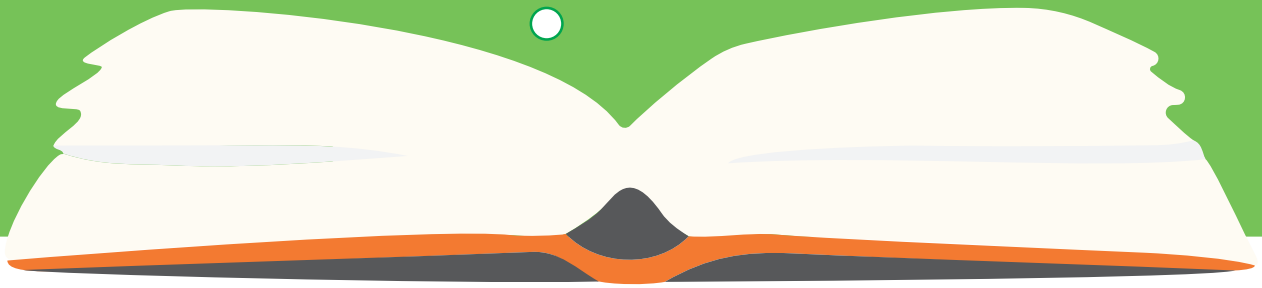
partnership with

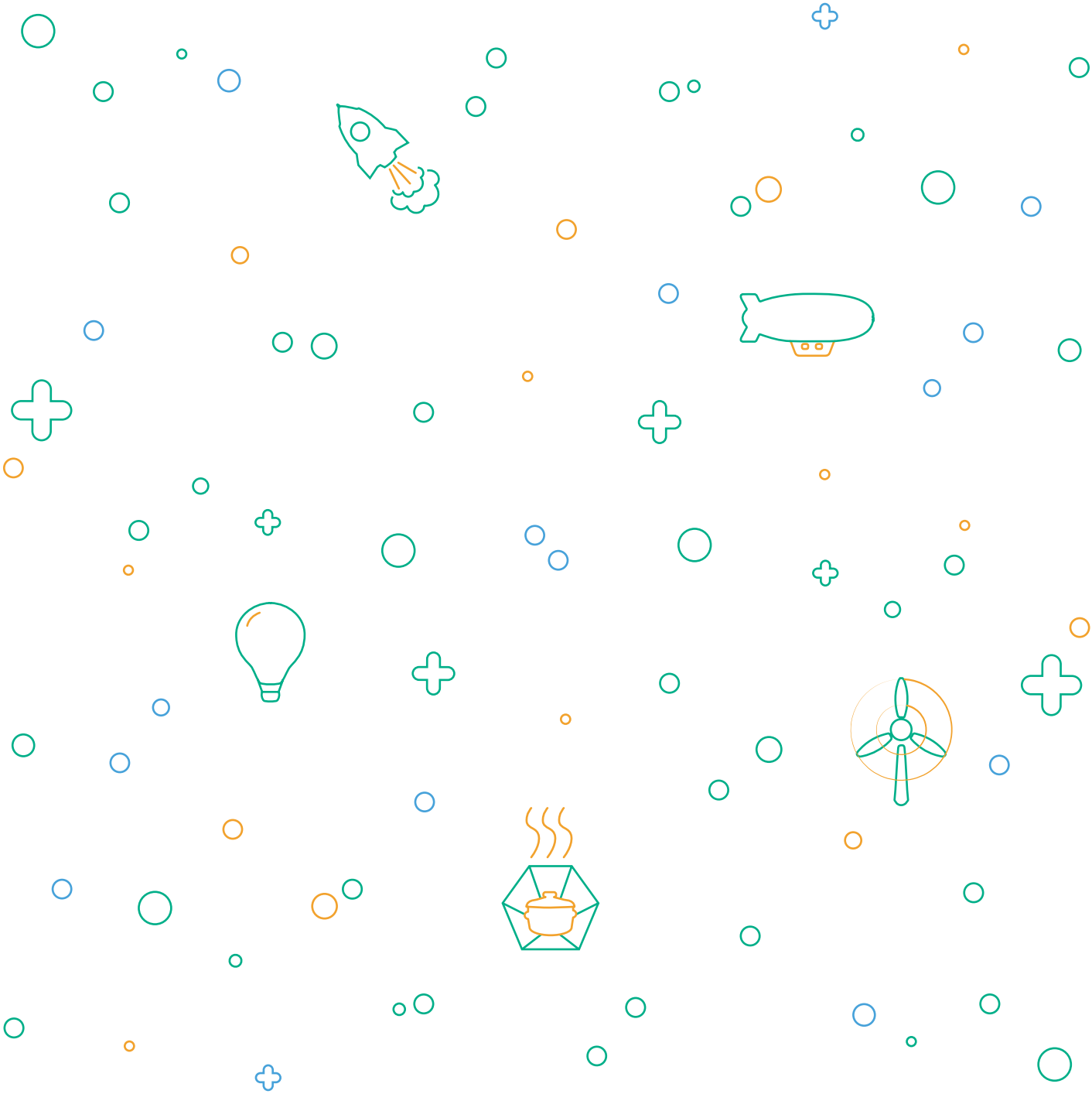
life.augmented

# CONNECTED TO NATURE



## USER GUIDE

# THE CONNECTED PLANT



vitta science

# USER GUIDE

# THE CONNECTED PLANT

Written by Damien Vallot
Layout and illustrations by
