cars and ramps, marble-track rollercoasters, and gate timers from Cambridge Physics Outlet, acceleration has been achieved through the force of gravity, and kinetic and (gravitational) potential energy have been introduced. Using ropes and pulleys, further explorations developed the concepts of force, work, and energy.

Sequence

It is time to turn to harmonic motion and the pendulum. The clock challenge will take five to eight days. Unpacking energy in pendulum systems will take a couple more days. The design and building of “energy cycle” devices or sculptures for the garden may take another five days. Students work in four-person groups with roles that rotate daily.

1. Students will be challenged to create a pendulum “clock” that will measure out one minute. This begins as an open, unguided exploration. Students will be provided with a timer, gate timer, stand, string, bob and weights, and an attachment plate on the stand that has markings for angles.
2. As they attempt to create a clock, students will have the options of changing the pendulum’s weight, amplitude, and length. After some period of exploration, lead students to distinguish these variables and reflect on them. Students may not have found on their own that length is the key variable for controlling the period of the pendulum. This is a great opportunity for students to experience the power of isolating variables, and of investigating effects by making regular incremental changes in one variable.
    a. Earlier explorations about the force of gravity should help students conclude that weight will not have an appreciable influence on regulating the period of the pendulum. Students may confirm this by varying only the weight.
    b. Experience and reflection may help them conclude that the increased speed of cycles with greater amplitude largely offsets the increased distance of travel. To help students uncover or confirm this idea, structure an exploration in which students vary only the amplitude. Measuring amplitude as the cycle degrades will require developing the idea of aiming for an average amplitude over some number of cycles.
    c. Challenge students to discover how period varies with length, and to graph the trend.

3. Return to the clock challenge. Students will need to select some workable number of periods that will equal one minute—either 60 periods of 1 second, or 30 periods of 2 seconds. Students will have succeeded in controlling motion.
4. We want students to understand harmonic motion as an energy cycle as well as a cycle of motion. Recall the wave-shape of the rollercoaster track in earlier investigations, and allow it to represent changing potential energy in the roller coaster system. How does pendulum motion correspond? Challenge students to picture when the pendulum has maximum kinetic energy, and when it has maximum potential energy.
5. Since energy is the capacity to make things happen (to do work), have students experience how pendulums can make things happen. In a simple demonstration, a ball and crane can knock over blocks. This is dramatic—but, of course, it interrupts the cycle. Therefore, have students explore the "Swinging Wonders" toy in which five or so balls are suspended in line, touching each other. Have them note the transfer of motion end energy as one, two, or more balls are pulled back and released. Motion and energy degrade here as well, but oscillation is clearly observable in a system in which energy is transferred mechanically through cyclic application of a force. One thing makes another move, which then returns the favor, etc. Note that the energy (and work done) is increased with amplitude.
6. To help students understand how pendulum motion can be prevented from degrading, explore real pendulum clocks. Using photographs, diagrams, or an actual grandfather clock, help students trace the mechanism of a working pendulum clock powered by weights. The potential energy of the weights is used as a carefully controlled input to maintain a regular, non-degrading period of the pendulum, and the pendulum's motion is transferred through gears to the hands on the clock face. All energy cycles require inputs—or "renewal" of their energy from an outside force.
7. Next have students explore pendulum motion on playground swings. Challenge students to act as deadweight pendulum bobs, timing their periods and measuring their amplitudes and lengths. These weights and lengths are much greater than experienced with the apparatus in the classroom. Has the period continued to increase with length? Then challenge students to pump (or push) just enough to maintain a constant amplitude. The kinetic energy of their bodies is adding enough energy to the swing system to maintain its energy and motion cycle.

Students can now be challenged to design a swing or pendulum sculpture for the garden with a known, convenient period for measuring short durations of time. Alternatively, projects may be more artistic or useful, and may extend to other energy systems. Examples were mentioned in the "Garden Projects" section, above. Analogically, the garden swing can later be used as a representative of how all energy cycles require renewing if they are to persist. It can be compared to photosynthesis (creating chemical potential energy) and respiration (releasing chemical potential energy), the major energy cycle in plant growth, which students studied in the latter part of seventh grade and which has obvious relevance to the schoolyard garden.

Potential Related Investigations

- A simple elastic system: Investigate how long different balls will bounce. How long can they capture, expend, and recapture energy? Dribbling provides the added energy needed to maintain the amplitude.

- Extended investigations could explore transformations between kinetic and potential energy in elastic spring systems, gravity pressure systems, sound systems, or renewable energy systems such as windmills, waterwheels, and dams.
- Enact Galileo's thought experiment leading to the concept of inertia. Form a trough out of flexible Hotwheels track and roll marble back and forth, then gradually lower on side of trough until it lies flat on floor. Ball moves "forever" in straight line.
- Visualize waves. What if we drop die or small object with specific gravity of 1 into wave motion of water? Compare to bouncing balls and pendulums. But now we have propagation, somewhat like colliding pendulums.
- Measure string vibrations on a guitar with an electronic tuner. Can we measure frequency of water waves or springs? Tuning fork A = 440 cycles/sec or Hz. Middle C = 263 Hz. Humans can hear from 20 to 20,000 Hz.
- Explore windmill battery and car battery systems as examples of capturing motion to store for energy to use for motion.

Celestial Motion and Cycles of Renewal

On each New Year's Day, the earth has returned to its old position.
On each new dawn, the sun rises again in the east.
Each spring, plants and animals respond to the return of longer days and more direct sunlight.

Massachusetts Learning Standards

Earth and Space Science: The Earth in the Solar System

9. Describe lunar and solar eclipses, the observed moon phases, and tides. Relate them to the relative positions of the earth, moon, and sun.

11. Explain how the tilt of the earth and its revolution around the sun result in an uneven heating of the earth, which in turn causes the seasons.

Curricular Resources

Regents of the University of California. University of California at Berkeley. Lawrence Hall of Science. (2001). *Full option science system: Planetary science.* Nashua, NH: Delta Education.

Regents of the University of California. University of California at Berkeley. Lawrence Hall of Science. (2000). *Great explorations in math and science: The real reasons for seasons: Sun-Earth connections.* Nashua, NH: Delta Education.

Morrow, C., and Zawaski, M. (2004). Lesson one: Sky time. On the astronomical meaning of the day, year, and seasons. *Kinesthetic astronomy.* Boulder, CO: Space Science Institute.

Objectives

Concepts

- Earth is round, causing lines of sight to be lost beyond the horizon and length of shadows to vary with latitude.
- Earth rotates on its axis once every 24 hours.
- Earth orbits the sun in an elliptical orbit that is nearly circular and takes 365.25 days.

- Earth's axis is tilted 23.5 degrees away from being perpendicular to the plane of its orbit .(the ecliptic plane) and nearly toward Polaris, the North Star.
- The tilt of Earth's axis, Earth's daily rotation and yearly revolution around the sun lead to varying hours of daylight away from the poles and varying angles of solar incidence.
- The moon orbits earth in a plane tilted slightly from the ecliptic plane.
- The moon's illumination from the sun and its orbit around Earth give rise to the cycle of phases of the moon.

