STUDENT INFORMATION: PLANNING STAGE

INTRODUCTION

SOIL HEALTH
"HOW DOES YOUR GARDEN GROW?"

Summary: (Six 50 minute class periods)

Students will explore soil chemistry, vegetable growth needs, environmental impact, and soil health through project based learning by creating a school garden proposal.

Focus OAS Standard: Environmental Science

HS-ESS3-2

Students who demonstrate understanding can:

Evaluate competing design solutions for developing, managing, and utilizing natural resources based on cost-benefit ratios.

Essential Questions

Overarching: How do soil health and farming practices connect to environmental impact?

Topical: How do farming practices impact soil health?

Lesson Snapshot

1. Engage: Students will view pictures of crops growing in unhealthy soil and answer the question, "What's wrong with this picture?" Students will then discuss their connection to agriculture and how this connection has its foundation in soil health. Students will view USDA Video: Healthy Soil, Healthy Farmers.

2. Explore: Students will use a USDA School Garden Checklist as a guide to conduct group research about preparing a school garden project proposal. This proposal will be presented to the class and administration.

3. Explain: Students will create and present a garden proposal that includes ways to improve vegetable production through recommended farming practices based on soil test results. Students will provide peer feedback on their presentations.

4. Extend: Students will test soil samples from possible garden sites and compare them to soil samples from other sites. Students will analyze each sample for common soil chemistry tests, which indicate soil with healthy balances of nutrients such as Nitrogen, Phosphorus, and Potassium.

5. Evaluate: Students will produce group School Garden Proposals to be presented to the administration and/or local community members and use a rubric to evaluate their project. As an option students may submit their proposals to a School Garden Proposal Review Committee consisting of community member or the local County Extension office.

Acknowledgement:

Funding provided by USDA to Project No. 2012-02355 through the National Institute for Food and Agriculture's Agriculture and Food Research Initiative, Regional Approaches for Adaptation to and Mitigation of Climate Variability and Change.

Materials Required:

- Soil test kits (These may be purchased at any big box hardware store)
- Internet connected devices (at least one per group of three)
- Stirring rods or sticks
- Paper towels
- Plastic cups
- Water source: approximately two gallons of **DISTILLED** water needed
- Soil Samples: Four soil samples from different locations
- Simple vegetable seeds, such as peas – several per group

TEACHER'S NOTE: To increase student engagement, have the students bring in their own soil samples the week before. A quart sized plastic bag is plenty of soil for each sample.

- Optional: 300mL or larger beakers
- Optional: 300 mL or larger graduated cylinders

Lesson Procedures:

Engage (30 minutes)

Show the students a series of pictures of poor soil health conditions (e.g. yard with yellow patches, compacted soil, poor drainage, erosion, etc.).

> TEACHER'S NOTE: It may be useful to describe what the cover crop for the picture is. You also may need to describe what healthy crop growth may look like.

Ask them: *What's wrong with this picture? What do you think is the cause?* You may lead a discussion or use a strategy such as commit and toss. (see http://k20center.ou.edu/instructional-strategies/).

Next, ask the students the question: *Does what we eat have an effect on the environment? How? What evidence do you have or how do you know this?*

Facilitate a student discussion to elicit student prior knowledge regarding agriculture and farming and how they relate to the environment. Once students have a general understanding of where their food comes from and that the beginning of most food production **depends on soil** to grow the food we eat or to feed the livestock that we eventually eat,

> TEACHER'S NOTE: You can draw a diagram showing the flow of energy and food beginning with soil to the student's plate.

Then ask the question: *What is soil?*

TEACHER'S NOTE: Soil is complex, yet it can be generalized to be composed of 4 components: Sedimentary material, organic material, water, and air. Soil also varies by region as different types and sizes (sand, silt, & clay) of sediments will be present and organic material will vary depending on region. Soil will develop specific layers called **horizons** over time. The development of soil horizons is a good indicator of soil health.

Student responses will vary; however the instructor should help guide students to understand the 4 components of soil and any other characteristics of soil.

Show the USDA Video: Healthy Soil, Healthy Farmers (link below)

https://www.youtube.com/watch?v=-qPu0xING8w

OR the Natural Resources Conservation Service (NRCS) Building Soil Health (link below)

https://www.youtube.com/watch?v=QaOpyycbDcM

Lead a discussion or ask students to think, pair, share about what the term "soil health" means, being sure they answer the following questions:

What criteria factor into soil health?