Laura Venezia and Diana Khalipina

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• Edition 2021 •
Printed in Italy

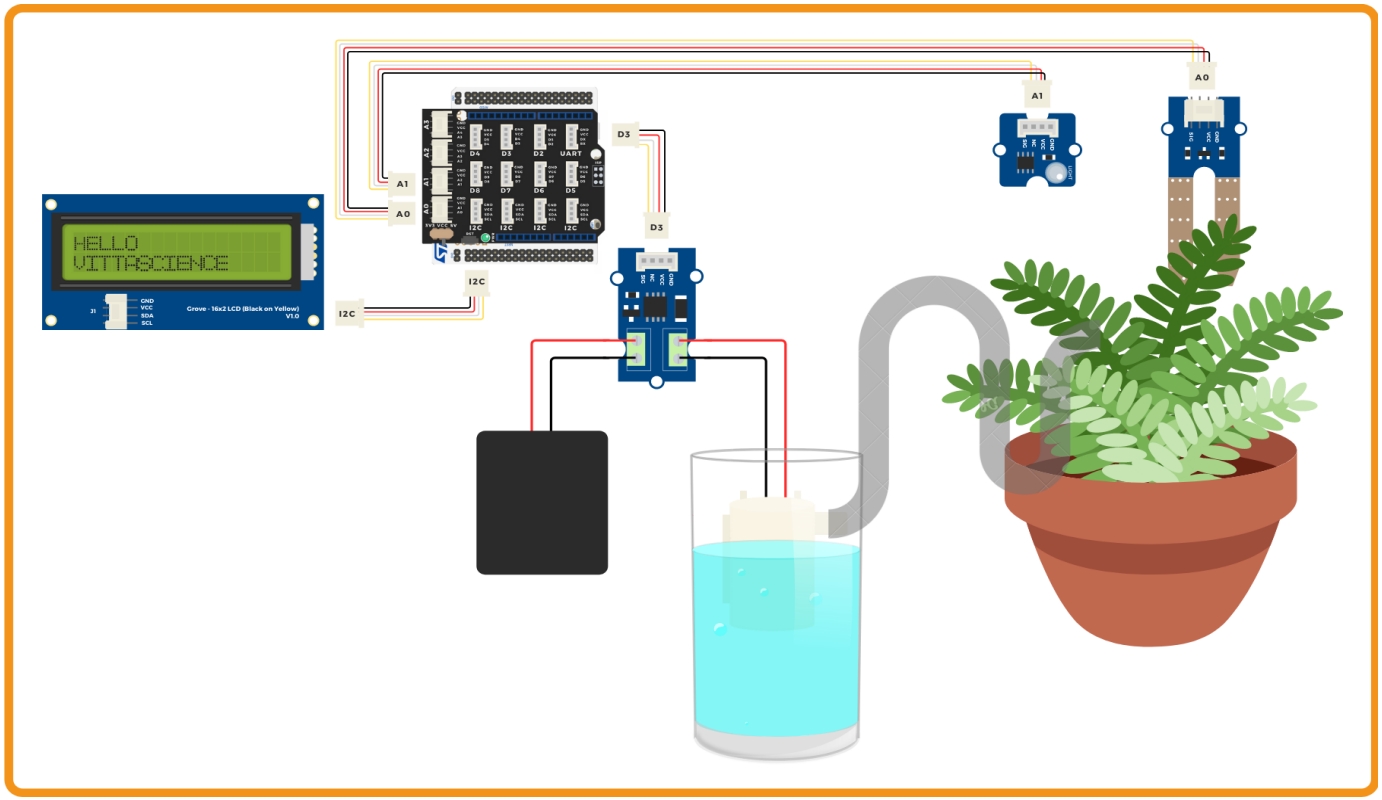
Are your flowers withering prematurely, with their leaves turning yellow? Don't have a green thumb?