Process and Study Skills

- Interpret models to form relational understandings and make inferences.
- Recognize and analyze alternative explanations and predictions.
- Use mathematics in scientific inquiry.

Habits of mind

- Finding and keeping focus.
- Asking good questions.
- Being attentive.
- Searching for patterns.
- Using models and metaphors; thinking by analogy.
- Finding elegant solutions.
- Cooperating and collaborating.
- Persevering and having self-discipline.

Performance. Students will be able to…

- Predict the relative changes in sun altitude and position, and in incidence of solar radiation, on different areas of the garden plot over days and seasons.
- Predict the phases of the moon, relate the moon's approximate path in the sky to the sun's, and recognize that the moon is up in the daytime as much as at night.
- Appreciate the connections that people have felt to the cycles of days, seasons and phases of the moon, and assess their scientifically determinable influence on agriculture.

Garden Projects

- Design, build, and observe sun dials. Connect to daily cycle of earth's rotation and yearly cycle of seasons.
- Chart sun incidence in the garden and create a map or series of maps profiling sun exposure in the garden throughout the growing season.

Driving Question and Curricular Context

The astronomy trimester could be organized around the driving question, "How do the heavens influence the earth?" This question can lead to investigations of celestial mechanics, historical models of the heavens, solar incidence, moon phases, tides, and cultural stories and beliefs relating the earth to the celestial realm. The portion of the astronomy unit explicitly connected to the theme of renewal could address the related question, "How can new things grow from the same old from the same old spinning?" or "How can we tap into periodic motion in the

heavens?" In the context of the garden, this question highlights how heavenly motions affect the major energy input into growth cycles: sunlight reaching earth's surface.

The astronomy trimester covers all learning standards under the heading, "The Earth in the Solar System," in the Earth and Space Science, Grades 6-8, framework. We will build upon learning standards from grades 3-5, which explain how our experience of day and year is caused by earth's rotation and revolution, and recognize the phases of the moon. We will address the standards cited above (relating to orbits, rotation, and relative position), before turning to standards addressing gravity, comparative properties and conditions of objects in the solar system, and the relative scale of the solar system, galaxies, and universe. In seventh grade, students will have addressed terrestrial earth science standards.

The City of Cambridge's description of major concepts for the Astronomy trimester includes reflection on the connection between human culture and scientific learning: "Many cultural traditions have looked to the sky to provide theories of our place in the universe. The evidence they have found has helped to shape the structures of their societies and cultures, and cultural influences have greatly affected the acceptance of astronomical theories." We will pursue this connection to the humanities by researching *The Old Farmer's Almanac*'s claim that above ground crops should be planted between new and full moons, while below-ground crops are best planted between full and new moons, and that weather corresponds to moon phases.

Sequence

Early in the year, students will begin periodic mapping of sunlight in the garden plot. The changing distribution of shadow and sun will eventually raise questions about the changing path of the sun across the sky. This experience will be a reference point for discussion as students, during the winter trimester, work to grasp the complex spatial relationships between earth and sun. A major challenge in these lessons is to help students achieve a conception of the relative positions and movements of the earth, moon, and sun that they can connect to earth-bound observations. The lessons draw on FOSS *Planetary Science* (*PS*), GEMS *The Real Reasons for Seasons* (*RRS*), and Morrow & Zawaski "Lesson One: Sky Time" from *Kinesthetic Astronomy* (*KS*). The lessons use physical models, whole-body models, and explorations of data on temperatures and hours of daylight to help students make these connections. Following these lessons, students and teacher work together to develop investigations that will add local data collection centered on the garden plot to make the connections concrete and to understand the dynamics behind the sunlight profile of the garden. Any point on earth's surface (including the schoolyard garden) taps into the energy radiated by the sun only as it exposed to solar radiation at varying angles through the day and year. The garden's sunlight profile will inform decisions about where to place the garden beds on the lot and where to place the greenhouse.

1. Assess students' prior knowledge using survey from GEMS *RRS*.
2. Round Earth: Model and gather evidence for a round earth (FOSS, Planetary Science, Investigation 2)
    a. Using small globes and pins, note the varying lengths of shadows at different latitudes, as cast by a light source.
    b. Using small globes and model ships, observe the appearance and disappearance of ships at the horizon.

    c. Measure the length and angle of a shadow cast by a vertical, one meter stick at local noon. Compare to data from other locations on earth. Continue these measurements once or twice a month to note changes.
3. Earth's Rotation
    a. Model using *KA* Sky Time lesson (pp. 9-13).
    b. Model with the sun as a light bulb and the earth as a globe (*PS*, Investigation 3-2).
4. Earth's Orbit
    a. Students draw ellipses representing the orbits of Earth and Pluto to gain a perspective on how nearly circular Earth's orbit is; then measure photographs of the sun taken at different seasons to see that its apparent size is smaller (indicating greater distance) in our summer than in winter. (*RRS* 4: What Shape Is Earth's Orbit?)
    b. Model Earth's orbit using *KA* (pp. 16-17).
    c. Students compare temperature data from northern and southern hemispheres as further evidence that distance from the sun does not cause the seasons. (*RRS* 5: Temperatures Around the World).
5. Earth's Tilt
    a. Using *KA* (pp. 14-24) students model earth's tilt, use it to identify winter and summer, and consider the reasons for the seasons.
    b. Students observe the apparent rotation of the star field around Polaris, connect this to the rotation of Earth, and determine the azimuth and elevation of Polaris. Why does this correlate to our latitude? Is Polaris in the same position even during the daytime?
    c. Students examine worldwide data to discover patterns in the length of the day in different parts of the globe and at different times of year. (*RRS* 6: Days and Nights Around the World).
    d. Students use balls to model how the tilt of the earth and its revolution around the sun cause global patterns in the length of the day. (*RRS* 7: Tilted Earth).
    e. Students use "sun angle analyzers" to see that as the angle of the sun changes, so does the area over which sunlight is spread out. (*RRS* 8: The Angle of Sunlight and Seasons Unraveled).
6. Measure (or examine data on) azimuth of sun at sunrise and sunset. Note elevation of sun at noon. Also note azimuth and elevation of sun when it first reaches garden and last leaves garden. Survey heights of trees and buildings. Measure and map areas of sunlight and shade at different times of day and year.
7. Students and teacher consider the garden plot and design investigations to determine the relative incidence (angle and duration) of solar radiation in different parts of the garden. Students may determine…
    a. the sun elevation at noon during the growing season
    b. the locations of sunrise and sunset at different times of year
    c. the azimuth and elevation of the sun when it first reaches garden and last leaves the garden
    d. heights of trees and buildings blocking sunlight
    e. areas receiving sunlight at different times of day and year.
8. As part of this investigation, students will design, build and observe sun dials, marking replaceable paper faces of them with shadow positions at recorded hours to investigate

the correlation between shadow angles, time of day, and time of year. They will seek to connect observed patterns with their mental model of earth's rotation, the tilt of its axis, and the yearly cycle of seasons.

