

Agricultural Cyberbiosecurity

Traceability in Hydroponic Greens

About this activity

In this activity, you will be using a hydroponic system to grow leafy greens such as lettuce. As your greens grow, it is important to carefully record your actions and observations to make sure that the final product is safe to eat.

SOLs and CTE competencies:

- CS 6.6: identify physical and digital security measures used to protect electronic information.
- Sci 6.6: investigate and understand that water has unique physical properties and has a role in the natural and human-made environment.
- Ag 8002: 42. Describe the interdependency of agriculture and other segments of society. 44. Identify basic requirements for plant growth and development.
- Ag 8003: 60. Explain the use of hydroponics and aquaponics in growing plants.
- Ag 8004: 70. Discuss the importance of water to agriculture. 77. Explore the food industry as it relates to agriculture, agriscience, and agribusiness.
- CTE Prof Comp: Demonstrate an understanding of information security. Includes: describing cybersecurity (e.g., risks, threats, vulnerabilities).

Learning

objectives:

1. Describe the role of monitoring water pH, water temperature, amount of water, and amount of nutrients in hydroponic systems.
2. Describe the importance of biosecurity in hydroponic growing systems.
3. Explain the role of traceability in the food system.

Vocabulary:

1. **Cybersecurity:** Protection of computer systems and networks from the theft of or damage to their hardware, software, or electronic data, as well as from the disruption or misdirection of the services they provide.
2. **Cyberbiosecurity:** identification of the weak spots between biosecurity, cybersecurity, and cyber-physical security to safeguard data and systems
3. **Hydroponics:** the process of growing plants in sand, gravel, or liquid.
4. **Automated:** carried out by machines or computers without needing human control.
5. **Food safety:** the practices and conditions and that ensure the quality of food to prevent contamination and food-borne illnesses.
6. **Growing medium:** the substance that plants are grown in.
7. **Fertilizer:** a substance added to soil to increase its fertility
8. **Water soluble:** able to be dissolved in water
9. **Germinate:** to begin to grow from a seed
10. **pH:** a number representing how acidic or alkaline a solution is
11. **Traceability:** the ability to find information about where and how a product was made

You will need:

1. Seeds (leaf lettuce, microgreens, and/or basil). There are many varieties of lettuce and leafy green seeds that exist and can be used in your hydroponic system of choice.
2. Growing medium
3. Water soluble fertilizer
4. pH strips or meter
5. Personal Protective Equipment

Safety:

Follow all relevant safety procedures as explained 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



STEP

1

Introduction: Answer these questions based on your group discussion

- What is a hydroponic system?
- What are cyberbiosecurity threats?
- What are some potential cyberbiosecurity issues that you see with your hydroponic system?



STEP

2

Seeding:

Follow your facilitator's instructions for seeding your crop. Observe your seeds each time your group meets until it is time to transplant. Record your data using the "Seeding Worksheet" at the end of this guide.



STEP

3 & 4

Transplanting:

Prepare to transplant by recording your final observations of your seeds. Follow your facilitator's instructions and/or the procedure in the video to transplant your seedlings to the hydroponic system. Record your data using the "Transplanting Worksheet" at the end of this guide.



STEP

5

Growth and monitoring:

Follow your facilitator's instructions to monitor your hydroponic system. Record your data using the "Growth Worksheets (1 & 2)" at the end of this guide. You will be monitoring water pH, water temperature, amount of water, and amount of nutrients.



STEP

6

Harvest:

Follow your facilitator's instructions and/or the procedure in the video to harvest your crop.



STEP

7

Traceability:

Use the directions on the “Traceability Worksheet” at the end of this guide to understand potential source(s) of cyberbiosecurity concerns with your crop.

Questions

Share

What did you find interesting in growing your plants?

What did you learn about cyberbiosecurity?

What are some important things you learned that impact hydroponic growing systems?

Generalize

How does lettuce recall happen?

What could go wrong in a hydroponics system that would be different from what would happen in a field?

Apply

What can be done to prevent contamination in hydroponics systems?

What ideas do you have for a new technology or software that could help prevent human or computer error within hydroponics systems?

Seeding Worksheet

Names: _____

Date seeds placed in foam: _____

Circle your crop: Lettuce Microgreens Basil Other: _____

Have your seeds sprouted? Record your data as "Yes" or "No" in the table below.
Include the dates or days of the week you examined your samples.

| Sample | 1 | 2 | 3 | 4 | 5 | 6 |
|--------|---|---|---|---|---|---|
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| | | | | | | |

Did you notice anything else interesting about your seeds? Record your notes below.

Transplanting Worksheet

Names: _____

Circle your tray: Tray 1 Tray 2 Tray 3 Other: _____

Date sprouts transplanted: _____

Where did you place your sprouted seeds in the hydroponic system? Fill in the example hydroponic system with your samples below.

| | | | | | | |
|--------|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|
| Tray 1 | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| Tray 2 | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| Tray 3 | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |

Record your observations about the transplanting exercise below.

Growing Worksheet 2

Names: _____

You are monitoring: Whole system Other: _____

Date sprouts transplanted: _____

As you are monitoring the hydroponic system, record your observations about the water temperature and whether nutrients or water were added below.

| Sample Day | Water Temperature | Were nutrients added? | Was water added? |
|-------------------|--------------------------|------------------------------|-------------------------|
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |

Did you notice anything else interesting about the system or the plants? Record your notes below.

Traceability Worksheet

Names: _____

On the top half of the page, draw the process flow for your crop. Include all the major stages from seeds to the grocery store. Once you have drawn that, draw arrows from each stage to the bottom half of the page. Here, list the potential cyberbiosecurity issues you think may have occurred.

Now, work with other groups to check their data for each of the stages. Were any of the data collected out of the optimum ranges? Did they notice any cyberbiosecurity issues in their data collection? As you determine which stages were not the likely cause of the food safety issue, cross them off on your process flow above. Once you think you have identified the issue, write your thoughts and reasoning down below. Don't forget to tell the grocery store which crops to recall!

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
- Biosecurity
- Sensors
- Bioeconomy

Acknowledgments

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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