Community Garden Proposal

Grade: Middle School	**Recommended Timeframe:** 2 ½ weeks

Unit Overview

This interdisciplinary unit is intended to be taught cooperatively in math, science, and engineering classes. Students will work cooperatively to write a proposal for developing a community garden from an unused, local, publicly-owned property. Because the scenario of the performance task relates to community gardens/soil health, students will spend time learning about soil health, gardening practices, landscape design, and the related scientific, math, and engineering concepts to provide context for their design and proposal. Technological tools will be used to collect and analyze soil health data and to present their proposal to a mock city council.

Essential Questions	**Major Concepts**
Why is soil health important? How does soil health impact a community? What is the best use for undeveloped land?	<u>Science</u> Soil health Human impact on natural resources Design process <u>Technology</u> Not a focus in this unit <u>Engineering</u> Design process <u>Math</u> Data collection and analysis Problem solving

Suggested Lesson Sequence

Prerequisites

<u>Science:</u>

Prior to this unit, students should be given a basic overview of soil and water quality. It is not necessary to understand these concepts at a deep level, but students should be familiar with the vocabulary and overall concepts.

<u>Engineering:</u>

Students need to be familiar with an engineering design process model to successfully complete this unit.

<u>Math:</u>

The lessons in this unit apply math concepts taught in previous grade levels and/or previously in the year. It is assumed that students are proficient with basic math computation, area, volume, rates, ratios, proportions, and scale drawings. All students will complete review activities about percentages and scale/ratio/proportions during the first days of the project so they have a common language and understanding when working on their budget and scale drawings.

Not all students may be in all classes for this unit. Due to this, there may be some overlap in explanatory/exploratory lessons to allow all students to have at least basic knowledge of necessary content.

Lesson 1
Establishing Context – Science, Engineering, Math
Lesson Overview: Students will view a demonstration of the amount of available soil on the Earth to understand importance of utilizing land effectively and will ask questions to clarify their understanding of the Community Garden Project.

Lesson 2
Soil Quality Tests – Science
Lesson Overview: Students will perform soil tests on samples taken from 3 differing areas in the community garden location.

Energy Sources – Engineering:
Lesson Overview: Students will review energy sources and take notes in their engineering notebooks.

Rates, Ratios, and Percentages Mystery – Math:
Lesson Overview: Students will complete review percentages, ratios, and proportions to solve a mystery.

Lesson 3
Soil Health – Science:
Lesson Overview: Students will work with a Master Gardener guest speaker to interpret the results of their soil tests. The guest speaker will offer plant suggestions given the location conditions.

Using Wind Energy Research – Engineering:
Lesson Overview: Students will research wind energy by watching selected Internet videos and exploring the Wind With Miller website.

Classroom Scale Drawing – Math
Lesson Overview: Students will review scale drawings and participate in guided practice to make a scale drawing of the classroom.

Lesson 4
Master Gardener – Science:
Lesson Overview: Students will create a brochure for engineering and math students and members of the community, with information about soil and plant suggestions given the location conditions.

Turbine Blade Design – Engineering:
Lesson Overview: Students will determine what type of energy source will provide power for irrigation pumps to water their community garden.

Community Garden Scale Drawings – Math:

Lesson Overview: Students will work in groups to create a scale drawing of their proposed community garden design.

Lesson 5
Garden Brochure – Science
The students will synthesize knowledge of soil health to create a brochure with information about local soil conditions and recommendations for a community garden.

Decisions, Decisions – Engineering
Lesson Overview: Students will design and test model wind turbines and learn how to measure the energy produced by the turbines.

Community Garden Budget – Math
Lesson Overview: Students will prepare a project budget.

Lesson 6
Assessment – Math
Lesson Overview: Students will complete a performance task or test.

Materials, Tools, & Technology	**Vocabulary**
☐ graph paper/Engineering Notebook ☐ copies of handouts (see Student Resources Appendix) ☐ apple ☐ paring knife ☐ computers with Internet access	soil microbes respiration pH/pH scale acidic/basic/neutral nitrogen phosphorus potassium tillage pan scale drawing

STEM Professional Involvement Ideas (see Teacher Resources Appendix for talking point template)

One or more of these STEM Professionals could be invited as a guest speaker at any appropriate point in the lesson sequence:

- **NRCS (National Resource Conservation Service) Conservationist**
  A conservationist could speak to students about factors of soil, the long-term effects of unhealthy soil, and best practices in planting.
- **Master Gardener**
  A master gardener could speak to students about gardening practices, the effect of local climate and soil on plant choices. Students could present their soil health data to the gardener and ask for help with interpretation of the results and/or recommendations of plants that would thrive at the given site.
- **Irrigation Specialist**
  An irrigation specialist could speak to students about irrigation practices and options for watering a community garden.

Standards

Science

- Construct an argument supported by evidence for how increases in human population and per-capita consumption of natural resources impact Earth's systems. (MS-ESS3-4)
- Apply scientific principles to design a method for monitoring/ minimizing a human impact on the environment. (MS-ESS3-3)

Technology

- Locate, organize and use information ethically from a variety of sources and media.
- Evaluate and select information sources and digital tools based on the appropriateness to specific tasks.
- Analyze, evaluate, and summarize information or data and report results.

Engineering

- Define the criteria and constraints of a design problem with sufficient precision to ensure a successful solution, taking into account relevant scientific principles and potential impacts on people and the natural environment that may limit possible solutions. (MS.ETS1.1)
- Evaluate competing design solutions using a systematic process to determine how well they meet the criteria/constraints of the problem. (MS.ETS1.2)
- Analyze data to determine similarities and differences among several solutions to identify the best characteristics of each that can be combined to better meet the criteria for success. (MS.ETS1.3)
- Develop a model to generate data for testing/modification of a proposed object, tool, or process such that an optimal design can be achieved. (MS.ETS1.4)

Mathematics

- Math Practices 1, 3, 4, and 6
- Understand ratio concepts and use ratio reasoning to solve problems. (6.RP.A)
- Solve real-world and mathematical problems involving area, surface area, and volume. (6.G.H)
- Analyze proportional relationships and use them to solve real-world and mathematical problems. (7.RP.A)
- Solve real-life and mathematical problems involving angle measure, area, surface area, and volume. (7.G.F)
- Create equations in one variable and use them to solve problems (A.CED.1)

Notes

For math and engineering, this unit is not written to address new content standards but is an authentic application of previously learned material. In science, the unit could be used to teach the 6th grade standards regarding human impact on natural resources. In science, for grades 7 and 8, the unit could still be used to teach and/or further students understanding of the design process and to review the 6th grade concepts as they relate to real-world applications.

