Marshall University Sustainability Department

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Nutrition & Nutrients

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OBJECTIVES

Students will realize the connection between essential plant nutrients and essential nutrients for humans through a "hamburger dissection". They will measure soil and plant health through observation and soil nutrient testing.

LESSON PARAMETERS

1. **Key Terms** - macronutrients (nitrogen, phosphorous, potassium, calcium, magnesium, sulfur), micronutrients (boron, copper, chloride, iron, manganese, molybdenum, zinc), nutrient deficiency, hydroponics, fertilizer
2. **Group Size** - groups of 3 to 5 students; applicable for a class ranging from 3 to 30 students
3. **Grade Levels** - 5^{th}- 9^{th}
4. **Duration** - one 45-60 minute session
5. **Setting** - outdoors and indoors (optional)
6. **Disciplines** - Science, art, health, environmental education
7. **Learning Techniques -**
    a. Discussion
    b. Hands-On
    c. Group-based Collaboration
    d. Interdisciplinary
    e. Activity-based
    f. Real-world application
    g. Expeditions
    h. Nature-based

GREEN CONNECTIONS

- **Connections to Home and Community -** Students realize that nutrients cycle through the soil, plants, and humans, offering a bond between people and nature.
- **Sustainable Perspectives -**
    - Gardening
    - Sustainable habitats
    - Sustainable food sources

LESSON SUMMARY

Students will discuss as a whole class how a hamburger relates to dirt/soil. They will “dissect” the hamburger, discussing where each element comes from and how it relates to dirt and plants. The instructor will help guide this discussion then show a brief PowerPoint explaining how “We eat dirt,” since most of our food originally comes from the ground. The PowerPoint will also introduce the nutrients provided to plants from the soil and how we also require such nutrients. It will conclude with pictures of plants suffering from nutrient deficiencies. This will serve as a transition for the class to move outside to the MU Student garden where they will search for plants displaying symptoms of nutrient deficiency.
Students will receive a handout with the essential plant nutrients and symptoms of deficiencies. Along with observations, students will also check soil fitness by measuring the nutrients available with soil nutrient testing equipment. If this is the students’ first time using the equipment, the instructor will demonstrate how to use the equipment beforehand. Students will record their observations and measurements in their notebooks or table.
To conclude the lesson, students will discuss their findings with the instructor. They will also discuss alternate sources of nutrients such as hydroponic systems, fertilizers, etc. (These will be discussion questions on their handouts).

ACTIVATING STRATEGY

The instructor will open the lesson with a hamburger (or bread, or any other food that comes from plants.) He/she will ask the students how this piece of bread relates to plants and dirt. The students may have a whole class discussion answering the question which activates any prior knowledge of agriculture or soil. All along the instructor should be probing the discussion with higher level questions to provoke deeper thinking.

LESSON DEVELOPMENT

Explanation Lesson - Students will be presented with new information from a PowerPoint presentation and discussion about essential nutrients. This may be the first time they have learned about micronutrients and macronutrients, or this may be their second, third, or fourth time learning about them. Either way, students will still participate in active listening as they assimilate or accommodate their schema.	**Application Lesson -** Having learned about the essential nutrients provided by the soil, students will apply this new information as they test the soil nutrients at the MU Student garden. This will be done with soil nutrient testing equipment. They will be "diagnosing" nutrient deficiencies through observations of either live plants or pictures of plants.

LESSON WEATHER CONTINGENCY

If the weather prevents any outdoor learning this day, most of the lesson will remain the same (indoors). Instead of going outside to the garden, students can test the soil from the greenhouse or any other potted plants. The instructor can also provide the students with pictures of plants suffering from nutrient deficiency and have the students "diagnose" the symptoms.

LESSON ADDITIONS

If time allows, students can do further research online about hydroponic agriculture and formulate their own opinions on hydroponic versus traditional farming. If they have strong opinions, the instructor can mediate a mild debate between the students. Or, students can read more and play games about essential nutrients at International Plant Nutrition Institute (IPNI) Academy (http://www.ipni.net/academy/homepage.html).

DISCUSSION QUESTIONS

- What nutrients do plants need to produce high-quality yields?
- What nutrition do we want to get out of our food?
- Which nutrients are essential for plants and people?
- Which plant nutrients are macro- and micronutrients and why are they classified this way?
- If we tried to grow a hydroponic tomato, would it have less nutrition?
- How does a plant indicate that it might be deficient in nitrogen?
- How can I test the soil for its ability to provide nutrients to plants?
- How do composts provide nutrients to plants?
- What is contained in a bag of fertilizer?

MATERIALS

Physical Materials	Potential Online Resources
• A hamburger or any other food demonstration • PowerPoint • Plant nutrients handout • Soil nutrient testing equipment	• The Mineral Nutrition of Plants http://www.d.umn.edu/~lshannon/biol1012/lab/exercises/documents/Ex6-Nutrition.pdf • K-12 Soil Science Teacher Resources http://www.soils4teachers.org/lessons-and-activities/teachers-guide/soils-food-health • Plant Nutrients (Kids' World) http://www.ncagr.gov/cyber/kidswrld/plant/nutrient.htm • Growing Tomatoes Hydroponically http://ag.arizona.edu/hydroponictomatoes/nutritio.htm • nutritional quality of hydroponics vs. soil grown veggies and fruit https://drannelinepadayachee.wordpress.com/2013/05/22/191/)

RATIONALES

- Next Generation Science Standards:
  - **MS-LS1-4 -** Use argument based on empirical evidence and scientific reasoning to support an explanation for how characteristic animal behaviors and specialized plant structures affect the probability of successful reproduction of animals and plants respectively.
  - **MS-LS1-5 -** Construct a scientific explanation based on evidence for how environmental and genetic factors influence the growth of organisms.
  - **MS-LS1-6 -** Construct a scientific explanation based on evidence for the role of photosynthesis in the cycling of matter and flow of energy into and out of organisms.
  - **MS-LS1-7 -** Develop a model to describe how food is rearranged through chemical reactions forming new molecules that support growth and/or release energy as this matter moves through an organism.
  - **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.
- 21st Century Science Content Standards and Objectives for WV Schools:
  - **SC.O.ENV.2.2 -** explain how the chemical components of biological and physical processes fit in the overall process of biogeochemical cycling such as photosynthesis, respiration, nitrogen fixation, or decomposition.
  - **SC.O.ENV.2.1 -** compare and contrast the rate elements cycle through the ecosphere, describing natural and human influences on reaction rates:
    - Carbon
    - Nitrogen
    - Phosphorus
    - Oxygen
    - Sulfur
  - **SC.O.ENV.2.24 -** classify and analyze characteristics of different soil types:
    - Texture
    - pH
    - Nitrogen
    - Phosphorus
    - Potassium
  - **SC.O.6.2.05 -** examine how abiotic and biotic factors affect the interdependence among organisms.

- **SC.O.6.2.08 -** predict changes in populations of organisms due to limiting environmental factors (e.g., food supply, predators, disease, or habitat).
- **SC.O.7.2.07 -** evaluate how the different adaptations and life cycles of plants and animals help them to survive in different niches and environments (e.g., inherited and acquired adaptations).
- **SC.O.7.2.10 -** analyze the differences in the growth, development and reproduction in flowering and non-flowering plants.
- **SC.O.7.2.11 -** predict the trends of interdependent populations if one of the limiting factors is changed.