

An Integrated STEM Day Camp for Tippecanoe County 4-H Members Using Forensic and Soil Sciences as a Context for Hands-On Learning



Overview of the Integrated STEM Day Camp

Who: A soil science and forensic science STEM day camp was organized for 4-H members in 6th - 8th grade by the Tippecanoe County 4-H educator, 1 undergraduate student in forensics, and 3 graduate students in Agricultural Sciences Education and Communication.

What: The program engaged participants in hands-on learning experiences, promoting scientific reasoning skills through integrated STEM education. The unit included 3 lessons relevant to Agriculture Forestry and Natural Resources (AFNR) and allowed the students to engage in solving real-world problems. The lab activities included:

- analyzing soil constituents,
- investigating the water-holding capacity of different soil types,
- examining the impacts of soil contamination on ecosystems,
- exploring the connections between soil quality and food production,
- learning about forensic toxicology, and
- discovering forensic science STEM careers.

When: June 2023

Where: Lilly Hall of Life Sciences, Purdue University (Tippecanoe County)

Why: By engaging in hands-on experiments and collaborative problem-solving, participants developed critical thinking skills, gained a deeper understanding of scientific processes, and enhanced their ability to apply STEM concepts to real-world challenges.

Image 1. Students completing Soil Identification Lab



Image 2. Instructor using an apple to demonstrate the percentage of earth's land use

DEFINING INTEGRATED STEM EDUCATION AND SCIENTIFIC REASONING

Integrated STEM: happens when several STEM subjects come together and learners are able to use what they learned to solve real-world problems across multiple disciplines (Nadelson & Seifert, 2017).

Scientific Reasoning: includes the thought processes that happen when conducting experiments, which should allow for deeper understanding of science among learners (Fugelsang and Mareschal, 2013).

INTEGRATED STEM PRESENCE IN EACH LESSON

Lesson 1: Grow in the Dirt - Mathematical concepts were used to help understand how agricultural land is used to feed the world. Science and Mathematics were used to explain the soil components.

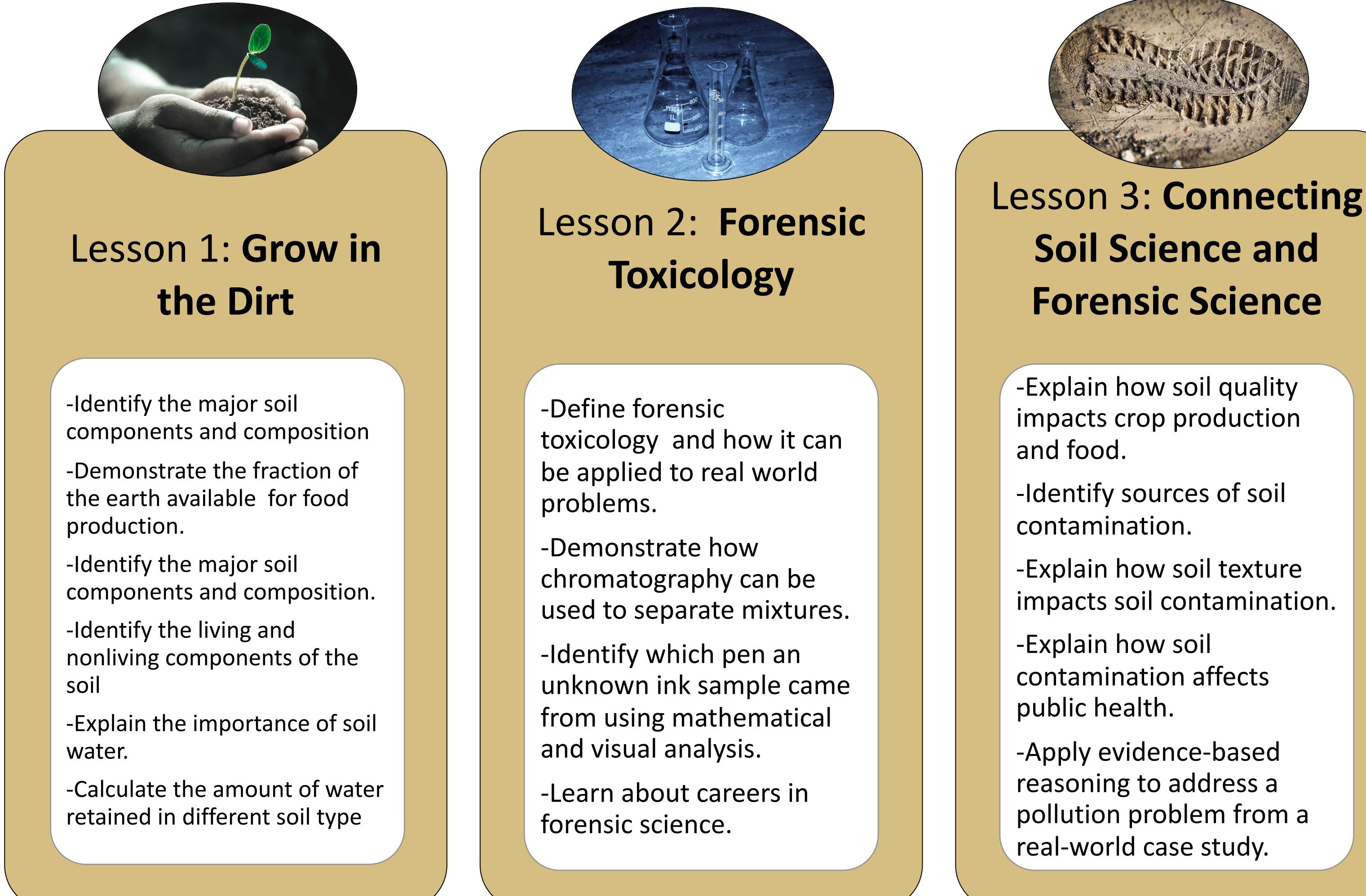
Lesson 2: Forensic Toxicology - Students completed a chemistry paper chromatography lab, using both chemistry and forensic sciences principles to analyze forensic evidence.