If your students have a very solid understanding of percentages, ratios, proportions, and/or scale drawings, you can begin the unit with Lesson 4 – Math.

The teacher will need to identify a local, vacant lot that is near a water source and collect soil samples.

Appendix List

Appendix A: Teacher Resources
Appendix B: Student Resources

Establishing Context – Community Garden – Lesson 1

Grade Level:	Middle School	**Time Needed:**	45-50 minutes	**Subjects:**	Science, Engineering, Math

Objective/ Learning Target: The students will understand the amount of soil available for human use on the Earth and the components of the Community Garden Proposal project.

Standards:

6.RP.A Understand ratio concepts and use ratio reasoning to solve problems.

7.NS.3 Solve real-world and mathematical problems involving the four operations with rational numbers.

Background Information:

A very small percentage of the soil on planet Earth is available for human use to produce food, but soil was historically viewed as an unlimited resource. Directly or indirectly, all living things depend on it as a source of food. Our food-producing land remains the same, while our population continues to increase. This demonstration illustrates soil as a limited resource and establishes the importance of using it responsibly and effectively.

Materials:

- apple
- paring knife (1)
- copies of the Community Garden Project Outline (Appendix A)
- copies of Lesson 1 Exit Ticket

Vocabulary:

soil
percentage
circle graph/pie graph

Resources:

Appendix A: Community Garden Project Outline and Lesson 1 Exit Ticket Answer Key
Appendix B: Lesson 1 Exit Ticket

Procedures:

1. How Much Soil Is There? Apple Demonstration
   a. Show students an apple, explaining that it represents the Earth for this demonstration.
   b. Cut the apple into four equal parts. Three of the parts represent the oceans of the Earth. Set these aside. The fourth part represents the land area of the Earth.
   c. Cut the land section into two equal, lengthwise pieces. Now you have two 1/8th pieces. One section represents land such as deserts, swamps, Antarctic, arctic, and mountain regions—areas where humans do not live. Set this section aside. The other 1/8th section represents land where humans can live but may or may not be able to grow food.
   d. Slice this 1/8th section crosswise into four equal, lengthwise parts. One of the 1/32nd sections represents the areas of the world that are too rocky and/or have poor soil where food does not grow. One of the 1/32 sections represents the areas of the world that are too wet for food production. One of the 1/32 sections represents the areas of the world that are too hot for food to be grown. Set these three sections aside. The last 1/32 section represents the areas developed by humans and available for food production.
   e. Carefully peel the last 1/32nd section. This small bit of peeling represents the soil of our earth on which humans depend for food production. However, this also is the land where our cities, houses, shopping malls, parks, etc. are located.

   ***While completing this demonstration and asking students questions about the fractions (and

percentages of each section), keep a list that is visible to students. It will be used for an exit ticket at the end of the lesson.

2. Discussion/Debrief of the apple demonstration. Some questions to ask students could include:
   a. What did you learn from this demonstration?
   b. Did you find the demonstration surprising? Or was it similar to what you expected?
   c. What are some items that you have used today that needed soil to be produced?
   d. What are some items that you have thrown away today that needed soil to be produced?
   e. Why do you think that we need to be concerned about the health of our soil?
   f. Do you have any questions that you would like to investigate further after watching the demonstration?

3. Community Garden Proposal project outline
   a. Go over the outline of the project with students. Ask for volunteers to read each section, and answer any general questions asked by students.
   b. Assign students to their project groups.

   ***Prior to the lesson, work with the science and engineering teachers to group students strategically. Whenever possible, include a student who has all three of the classes in the group. Those students can serve as a liaison between the different subjects, explaining what progress has been made in the other classes. If it is not possible to include a student who has all three classes, strategically include students who have two of the classes (for instance, one student who has the science and math class and another student who has the engineering and math class) to serve as dual liaisons.

4. Exit Ticket
   a. Hand out copies of the Lesson 1 Exit Ticket. Students will use the percentages recorded on the board during the apple demonstration to complete a pie graph representation of the activity.

Differentiation:

Supports	Extensions
Any students who are not capable of creating the pie chart for the exit ticket (or who would take an excessively long time to create the pie chart) can be provided with a template such as the one available in this lesson provided by the Soils Society of America: https://www.soils.org/files/about-soils/earth-science-week-2007.pdf	In this introductory lesson, it is unlikely that students will need any extensions. In the event that one or more students finishes the exit ticket extremely quickly, they could be given the radius of the earth and the depth of the earth's crust to figure and be asked to figure a more accurate percentage of the earth that is available for human use as food production, housing, etc.

Assessment Opportunities:

A formative assessment (the exit ticket) is included in the lesson procedures. The exit ticket is an informal assessment of students' understanding of the available soil on Earth and their engagement in the lesson. It also gives an opportunity for students to express their "Aha's" and wonderings prompted by the demonstration.

Citations:
Apple demonstration adapted from:
http://www.nrcs.usda.gov/Internet/FSE_DOCUMENTS/nrcs144p2_002490.pdf, page 6

Community Garden Project Outline provided by:
Joe Burris and Erica Jossi

Soil Quality Tests – Lesson 2: Science

Grade Level: Middle School	**Time Needed:** (2-3) 45-50 minutes class periods	**Subjects:** Science

Objective/ Learning Target: The students will understand how to administer various types of soil quality tests.
The students will interpret the results of their soil tests to find plants that would be suited for a community garden with specific soil qualities.

Standards:

5-LS2-1 Develop a model to describe the movement of matter among plants, animals, decomposers, and the environment.

5-ESS3-1 Obtain and combine information about ways individual communities use science ideas to protect the Earth's resources and environment.