Our solution: this kit will help you create your own automatic watering system.

Your plants will soon be in perfect shape!

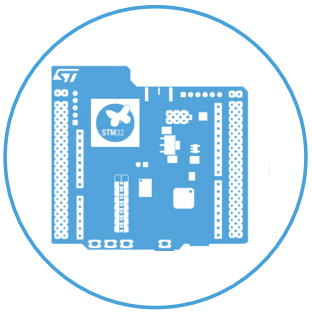
Are you ready to create it yourself?

# NEVER FORGET TO WATER YOUR PLANTS AGAIN!

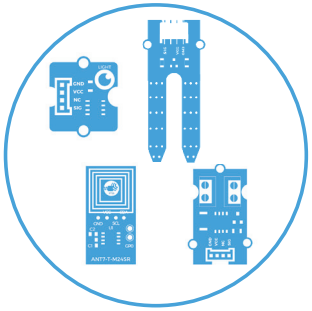


# THE EQUIPMENT NEEDED TO BUILD AND USE THE "CONNECTED PLANT" KIT

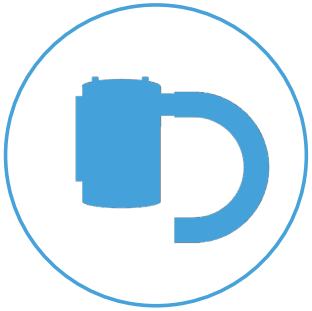
**The Kit contains:**



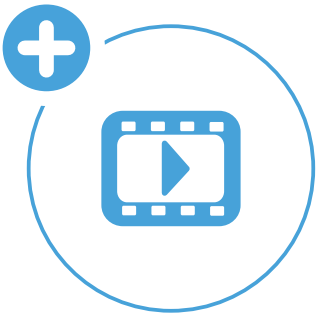
ST NUCLEO-WB55RG board



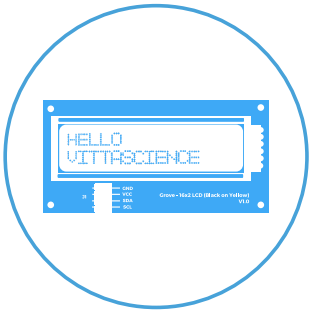
Brightness and soil moisture sensors, MOSFET module, NFC module ST M24SR64



Water pump + power supply

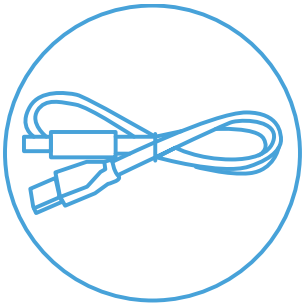


Digital resources online




Monochromatic Grove LCD screen

Grove Shield



Elements for assembling

A computer

# WARNINGS CONCERNING THE USE OF THE KIT

## CAUTION!

The MOSFET module provided in the kit does not support voltages that are above 12 V.

## CAUTION!

The kit includes small elements that should not be swallowed (risk of choking).

## Minimum age

Doesn't suit children under the age of 7.

# INSTRUCTIONS FOR SORTING AND RECYCLING

The following graphics explain the instructions that help you sort out the various elements of this kit for recycling. For more information, check out the website www.consignesdetri.fr

# CONTENTS

Through its 3 separate workshops, the "connected plant" kit will let you discover the programmable board and do various activities through which you will get to know each component in order to create an autonomous system.

