Assessing Soil Saturation Levels to Develop Self-Sustaining Watering Systems

Name of Project: Assessing soil saturation levels to develop a self-sustaining watering system		Duration: 2 weeks, 10 - 40 minute class periods
Grade Level(s): 8	Teacher:	Subject/Course/Unit: Living Environment
Big Idea: Integrate the Computer Science standards into a Content area such as Science: Using technology. Problem solve - a environmental issue Make DATA and THINKING VISIBLE THROUGH TECHNOLOGY	Plants require water as part of the process of photosynthesis, which is the process by which they convert light energy into chemical energy in the form of glucose. This process takes place in the chloroplasts of plant cells and requires water to be absorbed by the roots and transported up through the stem to the leaves. When water reaches the leaves, it is used in the photosynthetic reaction to produce glucose, which provides energy for the plant to grow and carry out other cellular processes. Cellular respiration, on the other hand, is the process by which cells convert the chemical energy stored in glucose into a form that can be used by the cells. This process takes place in the mitochondria of cells and requires oxygen to produce energy. The glucose produced through photosynthesis provides the fuel for cellular respiration, which releases energy that can be used for various cellular processes. This energy is critical for the survival and growth of plants, as well as for the survival of animals and humans that rely on plants for food. In this way, water and photosynthesis play a crucial role in supporting life on Earth by providing the energy that is required for cellular respiration. **How can we use technology to help us both water and monitor plants' water levels.** **Two steps to approach this problem.** Create (3D print) a watering system to deliver water directly to the roots of plants. The system can be customized based on the specific needs of different plants.The 3D printer allows for precise and accurate fabrication of the watering system, with the ability to create complex shapes and structures that optimize the flow of water to the roots. **Monitoring the water being delivered** One method to assess soil saturation without physically touching the plant is by using a soil moisture sensor. These sensors use capacitance or resistance to measure the water content in the soil, which can then be used to estimate soil saturation. The sensors can be placed in the soil near the plant roots and connected to a monitoring system to continuously track soil moisture levels.	
Authentic Purpose: (Why does this matter to your students?)	Can we use technology to make our lives easier? In this case, a person should be able to gauge easily when he needs to water his plants - the visible light on the sensor will be a reminder (at a glance) of water levels. A person can activate his Blink camera to view the sensor from any location, making his vacations a little easier. If we can design a self-watering device to use with the plant, the process can become even more automated.	
Future-Ready Competencies: __x_Collaboration __x_Communication __x_Critical thinking/Problem Solving __x_Creativity & Innovation __x_Other: Empathy	Objectives: Students will work together to brainstorm the use of plant sensors, a self-watering plant device to extend the effects of watering over a longer period of time, Audience Behavior Condition Degree After interviewing users and analyzing their research students will be able to plan their solution with all details in the sketch including measurements and a materials list.	

	Document the data they have collected Using the data to create an output Databot - Cooperative learning - Problem-solving - Visualization of data input/outputs
Project Statement: (Include: issue, problem or challenge; student role, purpose, beneficiary, and desired outcomes)	Project Statement: Automated Plant Watering System Using a Water Sensor Issue: Inconsistent watering of indoor plants can result in poor plant growth, reduced health, and even death. Problem or Challenge: People often forget to water indoor plants regularly, leading to inconsistent watering. Student Role: Design and implement a system that automates the watering process of an indoor plant using a water sensor. Purpose: The purpose of this experiment is to develop an automated system that ensures the consistent watering of an indoor plant, thereby promoting its growth and health. Beneficiary: The beneficiary of this experiment is indoor plant owners who struggle with inconsistent watering. Desired Outcomes: 1. Development of a functioning water sensor system that automatically waters an indoor plant when the soil moisture level drops below a certain threshold. 2. Demonstrate the improvement in plant health and growth compared to manual watering methods. 3. Evaluation of the system's reliability, ease of use, and cost-effectiveness. 4. Contribution to the field of smart agriculture by developing a low-cost, sustainable solution for indoor plant watering.
Empathy Anchor: (How will students develop empathy and care about this problem)	Students can develop empathy and care about the problem of inconsistent watering of indoor plants by: 1. Understanding the impact of inconsistent watering on plant growth and health through research and observation. 2. Engaging with plant owners and understanding their struggles with consistent watering. 3. Reflecting on their personal experiences with indoor plants (sustainable agriculture, growing our own food) and the importance of plant care. 4. Collaborating with their community, e.g. gardening groups, farmers, and nurseries, to raise awareness about the importance of consistent watering. 5. Incorporating the perspectives and needs of the target audience into the design and development of the automated watering system. By actively engaging in these activities, students can gain a deeper understanding and appreciation for the issue and develop empathy and care for the problem. This will drive them to work towards creating a solution that effectively addresses the issue.
Public Audience & Reveal:	Board presentation, Community Showcase, Digital Display Case