MS-LS2-1 Analyze and interpret data to provide evidence for the effects of resource availability on organisms and populations of organisms in an ecosystem.

Background Information:

Many factors impact soil health. The soil quality factors measured in this lesson are only a few of the most basic—appropriate for a middle school investigation.

The pH, salinity, temperature, and type of soil can have a significant effect on what types of plants will grow in a particular soil. Additionally, soil respiration measures how much "life" soil has, indicating whether other plants would thrive there as well.

There are three main types of soil: sand, loam, and clay. These three types of soil combine in different amounts to form numerous sub-types of soil. One simple method of identifying soil type is hand-texturing, an easy method for students to use in the classroom that doesn't require technology or additional materials beyond a soil sample. Each type of soil supports different types of plants. While the overall soil type of an area cannot be amended, it is possible to add to small areas of soil in order to increase productivity or support the growth of desired plants.

Materials:

- ☐ KWL Chart (see Appendix B)
- ☐ copies of Soil Quality Data Sheet for each group (see

Vocabulary:

pH
salinity

Appendix B) -OR- ☐ an electronic, fillable spreadsheet that is set up similar to the Soil Quality Data Sheet (see Appendix B) ☐ soil samples from three separate areas in the community garden location ☐ Vernier probes: pH, salinity, respiration (CO_2), moisture, and temperature ☐ Vernier LabQuests, LabQuest minis, or LoggerPro installed on computers/tablets ☐ copies of the Soil Identification handout -OR- ☐ an alternate soil identification flow chart can be found at http://www.soil-net.com/sm3objects/activities/Activity_HandTexturing1.pdf ☐ distilled water ☐ plastic spoons ☐ paper towels ☐ 100 mL graduated cylinders ☐ 250 mL beakers ☐ tablets/laptops/computer lab with Internet access ☐ paper coffee filters	respiration moisture soil quality temperature loam clay sand

Resources:

- See Appendix B for Vernier Soil Quality Lesson Plans (Soil pH-LoggerPro, Soil pH-LabQuest, Soil Salinity-LoggerPro, Soil Salinity-LabQuest, Soil Temperature-LoggerPro, Soil Temperature-LabQuest, Soil Moisture-LoggerPro, Soil Moisture-Labquest, Soil Respiration), Water Holding Capacity Instructions, KWL chart, Soil Quality Data Sheet, Soil Identification Handout

Procedures:

1. Warm-up
   a. Post the question, "What makes soil healthy?" as a warm-up for students.
   b. After 1-2 minutes of brainstorming time on their own, have them turn and talk to an elbow partner, working together to extend their individual ideas.
   c. As a class, develop the brainstorming session into a class KWL chart, filling out the first two columns at this time.

2. Demonstrations

***Prior to the lesson, set up each station with the materials listed on the individual lab plans. A fast-food-style tray is easy to carry to various places in the classroom and will help keep the materials contained. It may also be necessary to calibrate one or more of the Vernier probes according to the directions in the individual lab plans. See appendix A for the lab plans.

a. Demonstrate each of the seven stations for the students, giving specific directions on how much of each material to use and how long the test should last.
   i. Soil pH
   ii. Soil Salinity
   iii. Soil Moisture
   iv. Soil Temperature
   v. Soil Identification

vi. Soil Respiration
vii. Water Holding Capacity

3. Soil Quality Test Stations

a. Distribute copies of the Soil Quality Data Sheet to each student/group.
b. Each Community Garden Proposal group should be assigned to a station to begin testing the soil samples.
c. As you circulate the room, ensure that students are correctly using each probe in order to keep their data as accurate as possible.
d. After an allotted amount of time, have the students switch to a new station in a clockwise direction.
e. Continue in this manner until each group has visited all of the stations.
f. If necessary, the soil quality stations can continue into a second class period.

4. Research and Result Interpretation

a. Each student should be instructed to find two reputable sources for information on soil quality factors—government or university sites may be best.
b. Ask students to research ways that the soil quality factors they tested affect plant growth. Some questions to consider and/or require of students during their research:
   i. What is in soil that effects pH, salinity, moisture, and water holding capacity?
   ii. How do farmers, gardeners, and environmental scientists adjust the soil to get the desired levels of nutrients for their plants?
   iii. What plants/crops grow best in the students' specific region?
   iv. What plants/crops grow best in soil with the specific conditions of the soil students tested?
c. Each student should summarize the results of their soil tests and research in a paragraph.

Differentiation:

<u>Supports</u>

A single soil sample can be assigned to students who need extended time with each test. If it is not feasible for some students to complete all of the tests, the stations can be divided between two such groups and then their results can be shared. This will alleviate or eliminate the time crunch of fitting all stations into the allotted time.

<u>Extensions</u>

All students will extend this lesson to make plant suggestions for a community garden and create a brochure about soil conditions for community gardeners.

Advanced students can investigate ways to amend unfavorable soil conditions from their test results.

Students can bring in soil samples from their own yards and/or other areas (favorite camping sites, family yards/farms from out of town, the school playground, etc.) to test, comparing the results to those of the community garden site. What ideas do they have about the similarities/differences? What factors would change their test results?

More advanced students may be directed to

	gather more scientifically-accurate data by collecting multiple data points and taking an average of their readings.
Assessment Opportunities: The lesson is intended to be an inquiry into soil health and an opportunity for students to work with Vernier probes. No assessment opportunities were designed in this lesson.	
Citations: The alternate soil identification flowchart can be found at: www.soil-net.com	

Energy Sources – Lesson 2: Engineering

Grade Level:	Middle School	**Time Needed:**	30 minutes	**Subject:**	Engineering

Objective/ Learning Target:	Students will know a variety of ways that electricity is generated.

Standards: (MS-ESS3-4) Construct an argument supported by evidence for how increases in human population and per-capita consumption of natural resources impact Earth's systems.	**Background Information:** The teacher needs to have an understanding of energy sources and electricity generation. An easy-to-use overview can be found at http://www.eia.gov/kids/energy.cfm?page=about_home-basics
Materials: ☐ engineering notebook ☐ computer ☐ internet access	**Vocabulary:** energy electricity

Procedures:

1. The teacher will assess students' previous knowledge and misconceptions about energy. Ask questions like: What is energy? What are the types and forms of energy? Where does energy come from?