Lesson 3: Connecting Soil Science and Forensic Science – This lesson was taught by expanding on soil and forensic sciences knowledge in a soil forensics lab. Students also applied environmental science and soil science to design a solution for an environmental sciences case study.

SCIENTIFIC REASONING IN UNIT

Youth participants engaged in higher-level thinking in each of the hands-on integrated STEM labs by working to address real-world problems. For example, students calculated the amount of water retained in different soil types in a soil science lab in Lesson 1, like the work of a soil scientist. In Lesson 2, students predicted and conducted an experiment to complete forensic toxicology analysis of an ink pen sample to solve a fictitious crime. Additionally, students completed an environmental case study on soil contamination and design their own solution to the problem.

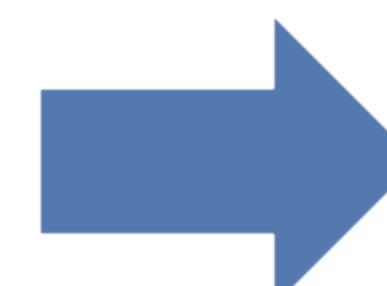
Figure 1. Unit Objectives by Lesson



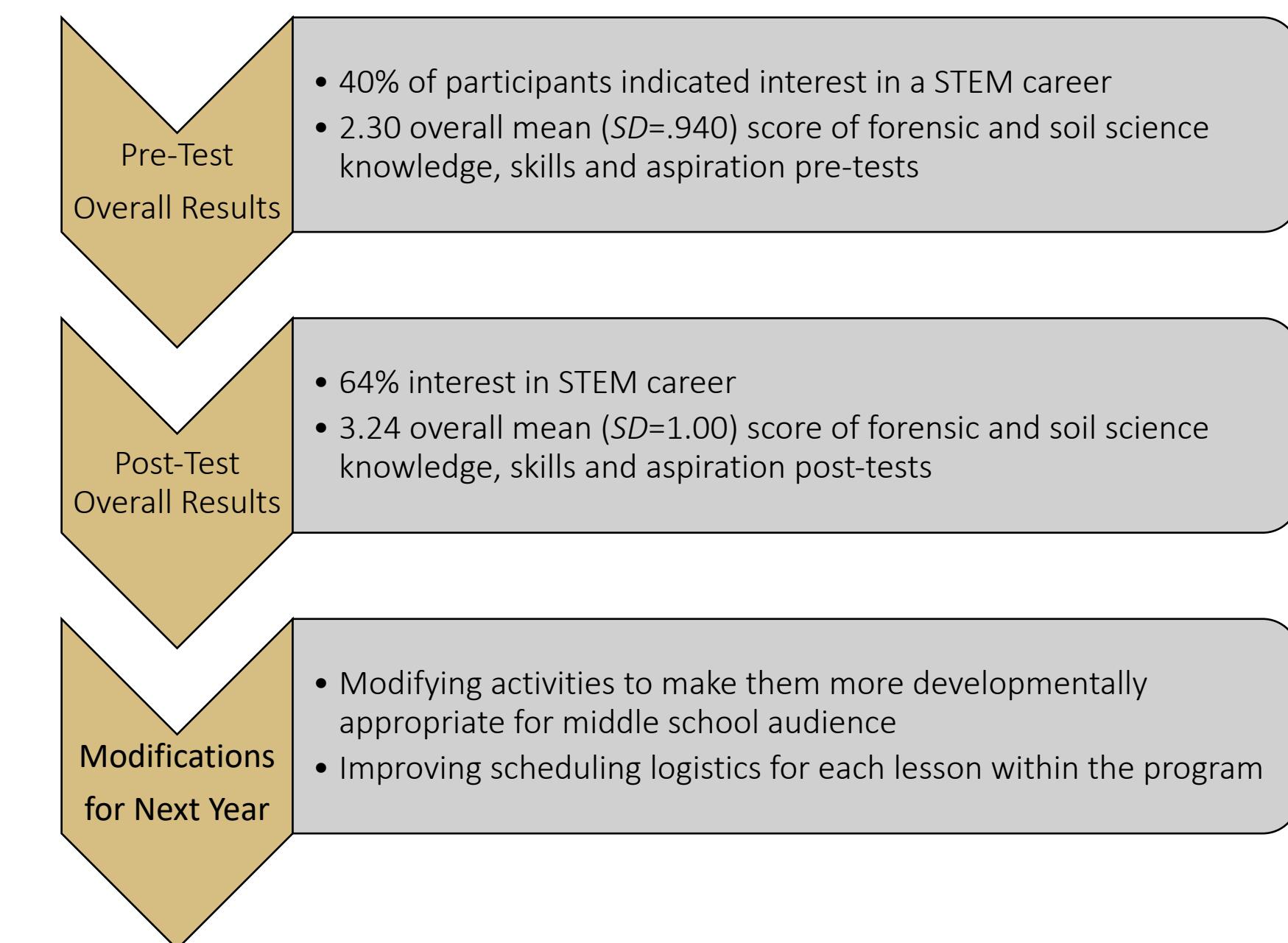
EVALUATION METHODS

- A paper-pencil pre- and post-test survey, with a 5-point Likert scale (where 1=strongly disagree and 5=agree), was used to assess:
 - Participants' interest levels in STEM careers
