

The Delicate Science of Making Food to Please the World

Description

In this lesson, students will apply the scientific method—using N-P-K soil test kits on a local farm—to develop a real-world application of how abiotic factors, like nitrogen, can impact the rate of photosynthesis, protein synthesis, and the cost of the food we eat.

Packet Contents

- [Introduction](#)
- [Curriculum Alignment](#)
- [Objectives](#)
- [Time and Location](#)
- [Teacher Materials](#)
- [Student Materials](#)
- [Safety](#)
- [Student Prior Knowledge](#)
- [Teacher Preparation](#)
- [Activities](#)
- [Assessment](#)
- [Critical Vocabulary](#)
- [Author Information](#)

Introduction

The focus of this problem-based learning lesson is for students to develop technology, science, and collaboration skills to analyze and draw conclusions about the impact that abiotic factors have on photosynthetic efficiency and overall crop production. In addition, students will also gain an understanding of the importance of agriculture for our society, and the skills necessary for success within the industry. Students will travel to a local farm (or bring the farm to the classroom) to measure the Nitrogen, Phosphorous, and Potassium levels in the soil using a N-P-K soil test kit. Prior to the trip, students will be divided into groups of 3-4. Within their group, each student will have a defined role as either a Farmer, Scientist, Manager, or Communications director. After a brief lesson on abiotic and biotic factors, and what it takes to be a farmer, students will be assigned the task of running an agricultural operation. Their objective will be to collect data on soil quality to assess what changes to the soil are needed to improve



the rate of photosynthesis and increase crop yield for the farmer. Using their research and understanding of the agricultural industry, students will also be challenged with the task of developing a brief public relations (PR) video. This PR video will highlight the students' collected data and their assessment of how their "mock farm's" efforts in soil management will help increase crop yields for an exponentially growing population. At the end of this lesson, students will have an expanded understanding of how photosynthesis, the nitrogen cycle, and protein production are connected and vital for the survival and growth of the human population. Students will be able to interpret data to make real-world connections between how the cycles of matter can influence the rate at which plants are able to make sugar and proteins. Consequently, this lesson should invoke an understanding of how these non-living factors impact crop yields for farmers and their abilities to supply food for an ever-growing population. This technology-driven, hands-on activity will also give students the chance to explore the many roles within the agricultural industry.

Curriculum Alignment

NC Essential Standards for Biology

Bio.2.1.1 Analyze the flow of energy and cycling of matter (such as water, carbon, nitrogen and oxygen) through ecosystems relating the significance of each to maintaining the health and sustainability of an ecosystem.

Bio 2.1.3 Explain various ways organisms interact with each other (including predation, competition, parasitism, mutualism) and with their environments resulting in stability within ecosystems.

Bio.2.2.1 Infer how human activities (including population growth, pollution, global warming, burning of fossil fuels, habitat destruction and introduction of nonnative species) may impact the environment.

Bio.2.2.2 Explain how the use, protection and conservation of natural resources by humans impact the environment from one generation to the next

Bio.4.2.1 Analyze photosynthesis and cellular respiration in terms of how energy is stored, released, and transferred within and between these systems

Objectives

- Students will explain how organisms interact with their living and non-living environment
- Students will analyze data to see how matter is recycled throughout our ecosystems and the implications that these cycles have on photosynthesis, cellular respiration, and protein production.
- Students will infer how human activities may impact the environment, agricultural production, and the conservation of our natural resources for future generations.
- Students will develop scientific reasoning skills and their understanding of how to use the scientific method to explore a hypothesis.



- Students will be able to effectively incorporate innovative technology as a tool for critical thinking, research and design.
- Students will further their career readiness by expanding their knowledge of the different agricultural career avenues within the industry.

Time & Location

Length of lesson plan: 4 days for a 90-minute block schedule

Location: Local farm or classroom

If possible, a trip to a local farm would be ideal for this project, as it increases exposure to your local agricultural industry and the community. However, make sure that you gain permission from the farmer and stress to the students the importance of having a minimal impact on the ecosystem. If you are not able to visit a local farm, you may ask permission to collect soil samples prior to the lesson and use them at different stations within the classroom. Another option would be to have students bring in soil from their personal yards or gardens. If possible, try to arrange for the farmer to talk with the class about agriculture, and address questions the students may have about soil management practices and plant production.