9. Students create a series of maps profiling sun exposure in the garden throughout the growing season. These are used to plan locations of beds and greenhouse.
10. Students keep a moon log, noting phase, inclination of shadow, azimuth and inclination. Note time of day and amount of daylight. Correlate with tide charts or tidal observations.
11. Follow paths of sun, moon and planets across sky using indoor StarLab planetarium or Sky and Telescope's Interactive Sky Chart.
12. Students research and collect diagrams and other images of the ecliptic in order to understand the relationship between the paths of the zodiac, planets, moon, and sun across the earth's sky and the orbits of Earth, Moon, and planets.
13. Students read moon myths (*PS* Resources) and search for scientific evidence of the Old Farmer's Almanac's recommendations on planting and predictions of weather based on moon phases. Students note that the cycle of moon phases does not correspond with a year, so that supposedly propitious planting times change each year, irrespective of the major energy input.

Potential Related Investigations

- Observe how morning glories open and close in response to sunlight.
- Keep a log of air temperature and precipitation in the garden. Research historical records for a nearby weather station.
- Read about the seasonal effects of energy changes on air and ocean currents, hence weather.
- Visit a salt marsh restoration project to investigate tides and tie tides to (1) life cycles and (2) renewal/restoration efforts.

Fast Plants, Life Cycles, and New Generations

This science unit is still in development. As indicated at the beginning of the Science and Renewal section, so many science units can be connected to the theme of renewal that it has not been feasible to include them all in this ITU. However, Fast Plants, Life Cycles, and New Generations, is intimately connected to both our theme and the schoolyard garden, so that even an incomplete presentation seems worthwhile.

Massachusetts Learning Standards

Life Science: Reproduction and Heredity

7. <u>Recognize that every organism requires a set of instructions that specifies its traits.</u> These instructions are stored in the organism's chromosomes. <u>Heredity is the passage of these instructions from one generation to another.</u>

9. <u>Compare sexual reproduction (offspring inherit half of their genes from each parent) with asexual reproduction (offspring is an identical copy of the parent's cell).</u>

Life Science: Evolution and Biodiversity

10. <u>Give examples of ways in which genetic variation and environmental factors are causes of</u> evolution and <u>the diversity of organisms</u>.

11. Recognize that evidence drawn from geology, fossils, and comparative anatomy provides the basis of the theory of evolution.

12. Relate the extinction of species to a mismatch of adaptation and the environment.

While this investigation does not deal with speciation, it does explore variation and selective breeding, which are the basis for developing varieties of cultivated plants. Garden brassicas are quite diverse and will impress students with their distinctiveness, making it easier for them to extend their understanding to eventual speciation.

Curricular Resource

System-wide Change for All Learners and Educators. Wisconsin Center for Education Research. (2006). *Exploring variation and natural selection with Fast Plants.* Madison, WI: Author.

This is an inquiry-based immersion curriculum currently being field tested. It is carefully structured to help students develop a realistic sense of scientific methods and reasoning, to open up for them the inquiry process, to involve them in developing investigations, and to develop cooperative learning skills. Key instructional methods include keeping science notebooks, teaching using the Think Aloud strategy, Think-Pair-Share, and a formative assessment method called REAPS (Recall, Extend, Analyze, Predict, Self/Peer Assess).

Objectives

Concepts

- Naturally occurring variations of traits in a population are influenced by genetic and environmental factors and evolve over generations by selective processes.
- The variation of organisms within a species increases the likelihood that at least some members of the species will survive under changed environmental conditions.
- Individual organisms with certain traits are more likely than others to survive and have offspring. Changes in environmental conditions can affect the survival of individual organisms and entire species.
- Some variation in heritable characteristics exists within every species. One of these characteristics gives individuals an advantage over others in surviving and reproducing, and the advantaged offspring, in turn, are more likely than others to survive and reproduce.
- New varieties of cultivated plants and domestic animals have resulted from selective breeding for particular traits.

Process and study skills. The immersion unit appears to address all fundamental science process skills listed in the *National Science Education Standards* (1996).

- Identify questions that can be answered through scientific investigations.
- Design and conduct a scientific investigation.
- Use appropriate tools and techniques to gather, analyze, and interpret data.
- Develop descriptions, explanations, predictions, and models using evidence.
- Think critically and logically to make the relationships between evidence and explanations.
- Recognize and analyze alternative explanations and predictions.
- Communicate scientific procedures and explanations.

Habits of mind

- Finding and keeping focus. Students will develop a question and design an investigation.
- Asking good questions. Students will develop a question.
- Simplifying questions and problems. Students will develop procedures to isolate variables.
- Being attentive. Students will make and record careful observations.
- Designing tests and experimenting. Students will design and conduct an investigation.
- Searching for patterns. Students will look for patterns in data to characterize results.
- Cooperating and collaborating. Students will work in teams.
- Persevering and having self-discipline. The six-week investigation will require patience and consistent work over time.

Performance. Students will be able to…

- Design and conduct an investigation to determine how environmental factors influence variation in traits and reproductive success.
-

Garden Projects

- Grow seedlings.
- Propagate cuttings.
- Develop hybrids.
- Assure good growing conditions, such as soil preparation, proper amount of water, and fertilizer.
- Create a demonstration bed showing the variety of brassicas: broccoli, cabbage, cauliflower, Brussels sprouts, mustards, etc.

Driving Question
What does a new generation need to succeed?

Curricular Context
In the Cambridge eighth grade curriculum, reproduction, heredity, genetics and evolution are addressed in the spring trimester. However, students will already need to have started young plants in the late winter. It would be best if this investigation of how environmental factors influence variation and reproductive success were conducted in the fall or winter in order to inform students' care for seedlings. Fall would be best, as this is the most concrete instructional follow-up in science to the intention of starting a schoolyard garden.

Sequence
A brief, very incomplete outline of the immersion unit.
Step 1
- Start growing Fast Plants.
- Familiarize students with Fast Plants.
- Expectations and procedures for science notebooks.
Step 2

- Develop inquiry skills and content knowledge needed to ...
- Ask a question and design an investigation into how environmental factors influence variation in traits and reproductive success

Step 3

- Study reproduction in flowering plants in order to
    1. Effectively pollinate plants
    2. Tend experimental plants
    3. Understand what constitutes reproductive success for seed-bearing plants.

Step 4

- Build content knowledge needed to analyze results, through
    1. simulations
    2. readings
    3. activities

Step 5

- Teacher models how to develop scientific explanation
- Students analyze results of investigation and develop evidence-based explanation for observed variation
- Students communicate and evaluate their explanations

Step 6

- Students apply and demonstrate understanding in several ways.

Potential related investigations

- A companion investigation with Wisconsin Fast Plants is *Investigating Life with the Cabbage White Butterfly and Brassicas in the Classroom: A model of organismal interdependence.* (draft). This investigation would allow observation of pollination and the insect life cycle, including the always amazing renewal process of metamorphosis.
- Selective breeding of giant pumpkins. Impressively on display at the Topsfield Fair every year, giant pumpkins would be sure to catch interest. A visit to the fair, a guest presentation from a grower, or attempts to grow and care for giant pumpkins could all be great learning activities.
- Study efforts to breed disease resistant American Chestnuts and Elms. Both these trees were once common in the U.S., but were decimated in the twentieth century by fungal blights inadvertently imported through increasingly global trade. Asexual cloning and controlled inbreeding and hybridization are being used to try to develop disease-resistant strains of both trees.
- Ecosystem revival after catastrophic change. What trees replaced the elms and American Chestnuts? What species colonized Mt. St. Helen's after the eruption or Yellowstone after the fire? What made dinosaurs go extinct?
- The danger of human-induced extinction has prompted many species restoration efforts.
- Habitat restoration. For example, salt marsh or wetland restoration.
- Compare restoration of vacant lot, recovery after Mt. St. Helen's eruption, and salt marsh restoration.
- Photosynthesis and respiration cycle.
- Compost and soil amendment. Soil as the intersection between the rock cycle and the life cycle.