2. Students will take notes in engineering notebooks while the teacher presents an overview of wind, solar and, if desired, other forms of energy sources. NEED_Solarshort.pptx and NEED_wind.pptx (available for download at http://www.need.org/ppts) are examples of PowerPoint that may be used to present information to students.

3. Students will write a question and answer about how electricity is produced by wind or solar energy as an exit ticket.

Differentiation:

Supports	Extensions
For students who may have difficulty taking notes, teachers may design a handout to go along with the presentation.	Students needing to extend the learning should explore additional alternative power sources and how they can produce electricity.

Assessment Opportunities:

Exit Ticket
notes check

Citations:

National Energy Education Development Project http://www.need.org

Rates, Ratios, and Percentages Mystery – Lesson 2: Math

Grade Level: Middle School	**Time Needed:** 45-50 minutes	**Subjects:** Math

Objective/ Learning Target: The students will understand how to solve problems involving percentages, rates, and ratios.

Standards:

6.RP.A Understand ratio concepts and use ratio reasoning to solve problems.

6.RP.3C Find a percent of a quantity as a rate per 100

7.RP.2 Recognize and represent proportional relationships between quantities.

Background Information:

In order to understand scale and complete scale drawings, students must have a solid understanding of rates and ratios. This mystery activity is designed to get students up and moving around the room while providing an opportunity to practice previously learned skills.

Materials:

☐ one set of Rates, Ratios, and Percentages Mystery Answer Cards (Appendix B)

☐ copies of A Rates, Ratios, and Percentages Mystery (Appendix B)

Vocabulary:

rate
ratio
proportion
percent

Resources:

See Appendix A for Rates, Ratios, and Percentages Mystery Answer Card key
See Appendix B for Rates, Ratios, and Percentages Mystery Answer Card
See Appendix B for Rates, Ratios, and Percentages Mystery handouts

Procedures:

1.Warm-up

a. Post the following problems (or similar ones that are appropriate for your class needs) on the board:
   i. If a leaking jug of milk loses 3 cups of milk in 4 hours, how much milk does it lose in one hour?
   ii. Which of the following ratios do not belong? Why?
   2:3, 8:12, 9:13, 6:4, 10:15, 6:9
   iii. If you win 13 games out of 20 while playing tic-tac-toe with a friend, what percent of the games did you win?
b. After students have had time to work on the problems, have them compare their answers with an elbow partner or neighbor.
c. Ask for volunteers to share their answers and thinking at the board.

2. Rates, Ratios, and Percentages Mystery

d. Before the activity, print the set of 24 Mystery Cards (Appendix A) and hang them around the room. For a shorter amount of time, make the cards clearly visible on the walls. For a longer activity with more movement, make the cards' placements less obvious (flat on desks/counters, on the back of student chairs, peeking out from behind posters, etc.)

e. Each student needs one copy of the Rates, Ratios, and Percentages Mystery handout. This activity works well with individuals or pairs, but not larger groups.
f. Students calculate the solution to each problem and then search for a matching answer on one of the cards around the room. When they find their answer, they should eliminate the suspect, weapon, or location from their list. Each correct answer will eliminate one choice.
g. When students have finished all 20 questions, they will be left with one suspect, one weapon, and one location. This is the answer to the mystery of who killed Mr. RRP.
h. If students do not quite finish this activity before the end of the class, leave the cards posted in the room. This activity can be finished quickly as a warm-up the following day.

Differentiation:

Supports

For students who work significantly more slowly than their peers, or need substantial help, an appropriate number of the following problem/clue pairs can be crossed off of their assignments, still allowing them to solve the mystery:
#20 and Rope
#19 and Detention Room
#18 and Vase
#17 and Weight Room
#16 and Golf Club
#15 and Gym
#14 and Hallway
#13 and Bathroom
#12 and The Math Teacher
#11 and Office

Extensions

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Assessment Opportunities:

This entire lesson is a formative assessment of students' skills regarding rates, ratios, and percentages. As the students work, the teacher has time to monitor students and see how they are solving each problem. The results of the activity and students' ability to solve the problems will determine whether further instruction is needed on these concepts before moving on to scale drawings in the next lessons.

Citations:

Rates, Ratios, and Percentages Mystery provided by:
Erica Jossi

Soil Health – Lesson 3: Science

Grade Level: Middle School	**Time Needed:** (1-2) 45-60 minutes class periods	**Subjects:** Science

Objective/ Learning Target: The students will understand why soil health is important.
The students will understand basic strategies used to improve soil health that are recommended by experts.

Standards:

5-LS2-1 Develop a model to describe the movement of matter among plants, animals, decomposers, and the environment.

5-ESS3-1 Obtain and combine information about ways individual communities use science ideas to protect the Earth's resources and environment.

MS-LS2-1 Analyze and interpret data to provide evidence for the effects of resource availability on organisms and populations of organisms in an ecosystem.

Background Information:

Soil health is the continued capacity of soil to sustain plant, animal, and human life. Many factors impact soil health and numerous strategies are employed by farmers, ranchers, and conservationists to improve the health of soil and increase its capacity to sustain life.

In this lesson, an NRCS conservationist will give a presentation on soil health and its factors.

Materials:

- ☐ guest speaker presentation guide
- ☐ lined paper
- ☐ laptops/computer lab (optional)

Vocabulary:

soil
soil health
summary

Resources:

See Appendix A for Guest Speaker Presentation Guide NRCSConservationist

Procedures:

***Prior to this lesson, contact your local office of the NRCS (information on local offices can be found at http://www.nrcs.usda.gov/wps/portal/nrcs/main/or/contact/local/ or by searching "NRCS + *your county name,*" ex: "NRCS Malheur County) to arrange for a guest speaker. The NRCS conservationists may already have suitable presentations for students on this topic. The Guest Speaker Presentation Guide (see Appendix A) can be provided to the conservationist by the teacher if desired.

