# LESSON PLANS

## Module 10: Creating STEAM Prototypes for Ecological Problems on the Farm

## Lesson Plan 1

Vertical Mini Farm Automated Environmental Control (part a)

**Proposed Students Age Range: 10-12 years old**

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| Purpose / Learning objectives |
| * Introduce students to ecological problems on farms and the role of robotics in solving them. * Investigate how integrating robotics to hydroponic gardening may enhance plant cultivation * Introduce students to microcontrollers (BBC microbit) and block programming (Microsoft MakeCode). |
| Intersecting objectives |
| * Raise awareness about ecological problems on farms * Empower students to take action and make a positive impact by understanding and implementing sustainable farming practices * Foster critical thinking, problem-solving, and programming skills through hands-on robotics activities. * Foster the use of approaches like Brainstorming Ideas, Concept Mapping, and Prototyping. |
| Facilitation |
| * Make sure you have the videos and other materials ready to use to ignite the initial discussion. * Check that all your equipment (tablets, robotic kits, micro controllers etc.) are fully charged and working. * You may have some pictures of robotic application in farms in print format in case the internet fails. * Groups of two will do for the robotics and programming training. * If you wish to use worksheets for the brainstorming sessions, have them printed out on time. * Make sure you are familiar with the steps of Engineering Design Process and the 5E approach (Engage, Explore, Explain, Elaborate, Evaluate). |
| Ideas for follow - up |
| * Explore more ways on how robotic integration in farming can enhance the efficiency, precision, and automation of plant cultivation. * Research ways that IoT is applied in farming. * Design, develop and program other innovative model ideas/prototypes that may support sustainable agriculture. |
| Resources required |
| * Micro controller kits (BBC micro:bits) and USB-B cables * Servo motors * Water level and Moisture Sensors * Long nails * Crocodile clips with cable * Computers with internet connection * Microsoft Makeblock Application installed (you can also use the web based coding environment) * Micro:bit coding and projects examples * Robotics & Farming-related videos and resources * Art supplies (e.g., markers, paper) * Access to a farm (if possible) or farm-related images and information * Science journals or notebooks * Post-it or worksheets for the brainstorming sessions |
| Source / The day of the lesson: Materials & Class preparation |
| * <https://wwf.panda.org/discover/knowledge_hub/teacher_resources/webfieldtrips/sus_agriculture/> * <https://youtu.be/wzjbkWSphco?si=oxCTzqblfA5Xhjg-> * <https://ec.europa.eu/research-and-innovation/en/horizon-magazine/futuristic-fields-europes-farm-industry-cusp-robot-revolution> |

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| Implementation |

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| Timing | Instructions step by step |
| 10 min | Engage your students in a discussion about how the technology of agriculture has evolved through the years.  You can watch part of the video “Can we create the perfect farm?” (<https://www.youtube.com/watch?v=xFqecEtdGZ0&t=13s&ab_channel=TED-Ed>) and discuss how agriculture has help the human civilization evolve and vice versa. |
| 10 min | Introduce students to robotics and discuss the role of robots in addressing real-world problems.  Use Brainstorming Ideas techniques to investigate students ideas about ways robots address real life problems. You may hand out post-it or worksheets to help them organize their ideas.  Have the student groups share their ideas with the class. |
| 20 min | Introduce students to robotics used in agriculture.  Show examples of robots used in agriculture, such as farm drones or autonomous tractors. You can use the video “Robotics and Agriculture” (<https://www.youtube.com/watch?v=wzjbkWSphco&ab_channel=LincolnLearningSolutions>)  Have your student groups conduct a brief research on hydroponic gardening systems using internet resources. They can use their notepads to take notes.  Have the student groups share their findings with the class. |

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| Hands on activity / farm - based learning |