MATHEMATICS UNIT

Rationale (Dorin and Jill)

Math is a component of our everyday life, whether through conscious or unconscious use. In this interdisciplinary thematic unit, students will use math as a tool to aid in the development of the school garden. Real world application of math concepts will engage students in an inquiry-based exploration of geometry, proportion, scale, pre-algebra, statistics, measurement, numbers and operations. The math topics that will help students with this project are:

Geometry – measurement, length, width, area, perimeter, circumference, volume, 2-D and 3-D shapes, angles, and polygons.

Data analysis/statistics – survey, sampling, variables, reasoning, tables, graphs, charts, and data bias.

Number sense – ratios, proportions, scale and measurement.

Learning Standards (Dorin and Jill)

8.N.3: Use ratios and proportions in the solution of problems, in particular, problems involving unit rates, scale factors, and rate of change.
8.N.10 Estimate and compute with fractions, integers, decimals, and percents.
8.N.11 Determine when an estimate rather than an exact answer is appropriate and apply in problem situations.
8.N.12 Select and use appropriate operations – addition, subtraction, multiplication, division, and positive integer exponents – to solve problems with rational numbers.
8.P.2 Evaluate simple algebraic expressions for given variable values.
8.P.5 Identify the slope of a line as a measure of its steepness and as a constant rate of change from its table of values, equation, or graph. Apply the concept of slope to the solution of problems.
8.P.6: Identify the roles of variables within an equation, e.g., $y = mx + b$, expressing y as a function of x with parameters m and b.
8.P.8 Explain and analyze – both quantitatively and qualitatively using pictures, graphs charts or equations – how a change in one variable results in a change in another variable in functional relationships.
8.G.1: Analyze, apply, and explain the relationship between the number of sides and the sums of the interior and exterior angle measures of polygons.
8.G.4: Demonstrate an understanding of the Pythagorean theorem. Apply the teorem to the solution of problems.
8.G.6: Predict the results of transformations on unmarked or coordinate planes and draw the transformed figure, e.g., predict how tessellations transform under translations, reflections, and rotations.
8.M.1: Select, convert (within the same system of measurement), and use appropriate units of measurement or scale.

8.M.2: Given the formulas, convert from one system of measurement to another. Use technology as appropriate.
8.M.4: Use ratio and proportion (including scale factors) in the solution of problems, including problems involving similar plane figures and indirect measurement.
8.D.1: Describe the characteristics and limitations of a data sample. Identify different ways of selecting a sample, e.g., convenience sampling, responses to a survey, random sampling.
8.D.3 Find, describe, and interpret appropriate measures of central tendency (mean, median, and mode) and spread (range) that represent a set of data. Use these notions to compare different sets of data.

Additional activities to be used as needed from the NCTM (National Council of Teachers of Mathematics) magazine: *Mathematics: Teaching in the Middle School*:

A Yin and Yang Approach to Area and Irregular shapes
Are we golden? Investigations with the Golden Ratio
Elastic, cottage cheese, and gasoline: visualizing division of fractions
Variables and spreadsheets connect with real-world problems

Habits of Mind (Dorin and Jill)

- Finding and keeping focus
- Asking good questions
- Simplifying Questions and problems
- Being attentive
- Thinking fluently and flexibly
- Searching for Patterns
- Finding elegant solutions
- Taking risks
- Cooperating and Collaborating
- Persevering and having self-discipline
- Competing
- Seeing how math works in an everyday life and combining math understanding to solve a problem.
- The understanding that problems can be solved in different ways
- How to strategize problem solving by prioritizing work and dividing work among group.

Activities
Activity One – (Dorin and Jill)
Understanding statistics: A review and investigation of statistics through surveys and analysis of articles using statistical data.

Objectives
- Through inquiry students will understand and be able to explain how and why surveys are conducted, characteristics and limitations of a data sample, ways of sampling, what biases might exist in surveys, how inferences can be made about a population, and the importance of statistical significance.

- Students will create and conduct a survey to poll the tastes of their peers, make predictions about the results of the survey, and organize and analyze the data to determine the crops that should be planted in the school garden.
- Through discussions and class activities students will understand how to use measures of center (mode) and measures of spread (range) to describe what is typical about data and understand outliers impact on the range and mode.
- Through activities students will have experience in evaluating a data set using the mode, median and mean. They will make decisions as to which method best describes the data and be able to explain why they choose one method over another.
- Calculate the median of a data set and experiment with the data set to see how changes in data values, number and magnitude; impact the mode, median and mean. Students will have a good sense of these relationships.

*Goal***:** To find out what crops are preferred for the school garden.

Materials

Variety of data samples
U.S. Census questionnaire
U.S. Census data
Data regarding school district
Samples of questionnaires
Overhead projector or Smartboard
Excel software
Microsoft Word software application
Pens/pencils

Procedures

- Unit agenda and goals overheads – discuss agenda for the day and goals for this unit.
- Begin the discussion and inquiry into why we use statistics. The following topic will be presented for discussion to be used as an example of why we need data and statistics about the world we live in:

  You want to open a day care center; you are fully licensed and trained, what kind of information do you need to know to determine where to establish your day care center.
  - How would you go about trying to make that decision?
  - What kind of information do you need to know about the town? [*Need to know age of population in towns, number of current day care centers, number of two parent households or single parent households, income of households*].
  - Where do you think we could find this type of information, how would it be collected?

- Companies, government, schools, etc use data to answer questions. Give me some examples of a question one of these organizations might have and what data would help them answer that question.
- Make the link to the vocabulary using examples offered in class. Discuss definition of data, population, sample, surveys, representative and biased sample, statistics and random sampling etc as well as the U.S. census.
- Ask the class to explain what they think each vocabulary word means before I give the text definition. Have the students give me example(s) of the vocabulary words.
- Math dictionaries – students need to create personal definitions of all vocabulary words, draw pictures if needed
- What is the purpose of the census? *[Primary use to find out how many people live in the U.S.]*
    - How do you think the data is categorized and organized? Give me examples of categorical and numerical data?
    - Social Studies link: State population data is used to determine what? *[Data organized by state is used to determine how many representatives each state will have in the House of Representatives in the U.S. Congress]*
    - What kind of information do we get from the U.S. Census? Why is it useful?
    - Break up into groups and look and www.census.gov and look at the depth of information found on the report and discuss in groups using a pens in the middle structure what this information might be used for. Are we confirming what we hypothesized? How might this data be biased?
- Write in math journal: Explain how you would go about conducting a random sample of students in the school to ask how they feel about starting a school newspaper and determine what the content of the paper should be.
- We can describe data in a multitude of ways. Much of how and why we describe data depends on what questions we are trying to answer. In what ways can we describe data to help answer questions? *[Descriptive, using words or measures, and in graphical ways.]*
- One of the descriptive ways we can express what is typical about a set of data is to look at the value that occurs most of the time (most frequently). Let's look at our data.
    - What value occurred most frequently and how did you determine that value?
    - The value that occurs most frequently is called the **mode.**
    - How does the mode describe the data set?
    - Can there be no mode in a data set?
    - Can there be more than one mode in a data set? [*bimodal]* Why?
    - Can there be no mode? *[When there are three or more values that appear then there are no modes in the data set]*
- Another way to describe data is known as the **range.**
    - What do you think that means? [*How spread out the data is}*
    - How do you find the range? [*maximum number-minimum number]*
    - Range can also be stated by giving both the lowest and highest value.
    - What is the range of our entire data set?
- Using the data handed out: This part of the activity will be done in a think-pair-share
    - Create a line plot using the entire data set compiled in the frequency table [*number line, X above corresponding value on line for every data point]*