1. Introduce the guest speaker. Information about the role of NRCS can be found on their *About Us* page on their web site at http://www.nrcs.usda.gov/wps/portal/nrcs/main/national/about/

2. Monitor children during the guest speaker, reminding them to take notes about key points.

3. When the guest speaker has finished his/her presentation, assist the students in asking specific and appropriate questions about the presentation, the speaker's job, and/or other related concepts.

4. The students will write a summary of the information provided by the guest speaker. The length of the summary can be assigned by the teacher based on student ability, grade level, and available time.

a. To complete this lesson in one class period, students can be directed to write a one- to two-paragraph summary in the same class period that the guest speaker presents.
b. To complete this lesson in two class periods, students can be directed to write a one- to two-page summary in a second class period. To integrate this with an English/Language Arts class/lesson, the rough draft could be written in the second class period and then turned over to the English/Language Arts teacher for revision and improvement, working toward the CCSS standard for non-fiction writing. This summary can be written by hand in the classroom or, if available, on the computer.

Differentiation:

Supports

Students who struggle with writing can be provided with notes about the guest speaker's presentation. This will allow them to focus on the presentation rather than struggling with the writing portion of jotting down notes.

Additionally, the length of the summary can be shortened to a length that is appropriate for each student individually. If the support of an instructional assistant is available, this would be an appropriate time to use them as well.

Extensions

Any student could be asked to turn their written summary into one of the following visual presentations:

- A digital slide show of any type (PowerPoint, Presi, etc.)
- A poster board presentation
- A collage of pictures/words representing the topic of soil health cut out of magazines
- A Wordle collage representing words that were present most often during the guest speaker's presentation

A variety of soil lesson plans are available on the NRCS website's Soil Education page. These lessons could be used to expand students' learning about soil beyond the scope of this Community Garden Proposal Unit.

A student who needs an extension for this lesson can be directed to the Web Soil Survey to gather information on soils in their area. The Web Soil Survey can be found at www.websoilsurvey.nrcs.usda.gov

An NRCS technician has created paintings of the Lewis and Clark Expedition using paint made of various soils. Her paintings can be found at http://www.nrcs.usda.gov/wps/portal/nrcs/main/soils/edu. Click on the Painting With Soil link. The page includes a link to a pdf file that explains how to create soil paints. Artistic students may enjoy making their own soil paintings.

Assessment Opportunities:

This lesson is designed to provide an introduction to the basic principles of soil health and strategies used to improve soil quality. No assessment opportunities were designed in this lesson.

Citations:

All NRCS resources and information taken from the NRCS website: www.nrcs.usda.gov

Using Wind Energy – Lesson 3: Engineering

Grade Level: Middle School	**Time Needed:** 90 Minutes	**Subjects:** Engineering

Objective: Students will understand how wind turbines produce electricity.

Standards:

OETS 3 Research and Information Fluency: Students select and apply digital tools to gather, evaluate, validate, and use information.

Background Information:

The teacher should familiarize him/herself with the "Wind with Miller" website: www.windwithmiller.dk to understand the parts of a wind turbine and how they function. The teacher should download the teacher guide for the site to understand what is available.

Materials:

computer with internet access.

Vocabulary:

tower
nacelle
transformer
rotor
foundation

Procedures:

1. The students will watch Wind Energy videos from the Internet
2. Students will complete the crash course found at www.windwithmiller.dk to learn how wind power works.
3. Students use engineering notebooks to sketch and label the parts of a wind turbine and take notes describing the function of each part of a turbine.

Differentiation:

Supports

Provide questions to guide students in the use of the Wind with Miller Crash course. Questions can be found at http://www.nrel.gov/education/pdfs/educational_resources/high_school/teachers_guide_wind.pdf

Extensions

Students may further explore the Wind With Miller website to understand wind turbines in more technical detail.

Assessment Opportunities:

Check student engineering notebook for correctly labeled sketches.

Citations:

www.windwithmiller.dk

Classroom Scale Drawing – Lesson 3: Math

Grade Level: Middle School	**Time Needed:** Two 45-50 minute class periods	**Subjects:** Math

Objective/ Learning Target: The students will understand the concept of scale and be able to calculate scale using ratios to make a scale drawing of the classroom.

Standards:

6.RP.A Understand ratio concepts and use ratio reasoning to solve problems.

7.RP.2 Recognize and represent proportional relationships between quantities.

Background Information:

Scale drawings, or plans, are sets of two-dimensional drawings used to communicate instructions and/or information about specific objects. These plans are used in a wide variety of fields, from engineering to urban planning to geology. Students often struggle with the concept of scale and making scale drawings. An important part of the Community Garden Project is a scale drawing of the design created by each group. This lesson on scale drawings will solidify students' understanding of scale and allow them to practice prior to working with less guidance during the project.

Materials:

- graph paper
- maps of the United States and/or other visuals that use scale
- pencils
- rulers
- tape measures
- copies of the Classroom Scale Drawing table handout (Appendix B)

Vocabulary:

ratio
proportion
scale
scale drawing
dimension(s)

Resources:

See Appendix B for Classroom Scale Drawing Table handout

Procedures:

1. Introduce the Concept of Scale
   a. Write the word *scale* on the board. Ask students to brainstorm examples of where scales are found and their purpose. Examples may include: weight of objects, temperature of air, length of objects, etc.
   b. Display a map of the United States (or your own state). Point out that this is not an exact representation of the United States—it is a smaller, scaled down version. Since we do not have paper that would accommodate an object the size of the United States, we shrink objects to make them easier to work with. Very small objects such as atoms or computer microchips can be enlarged to make details more obvious.
   c. Point out the scale on the map. Emphasize that the scale tells the viewer how much the object has been shrunk down or enlarged. For example, if the scale on the map says that 1 inch = 50 miles, then two cities that are one inch apart on the map are 50 miles apart in reality.
      i. Have students find pairs of cities that are specific distances apart: 50 miles, 100 miles, 200 miles, etc.

ii. Give students two cities and have them use a ruler to estimate the distance between them.