The last part of this booklet is dedicated to "furthermore" examples, with supplementary equipment.

PAGE 14

## Workshop 1 : Presentation of the Vittascience microcontroller and interface

- Presentation of the ST Nucleo-WB55 board
  - Connecting the assembly
- Presentation of the Vittascience interface

PAGE 20

## Workshop 2 : Activities and programming of the microcontroller

- Activity A: Displaying a message on a screen
- Activity B: Measuring the soil's moisture
- Activity C: Measuring the brightness
- Activity D: Activating the watering pump
- Activity E: Activating the pump according to the moisture level
- Activity F: Collecting information using an NFC tag and a smartphone

PAGE
32

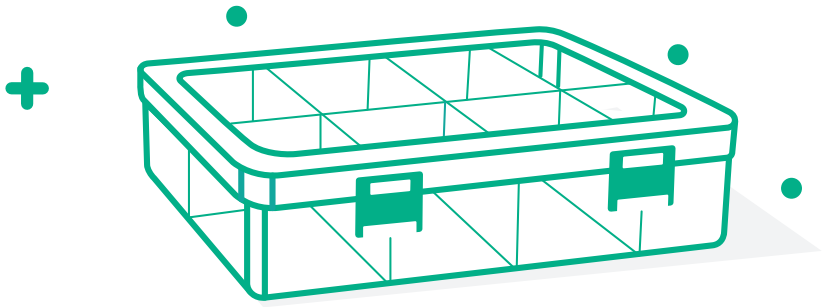
## Furthermore

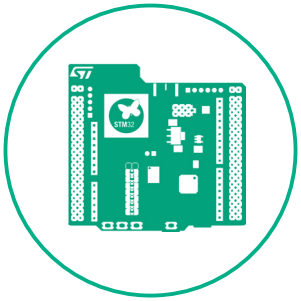
- **Proposition n°1 : Optimize the lighting for a better growth of the plants**
- **Proposition n°2 : Create a 3D printed container**
- **Proposition n°3 : Measure the air's humidity and temperature**
- **Proposition n°4 : Build a glasshouse and control the opening servomotors**

# The connected plant kit - Nucleo WB55RG version

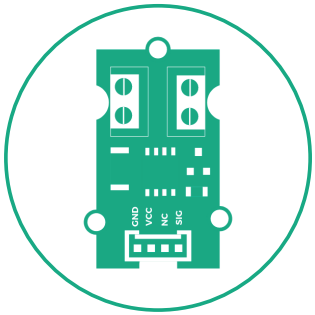
The "connected plant" kit contains all the equipment needed to monitor the brightness and the soil's moisture as well as to control the automatic watering of the plant.

Contents :
- a user guide,
- an electronic kit made up of a ST NUCLEO-WB55RG board,
- a Grove shield,
- a brightness sensor,
- a soil moisture sensor,
- a monochromatic Grove LCD screen,
- an automatic watering set including a MOSFET module, a water pump and a 6 V power supply (4 non provided AA 1.5 V batteries are needed),
- a batch of NFC badges,
- a NFC ST M24SR64 module,
- a USB cable.