 - Participants' levels of knowledge, skills, and aspirations in forensic and soil sciences topics.
- Participants were also prompted by open ended-questions to answer what went well and what could be improved within the program.

SCAN THE QR CODE BELOW TO SEE OUR EVALUATION SURVEY INSTRUMENT



EVALUATION RESULTS, LESSONS LEARNED FOR THOSE WANTING TO REPLICATE OUR PROGRAM



ACCESS INFORMATION

Lesson plans will be available to Extension Educators after revisions are completed in Summer 2024. The evaluation instrument is available upon request or by scanning the QR code.

REFERENCES

- Fugelsang, J., & Mareschal, D. (2013). The development and application of scientific reasoning. *Educational neuroscience*, 237-267.
- Nadelson, L. S., & Seifert, A. L. (2017). Integrated STEM defined: Contexts, challenges, and the future. *The Journal of Educational Research*, 110(3), 221-223

Contributors

Mariah K. Stollar Awan, M.S.
Graduate Research Assistant
Agricultural Sciences Education and Communication (ASEC)
awan3@purdue.edu

Mavis Akom, M.S.
Graduate Research Assistant
ASEC

Favour Chinenem Ojike
Graduate Research Assistant
ASEC

Dee Nicley
Extension Educator, 4-H Youth Development & County Extension Director
Tippecanoe County

Hui-Hui Wang, PhD.
Assistant Professor
ASEC