What are the benefits of having healthy soil?

What soil management practices or strategies would improve soil health?

EXPLORE

Inform students that they will be planning a school garden and that one component of planning a garden is assessing the health of the soil.

Divide the class into collaborative working groups of 5 or 6. Assign each student a role corresponding to the six components (i.e. evaluate your available space, find resources and make partnerships, soil health, design challenge, plant palette, build and use your garden)

found on the USDA School Garden Checklist (http://www.letsmove.gov/sites/letsmove.gov/files/pdfs/LM%20School%20Garden%20Checklist_0.pdf). Explain that each student will be responsible for leading the group in their assigned aspect of the garden-planning project.

Pose the question to the groups: *if we are going to plan a garden, what things might we need to consider?* Have the students discuss with an elbow partner to create a list. Give the students enough time to discuss this thoroughly. Have the students share out with the class and compile a class list on the board.

Pass out a copy of the Student Information: The USDA School Garden Checklist, Garden Planning handout, and the School Garden Presentation Rubric to each student.

Go over the USDA School Garden Checklist pointing out what each role in the garden planning will entail. Go over the Garden Planning handout directions along with the presentation rubric with the class so they understand the project and your expectations.

TEACHER'S NOTE: Students individual roles are explained in more detail on the Garden Planning handout as well as project expectations and Garden Proposal Presentation requirements are explained on the Presentation rubric. Relevant data tables (e.g. soil chemistry) will be provided in these handouts as well.

Explain to the groups the time they will have to plan their school garden. Since this is a group project, allow some class time and Internet access to research and plan. (Additional resources can be located at http://www.fns.usda.gov/farmtoschool/census/resources).

EXPLAIN

Have groups present a rough draft of their plans. As each group presents, ask the others to make one suggestion for improvement and ask one question for peer feedback. This feedback will be used to refine their final presentations.

After students have given peer feedback, provide students with a brief overview of nutrient cycles (http://pods.dasnr.okstate.edu/docushare/dsweb/Get/Document-5685/E-1003.pdf,

http://www.envirothon.org/pdf/CG/nutrient_cycles.pdf, http://biology.about.com/od/ecology/ss/nutrient-cycle.htm, http://www.soil-net.com/dev/page.cfm?pageid=secondary_cycles_nutrient&loginas=anon_secondary,) related to agriculture. Have students incorporate this information into their presentations.

EXPAND

Have students collect soil samples from possible garden sites around campus.

> TEACHER'S NOTE: You may have students collect soil from multiple sites to use as a comparison. Students may even bring soil sample from home to test.

Have students analyze each soil sample, making sure to record the data for the most common soil chemistry tests: soil pH, Nitrogen level, Phosphorus level, and Potassium level.

Preparing the Soil Samples:

- All of tests require a soil solution which is best to prepare at least a day before to get better results due to the nutrients leaching into the water.
- Have the students create a soil solution by adding 100 mL of soil and 200 mL of water to a beaker or other container.
- Now have the students use the stirring rod or sticks to blend the mixture.
- Ensure that students clean the stirring rod thoroughly or use a different stirring utensil for each soil sample

Testing the Soil Samples:

- Now that the students have a garden plan have them test the soil types to determine the level of the nutrients present and if any soil modification will need to be done based on the chosen crops and their nutrient requirements. Hand out the Student Information: Soil Testing & Presentation handout.
- Provide each group with a soil test data sheet OR have each group create their own data table (See *Sample Soil Test Table* below).

- Based on the specific directions for the soil test kit you have purchased, review the procedure for soil testing with your students.
- Have students document their process and results using tablets or their phone's camera if it is a "Bring Your Own Device" (BYOD) approved environment. These pictures can be incorporated into their final presentation.

Sample Soil Test Data Table

Soil Sample	pH	Nitrogen (N)	Phosphorus (P)	Potassium (K)	Is this soil deficient? How?	How could you improve the soil?

TEACHER'S NOTE: You could send the soil ample to an agricultural extension office to be tested and use this as an comparison to evaluate the accuracy of the classes soil tests.

Optional Extension:

(Initial setup is one class but analysis may be extended over weeks during growth cycle of plants)

Test Your Results

- Guide students to grow their own vegetables in the sample soils and predict the results using their soil test data as evidence.