2. Scale Drawing Guided Practice
   a. Use a ruler to draw a 12-inch square on the board. Tell students that you want to draw another square that is half the size of the original, or has a scale of ½.
   b. Draw a vertical or horizontal line through the square, creating a rectangle. Explain that an object that is cut in half is not drawn to scale. The whole object must be shrunken or enlarged proportionally—by the same amount on each side. The shape of the object should not change. It should only be reduced or enlarged in size.
   c. To further demonstrate this concept, show students a small, readily available object such as a carrot or a wooden pencil. Snap the pencil or carrot in half to demonstrate that half of an object is not the same as an object that is half of its original size.
   d. Use a ruler to draw a 6-inch square, demonstrating using ratios to figure the correct side lengths as below.

$$\frac{1\ inch}{2\ inches} = \frac{?}{12\ inches}$$

Students can use cross-multiplication to find the side length of the new square

$$\frac{1\ inch}{2\ inches} = \frac{x\ inches}{12\ inches}$$

1 inch · 12 inches = 2 inches · *x* inches

Divide by 2 inches to isolate the *x* variable

$$\frac{1\ inch\ \cdot 12\ \text{inches}}{2\ inches} = x\ inches$$

6 inches = *x*

   e. Compare the two squares, demonstrating that ratios can be shown in three ways: 6:12, 6 to 12, or 6/12, all of which can be reduced to 1:2, 1 to 2, or ½.

3. Classroom Scale Drawing
   a. Divide students into small groups (pairs or trios). Each team will measure the dimensions of objects in the classroom—desks, chairs, etc. Assign either metric or English measurements.
   b. Students will use the table to record the objects they measure and their dimensions.
   c. After the groups have recorded their measurements, the class needs to decide on an appropriate scale. Discuss the proportions that will allow students to draw the entire room on one piece of 8.5" x 11" paper but still be large enough to easily determine as many details as possible. As an example, if the longest wall in the classroom was 15 feet long, then a scale of 1 inch = 1 inch would not work since the paper is not 15 inches long. A scale of 0.5 inches = 1 inch would work well since the wall would be 7.5 inches long in the drawing, just fitting on the paper.
   d. Distribute graph paper to the groups. Have students convert their measured dimensions into

scaled equivalents and complete their scale drawing of the classroom layout. Remind them to include a title, appropriate labels, and the scale of the drawing.

e. As a few groups finish before others, have them figure the perimeter of the classroom and the perimeter of their drawings. They should determine the relationship between the two calculations and the scale of their drawing.

Differentiation:

Supports

For students who work significantly more slowly than their peers, the teacher can limit the number of classroom objects that need to be included in the scale drawing.

If students struggle with the calculations needed for the scale drawing, the teacher can strategically assign objects whose dimensions are whole number multiples of the scale. For example, if the scale is 1 inch = 2 feet, assign objects that are 2 feet, 4 feet, 6 feet, 8 feet, etc.

Extensions

Students who finish quickly and grasp the concept of scale easily can be directed to find the area of the classroom and the area of their scale drawing and then determine the relationship between the two figures. The ratio of the areas is the square of the scale they used to make the drawing. A similar exploration can be made about the relationship of the volume of the objects.

Students can complete a brief writing assignment about the importance of accuracy in scale drawings: Is it possible to be 100% accurate in a scale drawing? Why is accuracy important or unimportant? What/who might be affected if a scale drawing was inaccurate?

Assessment Opportunities:

This entire lesson is a formative assessment of students' skills regarding scale and scale drawings. As the students work, the teacher has time to monitor students and determine the accuracy with which they are calculating scale and translating that into a floor plan. The results of the activity and students' ability to draw a floor plan of the classroom will determine whether further instruction is needed on this concept before moving on to the scale drawings of their community garden layout.

Citations:

Classroom Scale Drawing lesson adapted from a scale drawing lesson provided by DiscoverySchool.com at http://www.discoveryeducation.com/teachers/free-lesson-plans/architects-in-action.cfm

Classroom Scale Drawing Table provided by:
Erica Jossi

Master Gardener – Lesson 4: Science

Grade Level: Middle School	**Time Needed:** (1) 45-60 minutes class periods	**Subjects:** Science

Objective/ Learning Target: The students will understand what plants grow well in their local area. The students will understand how the results of their soil quality tests from the previous lesson may affect their plant choices for the community garden proposal.

Standards:

5-LS2-1 Develop a model to describe the movement of matter among plants, animals, decomposers, and the environment.

5-ESS3-1 Obtain and combine information about ways individual communities use science ideas to protect the Earth's resources and environment.

MS-LS2-1 Analyze and interpret data to provide evidence for the effects of resource availability on organisms and populations of organisms in an ecosystem.

Background Information:

Soil Health has a large impact on plant growth, ranging from small changes in flower color to the inability to sustain plant life.

Master gardeners are experts on plant growth in local soils, producing both flowers and food consistently over numerous years. A master gardener will present to the class and help them interpret the results of their soil quality tests in the context of their community garden project.

Materials:

- ☐ guest speaker presentation guide
- ☐ data collected from the soil quality tests in the previous lesson
- ☐ KWL Chart started in Lesson 2

Vocabulary:

soil
soil health
sustain

Resources:

Procedures:

***Prior to this lesson, find a local master gardener to be a guest speaker in your classroom by contacting your state's representative. You can find your state's representative by looking at the American Horticulture Society's master gardener search page at http://www.ahs.org/gardening-resources/master-gardeners. The master gardener may already have suitable presentations for students on this topic. If asked, the Guest Speaker Presentation Guide (see appendix A) can be provided to the master gardener by the teacher.

1. Introduce the guest speaker. Basic information about master gardeners can be found on Wikipedia or the American Horticulture Society's web site.

2. Monitor children during the guest speaker, reminding them to take notes about key points and plants.

3. When the guest speaker has finished his/her presentation, assist the students in asking specific and appropriate questions about the presentation, the speaker's job, and/or other related concepts.

4. A small group of students should present the soil quality test data from the previous lesson to the master gardener. The master gardener can help the students to verify if there are any significant anomalies in

their data that may affect plant choices for the community garden.

5. As a class, complete the "L" column on the KWL chart started in Lesson 2. This class discussion will help students to synthesize the knowledge they have gained over the past three lessons and prepare to write their brochures, giving soil information and plant suggestions to the Engineering and Math classes, in the next lesson.

