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Smart Wireless Weather Station and Climate Console (Resource Exchange)

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Smart Wireless Weather Station and Climate Console (Resource Exchange)

STEM-based University Pathway Encouraging Relationships with Chicago High schools in Automation, Robotics and Green Energy (SUPERCHARGE) is an NSF-sponsored project where university faculty and undergraduates from Illinois State University have designed informal, after-school engineering-related activities focusing on robotics, green energy, and automation. An emphasis is placed on activities and partnerships that promote knowledge, engagement, and interest in STEM fields in underserved schools and communities. To learn more about SUPERCHARGE, please visit: https://about.illinoisstate.edu/supercharge/.

Figure 1. Smart Wireless Weather Station

This resource exchange presents activities from the final unit of the program's first year. In this project, high school students will build and experiment with a smart wireless weather station (Figure 1) and indoor climate console (Figure 3) with the goal of collecting and analyzing data to learn about the climate in their community while fostering STEM skills and interest in college and career pathways.

Students are presented with hands-on activities and coding challenges, data logging problems, and troubleshooting opportunities. Students begin with a simple, low-cost weather meter kit and Micro:bit microcontroller, which is ideal for novice and non-programmers. Students then add several elements to their design to go beyond the basics. This allows students to learn and explore concepts such as:

- Collecting temperature, humidity, dewpoint, pressure, rain, UV, wind speed, and wind direction data
- Monitoring indoor air quality
- Remotely transmitting data wirelessly through a Bluetooth connection
- Creating and modifying code to extend and optimize programming
- Displaying real-time data and conditions on an OLED display

Each activity is expected to take about 90 minutes to complete. There are 7 primary activities.

A brief summary of these activities can be found on the next page.

For more information and full access to activities, please visit: https://about.illinoisstate.edu/supercharge/

Questions? Contact:

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Smart Wireless Weather Station Project – Activities Overview

1. **Capturing & Analyzing Climate Date**
   Students will measure temperature, humidity, dewpoint, and pressure data using specially designed sensors that integrate with the Micro:bit development board. These sensor readings are then transmitted wirelessly (through Bluetooth) to another Micro:bit receiver. Students will create programming to log and create .CSV files. These files are then analyzed using spreadsheet software (Figure 2).

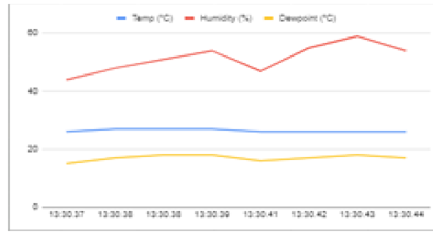

Figure 2 Climate data logging

2. **Developing a Wireless Climate Monitoring Console**
   Students utilize advanced programming concepts to send and receive data remotely between the outdoor weather station and an indoor monitoring device. This creates a "wireless climate monitoring console" (Figure 3). The OLED display is programmed to show climate conditions in real-time.

Figure 3. Wireless Climate Monitoring Console

3. **Windspeed & Direction**
   Students will add an anemometer and wind vane (Figure 4) to the weather station and create programming to read wind speed and direction. They will design a program to send and display this data to the wireless climate console as conditions change.

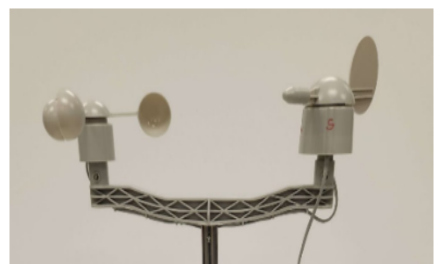

Figure 4. Wind vane and anemometer

4. **Rain & Sun**
   Students will connect a UV sensor to the weather station and design the programming required to convert raw sensor readings to UV index values (Figure 5). This data and all other climate sensor readings are sent and displayed on the monitoring console. A digital rain gauge is added and programmed. Students will also explore an additional method of data transmission and code redesign.

Sensor Reading	UVI (Value)	UV-INDEX
≥ 2283	≥ 11	**Extreme**
1661 to 2282	8 to 10	**Very High**
1246 to 1660	6 to 7	**High**
623 to 1245	3 to 5	**Moderate**
1 to 622	1 to 2	**Low**
0	0	**None**

Figure 5. UV sensor values

5. **Inside & out**
   This activity provides time and resources to finalize their designs, add any weatherization, complete additional testing and experiments, and determine potential future improvements such as including indoor air quality.
6. **Advanced Concepts**
   Students are encouraged to explore more coding concepts to enhance weather stations. They will experiment with advanced coding challenges such as remotely configuring weather stations and creating signal relay (mesh) networks.
7. **Design Challenges & Community Connections**
   Students will be presented with additional coding challenges such as reducing energy consumption, measuring light level or soil moisture, monitoring multiple weather stations at once, and more to enhance the functionality and reliability of their projects. Additionally, students are encouraged to connect with their local community.