- Choosing one simple vegetable type like peas, have each group grow one plant in each of the soil sample types.
- Have students plant in individual plastic cups that have holes punched in the bottom for water drainage.
- Have the students come up with the planting, watering, and sunlight schedule based on the recommendations that come on the seed packet.
- Also have the students come up with a plan for evaluation. How are they going to determine which soil is the best?
- Have each group write up and submit for your approval their group's watering schedule, light, plan of evaluation and predication.

EVALUATE

Option 1. Present your plan to the administration

- Now that your students have presented their proposals they can create a singular proposal based on the information they researched and presented.
- Have them prepare the proposal for a formal presentation to the school administration to receive feedback and possible approval to pursue and implement the school garden project.
- This extension will only be successful if you have a designated committee that is passionate about the project.
- The first step is to create a class committee, that is, a group of students that spearheads the collaboration as well as the members of the group who presents the proposal to the administration. Have student volunteer for committee member positions which can include a leader (and possibly co-leader), and then specialists in research, community outreach, and presentation production and design. You and the committee members must be willing to meet outside of class-time, either before or after school. During your meetings, facilitate the process of the proposal creation as well as outreach to the administration and the community. In addition to the information already researched, include additional research over other successful school garden projects. You can start with:
    - http://schoolgardenproject.org/
    - http://www.fao.org/docrep/009/a0218e/A0218E02.htm
    - http://edibleschoolyard.org/

Option 2.

Have students prepare and turn in their school garden proposal. Have various community members and/or your local county extension office serve as a School Garden Proposal Review Committee to "review" each proposal.

> TEACHER'S NOTE: This is similar to a blind grant review process. The instructor will have to contact community members ahead of time to find volunteers to form the review committee. You will need to provide the review committee with evaluation rubrics to score each proposal. Review committee evaluation rubrics will vary and can utilize components of the student planning sheet and/or the presentation rubric.

After the committee has reviewed each proposal return the proposals to the students to allow them to read the feedback provided by the committee. You can utilize the committee scores as one part of the project grade.

Additional online resources from the USDA

- Soil Health for Educators: http://www.nrcs.usda.gov/wps/portal/nrcs/detailfull/soils/health/assessment/?cid=nrcs142p2_053870
- Everything you want to know about soil tests including building your own: http://www.nrcs.usda.gov/wps/portal/nrcs/detail/soils/health/assessment/?cid=nrcs142p2_053873
- Soil Biology resource: http://www.nrcs.usda.gov/wps/portal/nrcs/detail/soils/health/assessment/?cid=nrcs142p2_053873
- Natural Resources Conservation Service (NRCS) YouTube channel https://www.youtube.com/user/nrcsnssc

OAS Standards:

Environmental Science

HS-ESS3-2

Students who demonstrate understanding can:

Evaluate competing design solutions for developing, managing, and utilizing natural resources based on cost-benefit ratios.

Clarification Statement:

Emphasis is on the conservation, recycling, and reuse of resources (such as minerals and metals) where possible, and on minimizing impacts where it is not. Examples include developing best practices for agricultural soil use, mining (for coal, tar sands, and oil shales), and pumping (for petroleum and natural gas).

HS-ESS3-3

Students who demonstrate understanding can:

Create a computational simulation to illustrate the relationship among management of natural resources, the sustainability of human populations, and biodiversity.

Clarification Statement:

Examples of factors that affect the management of natural resources include costs of resource extraction and waste management, per-capita consumption, and the development of new technologies. Examples of factors that affect human sustainability include agricultural efficiency, levels of consumption, and urban planning.

ELA - 10th Grade

Oral Language/Listening and Speaking: The student will demonstrate thinking skills in listening and speaking.

Standard 1: Listening - The student will listen for information and for pleasure.

Standard 2: Speaking - The student will express ideas and opinions in group or individual situations.

Visual Literacy: The student will interpret, evaluate, and compose visual messages.

Standard 3: Compose Visual Messages - The student will create a visual message that effectively communicates an idea.

Reading/Literature: The student will apply a wide range of strategies to comprehend, interpret, evaluate, appreciate, and respond to a wide variety of texts.

Standard 4: Research and Information: The student will conduct research and organize information.