Assessment Opportunities:
An informal assessment opportunity is provided in the last section of the lesson when the class completes the KWL chart started in Lesson 2. From the discussion, the teacher will be able to assess what students have learned over the three lessons.

Citations:

Turbine Blade Design – Lesson 4: Engineering

Grade Level: Middle School	**Time Needed:** 90 minutes	**Subjects:** Engineering

Objective: Students will be able to design a wind turbine.

Standards:

MS-ETS1-1. Define the criteria and constraints of a design problem with sufficient precision to ensure a successful solution, taking into account relevant scientific principles and potential impacts on people and the natural environment that may limit possible solutions. (MS.ETS1.1)

Background Information:
http://learn.kidwind.org/learn provides helpful background information on designing and building model wind turbines

Materials:
- design brief
- engineering notebook
- pencil
- computer with internet access
- (optional) computer with CAD software

Vocabulary:
criteria
constraints

Resources:
Click here to enter text.

Procedures:
1. Teams of students complete design briefs identifying the problem and criteria and constraints for their design for a community garden.
2. Students separate from their teams, individually brainstorm, research, and create two different annotated sketches of wind turbine blade shape ideas in their engineering notebooks.

Differentiation:

Supports
Students may do one design in their engineering notebook. It may be helpful to direct students that need extra help to http://learn.kidwind.org/learn/wind_turbine_variables_bladedesign

Extensions
Students use CAD software to make 3-D models of blade designs

Assessment Opportunities:
Check design brief for criteria and constraints or sketches for annotation as a formative assessment.

Citations:
http://learn.kidwind.org

Community Garden Scale Drawing – Lesson 4: Math

Grade Level: Middle School	**Time Needed:** Two 45-50 minute class periods	**Subjects:** Math

Objective/ Learning Target: The students will understand the concept of scale and be able to calculate scale using ratios to make a scale drawing of their group's community garden design.

Standards:

6.RP.A Understand ratio concepts and use ratio reasoning to solve problems.

6.RP.3C Find a percent of a quantity as a rate per 100

7.RP.2 Recognize and represent proportional relationships between quantities.

Background Information:

Scale drawings, or plans, are sets of two-dimensional drawings used to communicate instructions and/or information about specific objects. These plans are used in a wide variety of fields from engineering to urban planning to geology. Their purpose in these disciplines is to accurately portray the geometric features of a building or site. The end goal of most plans is to convey enough information to allow a builder or manufacturer to realize a design.

Materials:

- design layout ideas from the engineering class
- copies of the Community Garden Design Handout Math (Appendix B)
- graph paper (8.5x11 or 11x17)
- pencils
- protractors
- rulers

Vocabulary:

ratio
proportion
scale
scale drawing

Resources:

See Appendix B for Community Garden Design Handout Math

Procedures:

1. Distribute copies of the Community Garden Design Handout Math to students.

2. Allow work time for students to create their scale drawings.
   a. Students will obtain the design layout ideas from their engineering liaison.
   b. Students will use information from their Community Garden Project Outline to determine an appropriate scale for their drawing.
   c. Students will create scale drawings of their group's design.

   ***The instructions in this handout assume that a guest speaker has been invited to the classroom(s) and has provided students with information about scale drawings, specifically those for a garden space. If you have not invited a guest speaker, you may need to adjust the instructions accordingly or spend some time looking at scale drawings of garden spaces with your students to identify the appropriate and/or necessary elements/labels.

   d. The teacher will monitor students' progress, helping where necessary and offering questions to prompt their thinking.

Differentiation:

Supports	Extensions
For students who work significantly more slowly	Click here to enter text.

than their peers, the teacher can limit the number of design elements that need to be included in the scale drawing. If students struggle with the calculations needed for the scale drawing, the teacher can assist with parts 2a – 2d of the Community Garden Design Handout Math.
Assessment Opportunities: No assessments are included in this lesson
Citations: Community Garden Design Handout Math provided by: Joe Burris and Erica Jossi

Garden Brochure – Lesson 5: Science

Grade Level: Middle School	**Time Needed:** (2-3) 45-50 minutes class periods	**Subjects:** Science

Objective/ Learning Target: The students will synthesize knowledge of soil health to create a brochure with information about local soil conditions and recommendations for a community garden.

Standards:

5-LS2-1 Develop a model to describe the movement of matter among plants, animals, decomposers, and the environment.

5-ESS3-1 Obtain and combine information about ways individual communities use science ideas to protect the Earth's resources and environment.

MS-LS2-1 Analyze and interpret data to provide evidence for the effects of resource availability on organisms and populations of organisms in an ecosystem.

Background Information:

Click here to enter text.

Materials:

- ☐ copies of Community Garden Brochure Handout
- ☐ computer Lab/Laptops (optional)
- ☐ 8.5x14 paper/11x17 paper

Vocabulary:

pH
salinity
respiration
moisture
soil quality
temperature
loam
clay
sand
soil health

Resources:

See Appendix B for Community Garden Brochure Handout

Procedures:

The students will work in the Community Garden Proposal groups to complete a brochure that gives information about local soil conditions and makes plant recommendations based on those soil conditions.

- The brochure can be completed on paper if access to computers is not available.
- If access to computers is available, students can create their brochure on a program similar to Microsoft Word or Microsoft Publisher. There are several comparable open-source (free) programs available online if your school does not have licenses for Microsoft programs.
- See the Community Garden Brochure Handout for more specific details about the requirements of the project.

i. Distribute the Community Garden Brochure Handout to each group.

j. The students in each group will work cooperatively to assign roles for the brochure.

k. The groups will brainstorm for 10-15 minutes to make a plan for their brochure. If they struggle with planning, you can ask some of the following questions to prompt their thinking:
   a. What will go on the front of the brochure?
   b. What information is most important? Where in the brochure will that information be most noticeable?
   c. Should you have pictures? What kind of pictures? Or why not?
   d. Who is your audience? What size of writing would be most appropriate?
   e. Do you know who is responsible for each part of the brochure?
   f. When are you going to work together (as one whole group) to edit/revise the work you've accomplished at that point? How often will you check in with each other?