Teacher Materials

[Student Guide to Content Information](#)

[Student Project Prompt](#)

[N-P-K Soil Test kits](#)

[N-P-K Soil Test Teacher guidelines](#)

Access to a farm or local soil

Different fertilizers

Internet Connected Device (Teachers can print resources from the website if a device is not available)

Video recording device (If not available, students may use their phones)

Optional:

Digital Editing Software (Windows Moviemaker, iMovie, [WeVideo](#))

Student Materials

[Cycles of Matter Student Notes](#)

[Student Project Prompt](#)

[Student Lab Guide](#)



Safety

If visiting a farm please discuss with students about being observant of their surroundings and the dangers of farm equipment.

Material Safety Data Sheets

[Nitrogen MSDS](#)

[Phosphorous MSDS](#)

[Potassium MSDS](#)

[Floc-EX MSDS](#)

Student Prior Knowledge

Students should enter this lesson with a basic understanding of how organisms utilize the elements Carbon, Hydrogen, Oxygen, Nitrogen, and Phosphorous to make organic compounds such as glucose and proteins for survival.

Teacher Preparations

Order soil test kits.

Pick up different fertilizers at your local hardware store for demonstration and discussion purposes.

Arrange a time to visit a farm and schedule a field trip with your administration. (If possible)

Activities

Day 1: Students should enter the class with a head start by completing their notes on [The Cycles of Matter](#)

- The teacher will Introduce the Cycles of Matter and their impact on plant protein production and photosynthesis. (You may do this on the way to the farm or in the classroom)
- The teacher or farmer will Introduce the project and the importance of agriculture in North Carolina (This will be a great opportunity to have a farmer come speak to your class)
- The students will complete their [Soil Test Lab](#) (encourage filming of this process for their commercial). Students may use their phones or video recording devices to record the lab process

Day 2: [Student Project Prompt](#): The students will analyze data, research environmental issues associated with; nitrogen, phosphorous, and runoff, develop a plan of action, and begin working on each individual's task. Teachers will need to facilitate the learning process. As students are working, the teacher should travel to each group to check for understanding and encourage critical thinking



Day 3: Students will collaborate with their group members and complete their project. The teacher will guide the students through their project and assist with technology needs and content related questions.

Day 4: The teacher will review over the Cycles of Matter and explore the different careers associated with Agriculture. The students will [share student projects](#) and discuss the impact agriculture has on the environment

Extension Activities: Exploring Agriculture

[The Water Cycle and Agriculture](#)

[The Carbon Cycle and Agriculture](#)

[The Nitrogen Cycle and Agriculture](#)

Assessment

[Farm Plan Report](#) - completed by the Farmer and team members

[Soil Test Lab Report](#) - completed by the Scientist and team members

[30 sec - 1 min Informative commercial](#) - completed by the Communications director and team members

(Optional) [Digital Infographic on the impact of the overuse of nitrogen](#) - completed by the activist and team members

Daily Self-Reflection Bell Ringers - completed by all students. Students will complete a FlipGrid as they explore the different cycles of matter and their importance on agriculture

Critical Vocabulary

Nitrogen Fixation, Denitrification, Eutrophication, Algal Bloom, Fertilizer, Photosynthesis, Protein Synthesis, Nitrogen, Phosphorus, Runoff, Pollutants

Author Information

Kenan Fellow: William Edwards

- James B. Hunt High School, Wilson County Schools, Wilson
- Science (9-12th)
- 8+ years
- william.edwards@wilsonschoolsnc.net

Mentor: Susan and Randall Barnes

Randal was a self-employed farmer in Wilson, Johnston, and Nash county. He tended approximately 1,100 acres. Susan worked with Johnston County Schools. She spent thirty years at Glendale-Kenly Elementary as a teacher in 1st through 4th grades and a reading specialist for kindergarten and first grades. They are both active within their community. Randal has been the Wilson County Farm Bureau President for over 10 years and Susan is North Carolina Farm Bureau State Women's Committee Chair. She is also chair of the Tobacco Farm Life Museum and Vice Chair of the N. C. Tobacco Trust Fund Commission.

Email address: rbarnes69@nc.rr.com



KENAN FELLOWS PROGRAM
FOR TEACHER LEADERSHIP

Mentor: Michele Reedy

Michele Reedy works at the North Carolina Farm Bureau Federation on 5301 Glenwood Ave Raleigh, NC 27612. She is the Director of NCFB Ag in the Classroom and her responsibilities are to carry out the mission of AITC for the NCFB volunteer leaders and to the educational community of North Carolina. The mission of AITC is to promote the importance of agriculture to all Pre-K through 12th grade public and private school teachers and students.

Her email is Michele.reedy@ncfb.org

Potential Resources -

<http://www.chemistryland.com/CHM107Lab/Lab5/Soil/Lab5Exp3Soil.html>