    - What can you tell me about the data by looking at the Line plot? [*mode and range]* What are the mode and range based on looking at the LP and how did you find them? Are they the same as what we previously determine?
    - Are there any gaps in the data?
    - Are there any **outliers**? What do I mean by outlier?
    - What is the shape of the data? *[bell shaped, spread out in clusters, grouped at one end]*
    - What are some advantages to a LP? *[every piece of data is shown, easy to make, easy to understand*
- Assessment activity: Ms. Copper has 22 students in her class. The mode of the name lengths for the class is 14 letters. The range is 6 to 22 letters.
    - Create a set of name lengths that has this mode and range.
    - Create a line plot of the data
    - Choose two members from each group to come to the board and create a frequency table and a line plot.
    - Let's take a look at what has been done. [hopefully each group will have come up with a unique data set]
    - How are these line plots similar and how are they different?
    - How is it possible that we have different data sets?
- Again looking at our data find other measures of central tendency that help describe a data set (median and mean). We will work in groups to answer the following:
    - Where is the median? Is the median the same as the mode? Remember that the median does not have to be a value in the data set.
    - Let's add additional data points -what happens to the median and mode when you added the new data point?
    - Can the median be the same as the mode?
    - How would you go about finding the median?
    - What is the mean? Does the mean have to be a data point in the data set?
    - Can we average two or more averages? Is that average accurate?
    - How do very high values in a data set affect the mean and median? Activity 3 page 301 from Math Matters
    - Give examples of when it would be most appropriate to use each measure of central tendency.
- What's average Activity 4 from *Math Matters* (page 303) which measures of center best describe specific data sets?
- Through inquiry based discussion we will talk about developing surveys and what biases might occur during the development of the survey from the wording of questions to the way the survey is conducted. We will discuss the characteristics and limitations of a data sample and different ways of selecting a sample. We will look at questionnaire samples and evaluate them for bias.
- We will analyze many survey samples and discuss survey size and statistical significance.
- Students will then research possible plants for the garden and categorize the plants.
- The students will then break out into groups and create questionnaires for determining what crops are most favored by the student population, teachers, administration, and community.
- Students will conduct the survey in the cafeteria over a two day period and poll students, teachers and administrators. In addition students will poll community members at local

sporting events and via phone to community members. Each student will receive an assessment grade for appropriately participating in the data collection process and I will spot check to be sure people were called.

- Based on their observations students will make predictions about the outcome of the data.
- Using the data they collected students will discuss how data can be described. Each student will analyze and organize the data in an excel spreadsheet and determine the central tendency and frequency. Students will draw their own conclusions and then we will discuss everyone's findings as a class and make planting decisions.
- Students will create charts and graphs that visually describe the data which will be displayed at the culminating event.

Assessment

- Classroom participation
- Journal entries
- Data collection and analysis
- Data charts or graphs

Resources

CMP publications
Connected Math
Chapin, S. and Johnson, A. (2006). Math Matters. Math Solutions Publications. Sausalito, CA.

ACTIVITY TWO – Jill
Examine and apply geometric, number and operation, and measurement principles to the practice design of a stacking garden.

Objectives
Students will apply many mathematical concepts and reasoning skills to develop the layout of the garden. By first designing a stacking garden, students will explore:

- Concepts of measurement and geometry
- Algebraic thought through the exploration of functional relationships between perimeters and areas
- Perimeter, area and volume
- Patterns using pattern blocks
- Which measurement system is most appropriate for this work (Standard U.S. or Metric)
- Determining materials and associated costs needed

Goal: Design the school garden

Once students complete the exercise they will work in teams to apply what they have learned to the design of the school garden. They will then be challenged to use a persuasive and reasoned argument to convince the other teams that their plan is the most effective and aesthetic plan and is flexible enough to accommodate what the students learned about soil renewal and crop rotation during their trip to the Farm School.

Development of Skills

Inquiry skills:

- Questioning
- Recording and organizing data
- Finding meaningful patterns
- Synthesizing and Presenting Findings

Materials and Resources

Computer for research (research material availability and cost)
Graph paper
Rulers
Manipulatives (triangles, hexagons, squares, rectangles, trapezoid, rhombus)
Students from Boston Architectural College – landscape design program
Permission to access BAC's software CAD systems
Pattern block paper

Procedures

- Pre-Assessment
    - Using a K-W-L chart the class will engage in an activity that will activate prior-knowledge so that the teacher can assess learning gaps.

- The teacher will introduce the unit and begin by posing the following question: "what information do we need to know and what questions do we need to ask in order to appropriately plan the layout of the garden?"
    - Using a Think-Pair-Square structure, students will brainstorm questions to which they need answers.
    - Potential questions
        - What do we need to think about before we start to design the garden layout?
        - What plants will we be growing, how many, how big will they get?
        - Do the plants grow on a bush, vine or in mass (like scallions or carrots)?
        - What kind of space is needed between planning beds?
        - Are there plants we can intermingle?
        - Are there some plants that can't be next to each other?
        - Where is the water supply?
        - How wide should the beds be?
- Students then do the research to answer the questions they have and determine whether or not they have what they need to begin the design process. They use the results of the questionnaire they developed earlier.
- The idea of the stacking garden is introduced as a possible alternative to just rectangular, round or square beds. Using equilateral triangle and hexagon pattern blocks, students create a pattern of a 6 point star by putting a triangle adjacent to each side of the hexagon.

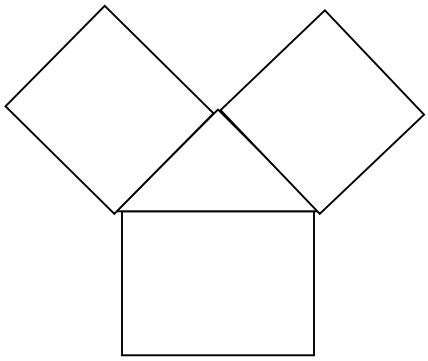
Students then transfer the design onto pattern-block paper with an understanding that they are going from a 3-D shape to a 2-D shape.