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| Timing | Description of activity |
| 20 min | Introduce your students to connecting and programming microcontrollers, and especially using programming blocks to code microbit.  Provide students with BBC micro:bit microcontrollers. Give them instructions how to open the Microsoft MakeCode application and connect their micro:bits.  Help them pair the microcontroller with the computer, so that the programs they create are downloaded at their microbits.  Guide them through the basics of the MakeCode software application and introduce them to the powerful characteristics of micro:bit, such as light detection, temperature measurement, motor handling, use of peripherals with edge connectors and crocodile clips. |
| 30 min | You will now guide your students through several simple application projects that may be used in farming using the micro:bit. These are included in the MakeCode for micro:bit software application. They can also be reached at the microbit.org website and they all include detaied instructions and coding examples you can use.  This project applications are:   * Environment Data Logger (<https://microbit.org/projects/make-it-code-it/environment-data-logger/>) * Soil moisture (<https://makecode.microbit.org/projects/soil-moisture>) * Environment Exploration (<https://microbit.org/projects/make-it-code-it/environment-exploration/>) * Plant Watering (<https://makecode.microbit.org/projects/plant-watering>) |

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| Annexes |

Annex 1:

1. <https://youtu.be/uD4mJCgsmdM?si=1WBBIymM6xSE8UtR>
2. <https://robotnik.eu/robotics-applications-in-agriculture/>
3. [https://builtin.com/robotics/farming-agricultural-robots “15](https://builtin.com/robotics/farming-agricultural-robots%20“15)
4. <https://youtu.be/hBkhUClyJvs?si=7JnQW2ULxBEu21Ev>
5. <https://www.agfoundation.org/bringing-biotech-to-life/>
6. <https://youtu.be/lXuQKoQCtOc?si=vECFB3DS9ZvvPhQU>
7. <https://agbot.ag/>
8. <https://www.elecfreaks.com/learn-en/microbitKit/smart_home_kit/smart_home_case_05.html>
9. <https://makecode.microbit.org/projects/science>
10. <https://microbit.org/projects/make-it-code-it/environment-exploration/>
11. <https://microbit.org/projects/make-it-code-it/environment-data-logger/>
12. <https://makecode.microbit.org/projects/soil-moisture>
13. <https://makecode.microbit.org/projects/plant-watering>
14. <https://lesley.edu/article/empowering-students-the-5e-model-explained>
15. <https://www.hmhco.com/blog/5e-instructional-model>

## Module 10: Creating STEAM Prototypes for Ecological Problems on the Farm

## Lesson Plan 2

Automated Environmental Control (part b)

**Proposed Students Age Range: 10-12 years old**

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| Purpose / Learning objective |
| * Investigate how integrating robotics to hydroponic and vertical farming may enhance plant cultivation * Introduce the Engineering Design Process and how important it is in solving real life problems. * Introduce students to prototyping and turning ideas to real life objects. * Empower students apply their knowledge on microcontrollers (BBC microbit) and block programming (Microsoft MakeCode) to prototypes. |
| Intersecting objectives |
| * Raise awareness about ecological problems on farms * Empower students to take action and make a positive impact by understanding and implementing sustainable farming practices * Foster critical thinking, problem-solving, and programming skills through hands-on robotics activities. * Foster the use of approaches like Brainstorming Ideas, Concept Mapping, and Prototyping. |
| Facilitation |
| * Make sure you have the videos and other materials ready to use to ignite the initial discussion. * Check that all your equipment (laptops, micro controllers, cables etc.) are fully charged and working. * You may have some pictures of robotic application in farms in print format in case the internet fails. * Groups of two will do for the microcontroller programming and prototype development. * If you wish to use worksheets for the brainstorming sessions, have them printed out on time. * Make sure you are familiar with the steps of Engineering Design Process and the 5E approach (Engage, Explore, Explain, Elaborate, Evaluate). |
| Ideas for follow -up |
| * Explore more ways on how robotic integration in farming can enhance the efficiency, precision, and automation of plant cultivation. * Research ways that IoT is applied in farming. * Design, develop and program other innovative model ideas/prototypes that may support sustainable agriculture. |
| Resources required |
| * Micro controller kits (BBC micro:bits) with USB-B cables and battery packs * Servo motors * Water level and Moisture Sensors * Long nails * Crocodile clips with cable * Computers with internet connection * Microsoft Makeblock Application installed (you can also use the web based coding environment) * Micro:bit coding and projects examples * Robotics & Farming-related videos and resources * Art supplies (e.g., markers, paper, mockup paper, glue, cutters) * Science journals or notebooks * Post-it or worksheets for the brainstorming sessions |
| Source / The day of the lesson: Matrials & Class preparation |
| * <https://youtu.be/wzjbkWSphco?si=oxCTzqblfA5Xhjg-> * <https://ec.europa.eu/research-and-innovation/en/horizon-magazine/futuristic-fields-europes-farm-industry-cusp-robot-revolution> * <https://youtu.be/VBwLMDVgA3Q?si=TJt8dwN9P0YGJS-R> |