Differentiation:

Supports	Extensions
Students who struggle with writing can be assigned to each section of the brochure with a partner. They can offer ideas but have help with the writing portion of the project. The list of required sections of the brochure can be shortened for any students/groups for whom it would be helpful.	Students who excel at this type of project could be assigned to complete a poster board display to accompany their brochure and to be displayed during the proposal to the mock city council. Another relevant extension for students would be to research, and add a brochure section addressing, organic gardening practices and the pros and cons of organic gardening.

Assessment Opportunities:
The brochure created in this lesson is an assessment of what students have learned in this unit.

Citations:

Decisions, Decisions – Lesson 5: Engineering

Grade Level: Middle School	**Time Needed:** 45 Minutes	**Subjects:** Engineering

Objective: Students will be able to make design decisions based upon criteria and constraints.

Standards:

MS-ETS1-2. Evaluate competing design solutions using a systematic process to determine how well they meet the criteria and constraints of the problem. (MS.ETS1.2)

Background Information:

Teacher will need to understand that the "best" solution is chosen by evaluating each design, one criterion at a time.

Materials:

- Decision Matrix
- CAD software (optional)

Vocabulary:

criteria
constraints

Resources:

Procedures:

1. Students work in small groups to use the Decision Matrix to agree on criteria for blade design.
2. Students take turns sharing their design ideas with the group, evaluating each design for each criteria, giving each design points for how well it meets the criteria.
3. Students add up their points for each design on the decision matrix and then come to a consensus on the best design by determining which design has the most points.
4. If CAD software is available, each team should create a 3D model of the best design.
5. Students each sketch an annotated scale drawing of the best design.

Assessment Opportunities:

Check Decision Matrixes to see that decisions were made based on criteria.

Community Garden Budget – Lesson 5: Math

Grade Level: Middle School	**Time Needed:** Two or three 45-50 minute class periods	**Subjects:** Math

Objective/ Learning Target: The students will understand the concept of a budget and apply math skills to create a comprehensive project budget for their community garden design.

Standards:

MP.1 Make sense of problems and persevere in solving them.

MP.6 Attend to precision.

5.NBT.7 Add, subtract, multiply, and divide decimals to hundredths

7.EE.D Solve real-life and mathematical problems using numerical and algebraic expressions and equations.

Background Information:

Click here to enter text.

Materials:

- copies of the Community Garden Budget Handout (Appendix B)
- pencils
- calculators (optional)

Vocabulary:

budget

Resources:

See Appendix B for Community Garden Budget Handout

Procedures:

1. Distribute copies of the Community Garden Budget Handout to students.
2. Allow work time for students to create their budgets.
   a. Students will create a list of necessary supplies.
      i. The teacher may need to prompt students to elaborate on their list of supplies.
   b. Students will do research (if necessary) to gather cost information for the supplies.
      i. Be sure that students have a way to gather cost information if necessary. Class tablets, a computer lab, a teacher computer, etc. are all options.
   c. Students will calculate the cost of the supplies needed for their design.
   d. Students will create a budget.

Differentiation:

<u>Supports</u>

For students who work significantly more slowly than their peers, the teacher can limit the number of design elements/supplies that need to be included in the budget.

If students struggle with the calculations needed for the scale drawing, the teacher can assist with

<u>Extensions</u>

For students who complete their budget quickly, a real-life issue can be provided. For example, tell the students that their budget has suddenly been decreased by a specific percent. Ask them to calculate the amount of their budget that they must cut and then adjust their design accordingly, completing a revised budget.

parts 2a – 2d of the Community Garden Budget Handout.	A similar extension can be provided by increasing their project budget by a specific percent and then asking them to add to their design accordingly. Both of these extensions are good opportunities for students to explain their reasoning. Students can be directed to verbally explain or write their reasoning for the decisions they make to adjust for their budget change(s).
Assessment Opportunities: No assessments are included in this lesson.	
Citations: Community Garden Budget Handout provided by: Joe Burris and Erica Jossi	

Assessment – Lesson 6: Math

Grade Level: Middle School	**Time Needed:** One or two 45-50 minute class periods, depending on the choice of assessment	**Subjects:** Math

Objective/ Learning Target: The students will be able to apply concepts of rates, ratios, percentages, and scale to solve problems in an assessment setting.

Standards:

MP.1 Make sense of problems and persevere in solving them.

MP.6 Attend to precision.

5.NBT.7 Add, subtract, multiply, and divide decimals to hundredths

6.RP.3C Find a percent of a quantity as a rate per 100

7.EE.D Solve real-life and mathematical problems using numerical and algebraic expressions and equations.

6.RP.A Understand ratio concepts and use ratio reasoning to solve problems.

7.RP.2 Recognize and represent proportional relationships between quantities.

Background Information:

Click here to enter text.

Materials:

□□copies of the Proficiency (Appendix B)
--OR--
□□copies of the Performance Task (Appendix B)
□□pencils
□□calculators (optional)

Vocabulary:

percentage
rate
ratio
volume
area

Resources:

See Appendix A for Proficiency (form A) Key, Proficiency (form B) Key, Proficiency (form C) Key, Performance Task Key

See Appendix B for Proficiency (form A), Proficiency (form B), Proficiency (form C), Performance Task

Procedures:

1. Distribute copies of the Proficiency or Performance Task.
   a. The Proficiency is a short-answer assessment expected to take one class period for the average student. It assesses a variety of middle school grade level standards, focusing on applying math

skills to solve problems relating to the Community Garden context of the project.

b. The Performance Task simulates an SBAC performance task with multiple, multi-step questions relating to a single context/situation, in this case, the Community Garden project. The first two questions stand alone, not depending on any other question(s) to find an answer. The following questions may or may not depend on previously solved problems.

***The proficiency was written for a class of Algebra students who completed a quadratics unit just prior to this project. If this lesson is completed with students who are not familiar with quadratics, it will be necessary to change questions #2 and #3.

2. Students will complete the assessment following assessment procedures set up by the teacher.

Differentiation:

Supports

Extensions

Assessment Opportunities:

This lesson is a formal assessment.

Citations:

Proficiencies and Performance Task provided by:
Erica Jossi