- Students then determine the perimeter of the garden. Students will choose a boarder material for their stacking garden from the research they did on garden center websites and determine how much of the chosen boarder material they will need to create the stacking garden. They will then move into a group-pair-share structure and discuss the methods they used to determine the perimeter of the garden. Students will check each other's work being sure that they accounted for the different layers and heights of the beds.
- There will then be a discussion of how students would find area of the stacking gardens. Once the formula for an area of a triangle is decided upon the students would discuss how to determine the area of a hexagon and discover that a hexagon is made up of 6 equilateral triangles. Students would then calculate the area of their gardens. They will then move into a group-pair-share structure and discuss the methods they used to determine the area of the garden. Students will check each other's work being sure that they didn't double count the area of the different layers of the beds (we are calculating area not volume).
- Using equilateral triangle, hexagon, trapezoid and rhombus pattern blocks, students stack and play around with different designs (all pattern blocks have equal side lengths). A moderate amount of time will be given to play with designs as later on in the unit they will be given far more time to work on a design proposal that meets the needs of the garden. Once they have a design that is reasonable (not too complicated) to practice concepts with they will transfer the design onto pattern-block paper.
- Because the patter blocks have uniform side lengths, relationships between the differing shapes should be apparent to students and this understanding will help them create a wide variety of gardens. This uniformity also allows for easy calculations. Students then calculate the area and perimeter of their gardens break into groups of four and share their information.
- These plans will then be put into the work in progress cubicles in the classroom to be used again in a few days when the class examines ratio, proportion and scale.

- Using the original 6 point star shaped stacking garden the teacher asks, "If 1cm=2ft what would the perimeter of the stacked garden be in real life? The class with the guidance of the teacher work through the ratio and proportional reasoning.

  - Students now take the stacking garden designs they created a few days earlier and answer the same question for their design. They will then move into a group-pair-share structure and discuss how they answered the question for their design.
  - The teacher would then ask, "What is the scale factor when we compare the area of a model to the real-life garden?" Students should work through the idea that perimeter is one-dimensional and that area is two-dimensional therefore the measurement units should be squared.
- Geometric exploration will turn to the Pythagorean Theorem using jelly beans to estimate the areas of squares and semicircles.
  - Using a K-W-L chart the class will engage in an activity that will activate prior-knowledge so that the teacher can assess learning gaps.

- Students will construct a mat using cardboard to the shape below (three squares and one right triangle).



-
- Students fill the squares on the legs of the triangle with jelly beans being sure the entire space is filled without jellybeans overlapping or creating a second layer.
- Next students remove the cardboard around the triangle and push the jelly beans into the square that is on the hypotenuse. Students place the cardboard triangle back and make sure all jelly beans are flat.
- What do you notice? Do the jelly beans completely cover the square located on the hypotenuse? Let's talk about the sum of the area of the squares on the legs compared with the area of the square on the hypotenuse.
- Students label the squares on the legs as 'a' and 'b' and the hypotenuse 'c' and then express the relationship that they see as an algebraic expression: $a^2+b^2=c^2$.
- Extending the Pythagorean Theorem discovery students will repeat this activity using semi-circles and triangles. The class will break into groups with half the class using the semi-circles and the other half using triangles. What do you think will happen? Are the results the same for the different shapes? What do you think will happen if we don't use similar shapes?

- Final garden design, development of scaled drawings and models and material cost planning.
  - Now that students have had quite a bit of practice with design gardens using varying shapes students will be given plenty of time to create a proposed layout for the school garden. While they are designing their layout they will be reminded to evaluate the appropriateness of their based on the information they have researched.
  - Making scaled drawings and scaled three-dimensional models. The class will be broken down into two groups. During the technology block half the class will work with students from BAC to create scaled drawings of the students' designs using BAC's design software. This software will aid students in focusing on the concepts of transformation geometry and they practice creating different regions by rotating, reflecting, or translating the original triangles and plans.
  - The remaining students will work during their art block on creating scaled three-dimensional models.
  - Students will calculate the actual volume of soil needed for the garden beds.

- Students will then research and calculate the cost of needed material to implement the student design. Students will use Excel spreadsheet software to summarize and communicate the material costs of their garden design.

Assessment

- Class participation
- Paper block patterns and proportional calculations
- Individual designs
- Accuracy of calculations
- Presentation to BAC students

Unit adapted from:

Beck, S., Huse, V., & Reed, B. (2007, September) How does your mathematical garden grow? *Mathematics teaching in the middle school, 13*(2), 69-76.

Oak Yun, J. and Flores, A. (2008, November) The Pythagorean Theorem with Jelly Beans. *Mathematics teaching in the middle school, 14*(4), 202-206.

ACTIVITY THREE – *Jill*

The Mathematics of Architecture and Design (this is a four week unit adapted for our time frames)

Objectives

Students will use measuring and geometric principles to design a greenhouse for the school garden. Students will:

- Create a site plan
- An isometric drawing
- A scale model
- Cost estimate of building the green house

Materials

Drafting paper
Measuring tools
Site plans
Metric conversion formulas
Computers with Internet access for research
Dot paper

Procedures

- Students will work in groups of five or six and at times will be aided by a student from Boston's Architectural Center.
- First, students will develop a site plan, drawn to scale, of the lot.
  - Students will examine other site plans loaned to the school by BAC.

    - Students will measure the lot and area for the greenhouse using at least three different methods one of which must require conversion measurement (metric to standard or vice versa)
    - Using stirring up the class students will share their team measuring results with other teams.
- Students will research with the aid of BAC students and the industrial arts/engineering teacher appropriate shapes, angles and slopes used to design the foundation, walls and roof structure of the greenhouse. Guided inquiry would include questions like:
    - Why do we use triangles as the basic structure for roofs?
    - What is the best slope for a roof?
    - What types of material should we use?
    - How deep do we dig the cement footings? Why?
    - Where do we put the door? Should it open in or out?
- Students draw an isometric drawing of the structure using 1 inch cubes.
- Students with then make scaled drawings and scaled three-dimensional models of their greenhouse designs. The class will again be broken down into two groups (the same groups for the software design and model design of the garden layout).
    - During the technology block the half of the class that made a 3-D model of their garden design will work with students from BAC to create scaled drawings of their greenhouse design.
    - Students who made scaled drawings of their garden layout will this time be making three-dimensional models of their greenhouse designs.
- The students will then complete a job cost estimate for their design. Students will create a bill of materials for the construction of the greenhouse and then research the costs of the material. Students will use Excel spreadsheet software to summarize and communicate the material costs of their greenhouse design. Guided questions could be:
    - What wood do I need and how many pieces?
    - What type of wood is best for the floor?
    - What type of plastic would work best?
    - What roofing material works best and how much do I need?
    - What is the volume of the cement footings? How much cement do we need?
- Each team will then present their designs and the BAC students will decide on the design best suited for the site.

Assessment

- Class/group participation
- Site plans
- Isometric drawings
- Model of design
- Presentation to BAC student

Resources

Lesson plan adapted from

Reynolds, S., Mahan, M., Lee, B. and BelRisco, G. (2008, March) Building for the future: the mathematics of architecture and design. *Mathematics teaching in the middle school, 13*(7), 382-389.