<table>
<tr><td colspan="2">Knowledge Construction:
Students can construct content knowledge and practice it by:
- Conducting research on the science of plant growth and the effects of inconsistent watering.
- Learning about water sensors, their function, and how they can be integrated into an automated watering system.
- Experimenting with different sensor designs and configurations to determine the most effective solution.
- Programming and testing the automated watering system to ensure it functions properly and meets the desired outcomes.
- Reflecting on the design process and iterating on their solution based on feedback and testing results.
- Presenting and communicating their findings to peers, teachers, and other stakeholders.
By engaging in these activities, students can develop a deep understanding of the necessity of balancing water content for optimal plant health and growth. This hands-on, project-based approach will help students internalize and retain the content knowledge, making it a valuable learning experience.</td><td>Student Assessment:
(*See below)</td></tr>
<tr><td>Design Process:
1. Discover
2. Research & Empathize
3. Brainstorm
4. Choose
5. Build
6. Test
7. Communicate
8. Redesign</td><td colspan="2">Describe what (& how) students are going to do in each step:
1. Discover: Problem: Teacher Name's plants keep dying because he forgets to water them.
2. Research & Empathize: Teacher Name has spent a lot of money (plants, soil, containers, fertilizer) and effort to keep his plants alive. However, he wants to use technology to make his life a bit easier to avoid overwatering, and so he knows when he needs to come in and water his plants when he is on vacation.
3. Brainstorm what your data collection should be: Data collected prior to the experiment: plant health observations. Data collected during experiment: water levels in soil across time along with plant health observations.</td></tr>
<tr><td>Resources needed:
Microbits, plant sensor, plants/soil/water, Blink camera</td><td>NYS Standards (content + CS & DF):</td><td>Student Reflection:

Use Flipgrid with talking points for demonstration and showcase (create a QR Code near each photo or 1</td></tr>
</table>

Student Assessment:

Automated Plant Watering System Experiment Rubric:

Criteria	Excellent (5)	Good (4)	Satisfactory (3)	Poor (2)	Unsatisfactory (1)
Design	Clear, well-thought-out design of the experiment. Appropriate selection of indoor plant and placement of water sensor. Effective methods for measuring and comparing plant growth and health.	Meets most design criteria, but with some minor limitations.	Meets minimum design criteria, but with some areas for improvement.	Fails to meet several design criteria, with significant limitations.	Fails to meet the majority of design criteria.
Control Group	Establishment of a control group for comparison with the automated watering system. Comparison of results with manual watering method.	Control group is established, but with some limitations.	Control group is established, but with significant limitations.	Control group is not established or is incomplete.	Control group is not established.
Replication	Multiple replications of the experiment to reduce the impact of random factors. Consistent implementation of the experiment across all replications.	Most replications are completed, but with some limitations.	Limited replications, with significant limitations.	Few replications, with significant limitations.	No replications or replication is inconsistent.
Data Collection	Accurate data collection methods established and consistently used. Objective recording, analysis, and interpretation of data.	Data collection methods are established and used, but with some limitations.	Data collection methods are established, but with significant limitations.	Data collection methods are not established or are inconsistent.	Data collection methods are not established.
Bias	Minimization of bias by controlling for extraneous variables. Random assignment of plants to either the control or experimental group.	Bias is controlled for, but with some limitations.	Bias is controlled for, but with significant limitations.	Bias is not controlled for or is inconsistent.	Bias is not controlled for.

By using this table, the validity of the experiment can be objectively assessed, and areas for improvement can be identified. This will help to ensure that the investigation provides accurate and meaningful results.