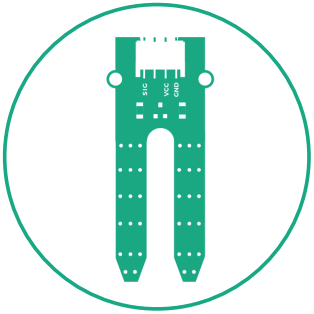




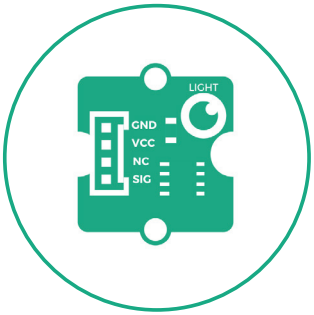
**ST NUCLEO-WB55RG board**



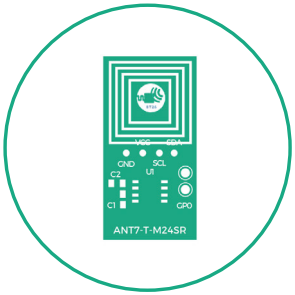

**MOSFET module**




**Soil moisture sensor**




Brightness sensor




ST M24SR64 NFC module depending on version

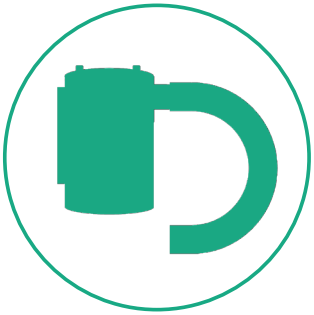
User guide

6V Power supply

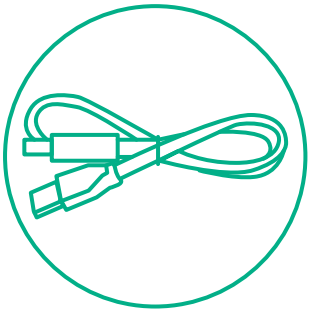
Batch of NFC badges depending on version

Grove Arduino shield

32 characters LCD screen



Water pump



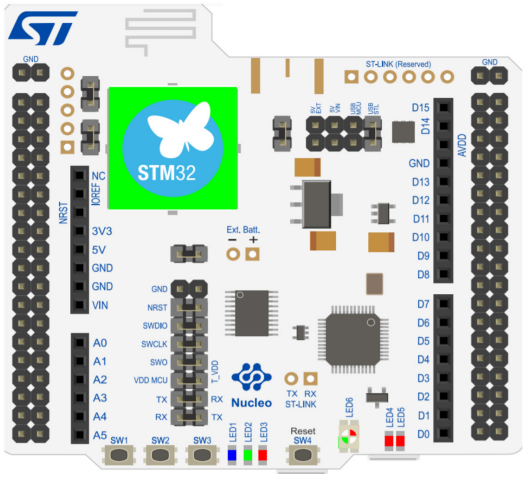
USB cable

# Workshop • 1 ⏱ depends on the tutor's estimation
# Presentation of the Vittascience microcontroller and interface

The "connected plant" kit contains all the necessary equipment to build an electronic components circuit that can automatically water a plant.
It comes with a ST NUCLEO-WB55RG board developed by STMicroelectronics. This board has a STM32 microcontroller with Bluetooth low energy BLE.

## • NUCLEO WB55RG presentation ⏱ 15 min

The following image shows the entries and exits of the NUCLEO-WB55RG board, which can be used as a support to various electronic components circuits along with the provided components.

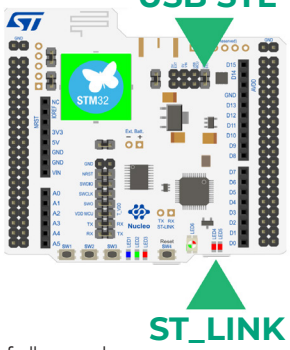



This board is programmed through the Vittascience interface in MicroPython.
Before using the NUCLEO-WB55RG board for the first time, it is required to upload a firmware to program it (see details in the boxed part).

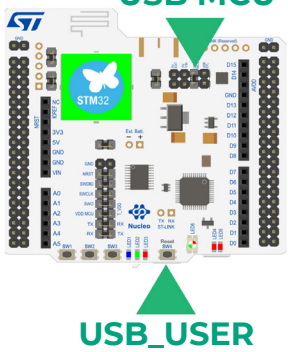
## ABOUT THE UPLOAD OF THE PROGRAM:

In order to program the board in MicroPython either by code or by bloc from the Vittascience website, the right firmware should be uploaded.

(1)




(2)