INTEGRATED ARTS

Art:
Joyce Ting

Art classes will be dedicated to supporting the efforts of the humanities and math content area. Those students who will create original art informed by their study of the Harlem Renaissance and inspired by their reflections upon renewal throughout ITU will have opportunities to do so during their art block

Music
Joyce Ting
In support of the Humanities aspect of the unit, students will further explore the musical contributions of artists such as Duke Ellington, Louis Armstrong, Bessie Smith, and Billie Holiday. As a part of the culminating activity, students can perform the music of these artists, write original music revolving around themes of renewal and/or transform their original poetry into song form.

Industrial Arts
Industrial arts will support both the content area of science and math. Through the industrial arts instructional blocks the students will pre-fab the greenhouse and then raise the structure in late winter. The industrial arts block will also support science by helping with the design and construction, for installation in the garden, of practical, artistic, or curious devices that use or symbolize the repeated transformation of potential energy into kinetic energy, and vice versa. The industrial arts block time will also be used to design, construct and install sun dials.

Health

Activity: Nutrition:*Jill LeBallister-Dudka*

Frameworks

3.8 List the functions of key nutrients and describe how the United States Dietary Guidelines relate to health and the prevention of chronic disease throughout the life span

3.9 Describe a healthy diet and adequate physical activity during the adolescent growth spurt

3.10 Describe the components of a nutrition label and how to use the information from labels to make informed decisions regarding food

Objectives
- Students will understand and be able to describe the components of a nutrition label and how to accurately read and use label information to make informed decisions regarding healthy food choices.
- Students will also have an understanding of good and bad fats.
- Students will continue to gain experience in working with the metric system.
- Students will understand the necessity of proper nutrition.

Materials:
Food labels brought in by students
internet access
overhead projector
food pyramid
Blank form of nutrient and uses

Activities

- Students will be broken into groups and each assigned a nutrient (i.e. calcium, vitamin C, Vitamin D). We will brainstorm about what we would like to know about these nutrients and why they are important to our health.
- A blank Nutrient summary form will be handed out to each group and they will be instructed to find the answers to their questions and the questions on the form and complete the forms. They will need to find out
    - Why do we need nutrient?
    - What foods is it found it?
    - How is it used in our body?
    - What are the side effects of too much or too little?
    - How does this nutrient help to prevent chronic disease
    - etc
- We will get together as a class and each group will present what they learned about their assigned nutrient
- As a class we will discuss based on what we have learned what a healthy diet consists of and look at the food pyramid.
- Label reading and nutrition will begin with the following questions (student responses will be written on the board):
    - What information do we always see on food packaging?
    - Why do we see food labels on products?
    - What is the purpose of food labels?
    - Who regulates or makes the decisions regarding the required information on food labels?
- Next, I will present the following information using an overhead projector:
  Food labels help us determine if a food is nutritious and inform us about the ingredients found in the food we consume. Some of the information found on food labels includes:

a) Ingredient list:
   i) All ingredients in product must be listed (Can you name some ingredients?)
   ii) Ingredients are listed in order by weight, with the ingredient that weighs the most listed first. (Why do you think they are listed this way?)
   iii) New labels require more specific ingredients lists to help those with allergies and health problems
   iv) In-Class activity – Play the "match the food to the label" game. Students will be provided with the ingredient list of five different food products and five names of products. Students will be divided into pairs and try and match the food label to the food name

b) Nutrition Information:
   i) List of nutrients per serving in food as a % of USDA daily recommendations
   ii) List fat content, sodium, sugar, fiber, carbohydrate contents in metric measure
c) New label guidelines will tell us more information in terms that people can understand and will;
   i) be easier to compute the amount of calories from fat and the amount of saturated fat in the product
   ii) have more realistic serving sizes set by the FDA
   iii) require special descriptive claims, meeting a certain standard
      (1) Such as calorie free, sugar free, fat free etc.
   iv) List amounts of Vitamin A, C, Calcium and iron
   v) Require beverages to state the exact percentage of juice they contain
   vi) What do you think about the new guidelines?
d) Fat Content
   i) Using "The Facts about Fat" overhead, discuss good and bad fats
   ii) Limit or avoid foods that name saturated fats first. (Can you name some foods with good or bad fats?)
   iii) Determine the fat content in food using the Fat Calorie Calculation overhead
      (1) Use some of the labels provided by students to obtain initial fat grams and calculate calories from fat from that information.
e) Review some of the food labels brought by students and discuss the nutritional value of the products, commenting on the ingredients with respect to nutritional value.
f) Discuss the fact that most fast food meals are high in fats, sodium and calories. Using the www.foodfacts.info web site, have students:
   i) Select their favorite fast food restaurant meal. Look at the fast food nutritional statistics and compare the fat grams of the meal to USDA guidelines.
   ii) Complete the "Nutritional Lab Worksheet" to gain a better understanding of what eating just one meal at a fast food restaurant means in terms of total calories and fat grams. Emphasize little they can eat for the rest of the day in order to stay within the USDA guidelines.

Assessment

- Nutrient fact sheets and presentation
- Class participation during class discussion and during the "match the food to the label" game.
- The next class session will begin with a 15 minute "Fats" quiz – students will be quizzed on fat definitions, examples of good and bad fats, how to convert fat grams into calories and then calculate the % of total calories that are from fat, and how fat affects cholesterol

The Facts about Fat

- We all need fats.
- Fats helps nutrient absorption, nerve transmission, maintaining cell membrane integrity etc. However, when consumed in excess amount, fats contribute to weight gain, heart disease and certain types of cancer.

Not All Fats are created equal.

Some fats promote our health positively, while other fats increase our risks of heart disease. The key is to replace bad fats with good fats in our diet.

<u>Bad Fats</u>

Saturated fats
- Raise total blood cholesterol
- Raise LDL cholesterol (the bad cholesterol)
- Are mainly found in animal products such as meat, dairy, eggs and seafood
- Some plant foods are also high in saturated fats such as coconut oil, palm oil, and palm kernel oil.

Trans Fats
- Were invented as scientists began to "hydrogenate" liquid oils to better withstand food production processes and provide a better shelf life.
- As a result of hydrogenation, trans fatty acids were formed
- Trans fatty acids are found in many commercially packaged foods as well as in vegetable shortening and hard stick margarine.

<u>Good Fats</u>

Monounsaturated fats
- Lower total cholesterol and LDL cholesterol
- Increase the HDL cholesterol
- Nut, canola and olive oils are high in monounsaturated fats

Polyunsaturated fats
- Lower total cholesterol and LDL cholesterol
- Seafood like salmon and fish oil, as well as corn, soy, safflower and sunflower oils are high in polyunsaturated fats
- Omega 3 fatty acids belong to this group

Fat Calories Calculation

- ALL fats contain 9 calories per gram

Estimate the calories from fat

- Use the nutrition label to find the grams of fat and multiply by 10 (9 calories per gram of fat rounded for ease in computing).
- To find the maximum number of calories that should come from fat, divide the total calories per serving in half.
- If the fat calories calculated in 1 are equal to or greater than half the calories calculated in 2, then the food is considered high fat.