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| Implementation |

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| Timing | Instructions step by step |
| 15 min | Using the 5Es Approach and the Engineering Design Process   1. Engage   Invite a local farmer or agricultural expert to speak to the class (in person or via the web) about the real-world challenges of ecological problems on farms and how technology, including robotics, can help.  If this is not possible, use video resources or pictures of technological applications in farms.  \*This is the Engoneering Design Process (EDP) “Ask” step.  Inform the class that they will either have to choose one of the microbit projects they were introduced at the previous lesson or they can create their own innovative solution using the materials available. Their solution will be implemented in the vertical farm they have already created. |
| 30 min | 1. Explore   Ask students to decide in a brief 5 minute session what is their choice of action. They will also have to make a diagram/concept map of the problem they have decided to undertake and their solution, as well.  Have students create their solution of choice to address these problems within the mini farm.  Let them install their prototypes ans ask them to record data related to their mini-farm project (e.g. the robot's actions and their observations).  \*EDP steps “Create”, “Test & Evaluate” |
| 20 min | 1. Explain   Have students present their mini-farm projects and robot designs to the class, as well as their observations. |
| 20 min | 1. Elaborate   Give the students time to elaborate on their designs or solutions and make their final adjustments.  \*EDP step “Improve & Redesign” |
| 5 min | 1. Evaluation   Lead a class discussion on what students have learned throughout the project.  Ask them to reflect on the potential impact of robotics in addressing real-world ecological problems on farms. |

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| Annexes |

Annex 1:

1. <https://ec.europa.eu/research-and-innovation/en/horizon-magazine/futuristic-fields-europes-farm-industry-cusp-robot-revolution>
2. <https://youtu.be/VBwLMDVgA3Q?si=TJt8dwN9P0YGJS-R>
3. <https://youtu.be/uD4mJCgsmdM?si=1WBBIymM6xSE8UtR>
4. <https://robotnik.eu/robotics-applications-in-agriculture/>
5. <https://builtin.com/robotics/farming-agricultural-robots>
6. <https://youtu.be/hBkhUClyJvs?si=7JnQW2ULxBEu21Ev>
7. <https://www.agfoundation.org/bringing-biotech-to-life/>
8. <https://youtu.be/lXuQKoQCtOc?si=vECFB3DS9ZvvPhQU>
9. <https://agbot.ag/>
10. <https://www.elecfreaks.com/learn-en/microbitKit/smart_home_kit/smart_home_case_05.html>
11. <https://makecode.microbit.org/projects/science>
12. <https://microbit.org/projects/make-it-code-it/environment-exploration/>
13. <https://microbit.org/projects/make-it-code-it/environment-data-logger/>
14. <https://makecode.microbit.org/projects/soil-moisture>
15. <https://makecode.microbit.org/projects/plant-watering>
16. <https://www.teachengineering.org/populartopics/designprocess>