

Agricultural Cyberbiosecurity

Data quality in automation of food production

About this activity

For this activity, you are going to be a group of plant scientists. We are going to focus on plant growth. We are trying to optimize the system; this requires good data to input into the automated systems to tell it what to do to maximize production and minimize cost and environmental impact. Your job is to collect the best data that you can.

SOLs and CTE competencies:

- CS 6.10: use models and simulations to formulate, refine, and test hypotheses.
- CS 7.8: discuss the correctness of a model representing a system by comparing the model's generated results with data that were observed in the system being modeled.
- Sci 6.1: demonstrate an understanding of scientific and engineering practices...
- Ag 8002: 44. Identify basic requirements for plant growth and development.
- Ag 8004: 40. Perform an agriculture/agriculture experiment.
- CTE Prof Comp: Demonstrate proficiency with technologies, tools, and machines common to a specific occupation.

Learning objectives:

1. Determine _____ through experimentation, observation and data collection, and data analysis the effects of nutrient application(s) on plant growth.
2. Explain the role of data quality in ensuring food safety and security in automation of food production.
3. Describe techniques for ensuring validity and reliability of data in experimental design.

Vocabulary:

1. **Independent variable:** the variable that is changed by the researcher
2. **Dependent variable:** the variable that responds to changes and is measured by the researcher
3. **Controlled variable:** a variable that is not changed (held constant) in a study
4. **Validity:** accuracy of a measure; do the results actually represent what they are supposed to?
5. **Reliability:** consistency of a measure; if you measure the same thing in the same way, do you get the same result?
6. **Precision agriculture:** A farm management technique that uses observations and measurements to optimize production.
7. **Automated:** carried out by machines or computers without needing human control.
8. **Fertilizer:** a substance added to soil to increase its fertility
9. **Cyberbiosecurity:** identification of the weak spots between biosecurity, cybersecurity, and cyber-physical security to safeguard data and systems
10. **Germinate:** to begin to grow from a seed
11. **Bolting:** when a plant grows flower stalks and produces seeds too early to produce a good harvest.
12. **Leaf:** flat green blade growing out from the stem; main site of photosynthesis
13. **Foliage:** leaves of a plant, typically a mass of leaves
14. **Micronutrients:** elements that are essential for plants that are needed in small amounts
15. **Macronutrients:** elements that are essential for plants that are needed in large amounts
16. **Nitrogen cycle:** the processes that move nitrogen through the atmosphere, soil, water, plants, animals and bacteria in a repeating cycle

You will need:

1. Seeds
2. Containers
3. Soil
4. Fertilizer
5. Water
6. Measuring Equipment
7. Personal Protective Equipment
8. Precision Agriculture Fact Sheet

Safety:

Follow all relevant safety procedures as described by your facilitator and general laboratory safety rules, including but not limited to:

1. Proper handling of all materials
2. Personal Protective Equipment (PPE)
3. Proper disposal and storage of chemicals and materials



Measurement and Experimental Design: Record your plan as developed in the group planning discussion.

Variables

- Independent variable:
- Dependent variable(s):
- Control variables:

Data collection plan

Data to collect: _____ What will it tell us? _____

**STEP
1**

Tools for collecting data:

Plan for recording data:

Experimental procedures

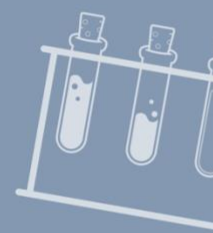
Plan for caring for plants:




Plan for applying fertilizer:

Data analysis plan

Calculations:

Plots/graphs:







Planting: Record your planting procedures here.

STEP

2







Plant Growth and Data Collection: Follow the procedures in your plan for the whole growth experiment. Make sure you:

- Follow your plan for watering and fertilizer application
- Pay attention and make sure you record everything you did
- Record your data/ observations

STEP

3



Data Analysis and Draw Conclusions: Follow your data analysis procedures and then answer the following questions:

What was the relationship between your dependent and independent variables?

STEP

4

What evidence supports this claim?





Recommendations for Automated System:

For this activity, you have been a plant scientist. Your data will help to optimize an automated growing system, helping the programmer tell it what to do to maximize production and minimize cost and environmental impact.

What would you recommend as fertilizer application rates for this system?



STEP 5

Defend your recommendation using your data and quality control measures that you used during your experiment.



Connections to Cyberbiosecurity:

You will discuss the following questions with your group:

- If we were to build an automated system to grow the same plants that we did, what would you look for to know that the system is working?
- How would you know if the system was “hacked” (i.e., controls were tampered with)?
- If you were in charge of making sure an automated system was operating properly, how would you monitor the system? What safeguards would you put in place?

STEP 6

Questions

Share

What are the benefits and drawbacks to precision farming?

What are some career opportunities that might exist in precision farming now and in the future?

Generalize

Why is measurement important in optimizing plant growth and minimizing environmental impact?

Why is the scientific method important for data quality?

Apply

What are some other types of agricultural production that could benefit from automation?

Learn more

To learn more about cyberbiosecurity concepts in this activity, you can read the Fact Sheets in the Cyberbiosecurity Education Resource Collection at <https://doi.org/10.21061/cyberbiosecurity>

These topics are a good place to start to build on what you learned in this activity:

- Cyberbiosecurity
- Data Literacy
- Precision Agriculture
- Sensors

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Authors

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How to access these templates

The main landing page for these resources is <https://doi.org/10.21061/cyberbiosecurity>.

This page includes a downloadable and editable Word document for the:

- Student fact sheet
- Student activity sheet
- Faculty guide

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