Actual calories from fat equation

[(Grams of fat per serving X 9) / total calories per serving] X 100 = Total Calories from Fat

Activity: Sleep Deprivation Dorin Shams

Objectives:

- Identify good and bad sleep habits
- Lack of sleep is widespread and has negative impacts on society
- Recognize that drowsy driving is a major cause of accidents
- Lack of sleep can cause many health problems

Goals: See sleep as a renewal process and examine the importance of sleep in our daily lives.
Time: 45 minutes

Activity I

Share these statistics with the class and then ask students to discuss the following questions in their small group.

Statistics and related to sleep deprivation

- The National Highway Traffic Safety Administration (NHTSA) estimates conservatively that each year drowsy driving is responsible for at least 100,000 automobile crashes, 71,000 injuries, and 1,550 fatalities.
- Sleep deprivation costs $150 billion a year in higher stress and reduced workplace productivity.
- There are indications that the Challenger disaster, the Chernobyl nuclear reactor meltdown and the Exxon Valdez oil spill can all be partly linked to people suffering from a severe lack of sleep.

- A growing collection of research indicates that America's sleep problems have reached epidemic proportions, and may be the country's number-one health problem.
- Those who sleep fewer than six hours a night don't live as long as those who sleep seven hours or more.

1. List what are good and bad sleep habits?
2. What are the consequences of bad sleep habits?
3. How much sleep do we need?

Discuss what each group found out and share that with the class.

Activity II

Share this hand out with the students and read aloud. Come up with at least one idea that will help each student maintain good sleep habits.

Handout

Both internal and external factors are important in determining the quality of our sleep. Advice for developing good sleep habits includes the following:

1. Maintain the same sleep/wake cycle on both weekdays and weekends. This prevents our internal biological clock from being reset by altered bedtimes and wake times.
2. Avoid alcohol. Alcohol inhibits REM sleep and disrupts sleep during the last part of the night. Alcohol does not promote good sleep and it can exacerbate existing sleep disorders, especially apnea.
3. Avoid caffeine from mid afternoon on. Caffeine is a stimulant that interferes with sleep onset and the rhythm of sleep. Caffeine may take up to 8 hours to be cleared from the body.
4. Avoid nicotine. In addition to other health-related issues of smoking, nicotine is a stimulant, which produces changes in the body and brain that are not compatible with good sleep.
5. Engage in exercise. Exercise during the day improves the quality of NREM sleep. However, exercise up to four hours prior to bedtime can interfere with sleep.
6. Control your bedroom environment. Make your room and bed as comfortable as possible. At bedtime, keep your room as dark and quiet as possible. Keep the temperature on the cool side. A temperature of 65°F is recommended for good sleep.
7. Avoid late evening meals, although a light snack (not too much) is okay. Foods such as milk, bananas, fish, and turkey, which contain the amino acid tryptophan, may have some benefit in promoting sleepiness.
8. Try to get outside in natural sunlight for at least 30 minutes each day. Daylight is important in regulating our circadian rhythm.
9. Try to relax and leave the day’s problems behind. Unwind by reading or listening to the radio. Don’t watch the clock and worry about getting to sleep.
10. If you believe you have a serious problem, there are sleep specialists who can help. Begin by talking with your physician.

Homework: Write a paragraph or two in their journal about what they have learned from this class and the handouts.

Assessment:

- Student participation in big and small groups 10 points.
- Journal entry 10 points.

CULMINATING ACTIVITY

Osprey Team

The culminating activity will take place at the beginning of June. The focus of the culminating activity is to demonstrate ways in which the school garden has renewed the once vacant and littered lot while also sharing with guests the process by which students' vision was implemented. The students will host a party in the garden for visitors to experience the beauty, food, creativity, learning and sense of community developed within and around the garden. Guests of the garden party will be incoming eighth graders, other students, teachers, administration, parents, and individuals or businesses who volunteered their time or resources.

The first group of people to arrive at the garden party will be the 7th grade team responsible for next year's garden. The 7th grade team will walk through the garden while the 8th grade teams give a formal presentation to teach incoming 8th graders about the care and maintenance of the garden. The presentation will focus on the:

- current 8th grade's original vision for the garden
- ways they felt this vision would renew the lot and community
- implementation of their vision
- process for soil renewal
- steps for planning the layout
- process by which they built the greenhouse
- method for creating the compost area
- ways in which ideas succeeded and failed
- possible activities for next year i.e. the recipe book, selling flowers, creating business plans

Included in this presentation will be a presentation of poetry, music and artwork revolving around the students' personal experiences of renewal inspired by the process of this specific project and by life itself. Items created in science class will also be on display: devices curious, artistic, or useful that store and release energy, sundials, the maps of garden sunlight, and the demonstration bed of varieties of brassicas. At the end of the event, the garden will be handed over to the 7th graders.

Once the mini-event with the 7th graders is completed, the event will continue in the garden with the other invited guests. To begin, guests will participate in a walking tour of the garden. Each team responsible for a particular vegetable, herb or flower will stand next to that part of the garden and visitors will walk stroll down garden pathways while listening to short presentations on growing the particular plant – its nutritional needs, challenges with pests and disease etc, concluding with information on how the seeds will be acquired to save for next year's garden. For interested guests, the teams will have created handouts summarizing the best ways to grow each plant. Hopefully, there will be some produce available for guests to taste (perhaps herbs or tomatoes grown in the greenhouse).

While the event is occurring, the school band can play in the background. In addition to the walking tour and plan displays, the students will express in a variety of ways what the garden has meant to them and how they feel this project has renewed the community. They can reflect

upon all the examples of renewal learned throughout the unit. They can read a poem, perform a dance or song, or perhaps put on a short play or discuss a piece of original artwork.

The event will end with a public "thank you" for all the community support offered to the students. In conclusion, the students will officially hand-off the “keys” to their garden to the CitySprouts group of students and community volunteers who will maintain the garden over the summer.

Assessment:

- 7th grade presentation
- Participation during event

APPENDIX

August XX, 2009

[Parent name]
[Street]
City, MA [zip]

Dear [Parent name]:

Welcome to team Zebra! The teachers of team Zebra are hoping that you have had some opportunities to enjoy the summer. It is hard to believe but the beginning of school is only a few weeks away. We are busy finalizing our lessons for the upcoming year and have many exciting activities and learning experiences planned for your child.

We will be taking a field trip early in the school year and would like to share the purpose of the trip with you. One of the thematic units we will be working on through the year is focused on the idea of renewal in the community. As a service-learning project team Zebra will develop of a school garden that we hope will provide many exciting learning opportunities for your child. In addition, the garden will enhance the community environment and provide a place where you and your children could enjoy the sights, sounds, and smells of nature.

In early October we will be taking a trip to The Farm School. At The Farm School students will be analyzing soil, learning about natural cycles of plant renewal and soil renewal, organic methods of gardening, and garden "how-to's". Prior to the field trip we will be developing a large list of questions to help us develop the most productive garden possible. As the date gets closer we will be sending home permission slips so please be on the lookout for the form. This is field trip is an integral part of the entire unit and we are hopeful that all students will be able to attend.

If you have questions please contact us at the school 617-XXx-XXXX. Enjoy the last few weeks of summer and we look forward to seeing your child on August 26th!

Sincerely,

The Zebra Team
Mr. Paul Kelly, Ms. Jill LeBallister-Dudka, Ms. Dorin Shams, Ms. Joyce Ting

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