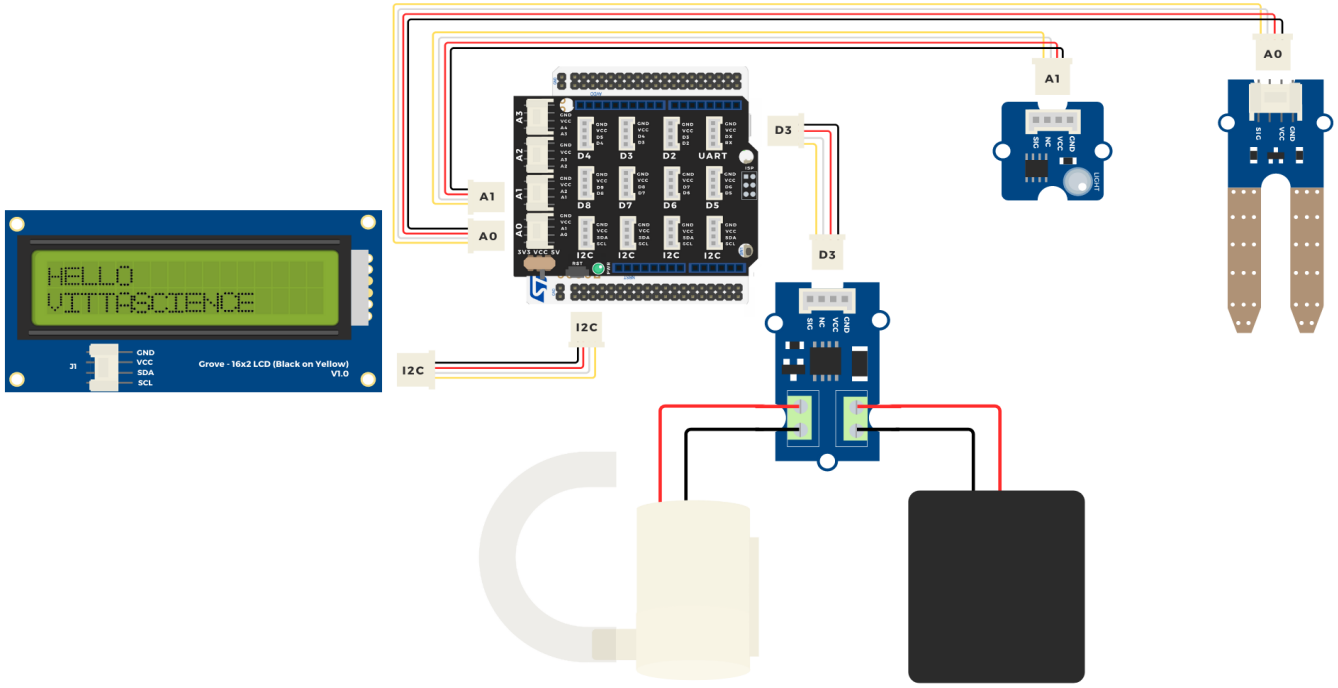

Here are the steps to be followed:

1. To flash the board, make sure the jumpe (metallic piece wrapped in black plastic) is positioned on the USB STL above the board on the same level as the supply sources. If it is not the case, move the jumper to see USB STL (see image1 ).
2. Plug the USB cable in the STLINK port to upload the firmware. 2 red led lights will come on.
3. Download the firmware on the address: https://stm32python.gitlab.io/fr/docs/Micropython/Telechargement, then drag and drop it on your board that will appear as a USB named "NOD-WB55". Warning: do not unzip the file.
4. When the download is finished, a green led light will come on (led 6, to the right of the Reset button).
5. Unplug the USB cable.
6. Move the previously used jumper (see step 1) to the USB MCU. See image (2).
7. Re-plug the cable in the USBUSER port (the other USB). See image (2).
8. Connect the board to the computer; the red led light number 5 will come on, this shows that the board is well connected.
9. Use the Vittascience interface to program the board:
    - it is preferable to use a Chromium browser,
    - go to Vittascience - "Program",
    - select the STM32 interface,
    - click on "Connect" and select the board,
    - the loaded file main.py is executed continuously.

**Tip :** Do you have any problems or questions? We are available to answer you on: support@vittascience.com

## • Connecting the circuit ⏱ 15 min

Here is an example of a circuit that includes all the elements provided in the kit. This circuit allows you to measure the brightness and the soil's moisture levels and to activate the watering of the plant. You can also display the measured levels on an LCD screen. The connections are made through Grove cables (4 wires and 1 alignment failsafe).




**Caution :** The Vittascience kit uses a ST NUCLEO-WB55RG board from STMicroelectronics. Vittascience and STMicroelectronics are two separate brands. If a technical problem occurs, please contact the Vittascience support team only.

## • Programming the board ⏱ according to the supervisor's estimations

You can find all the details about how the online programming interface works on Vittascience.com.

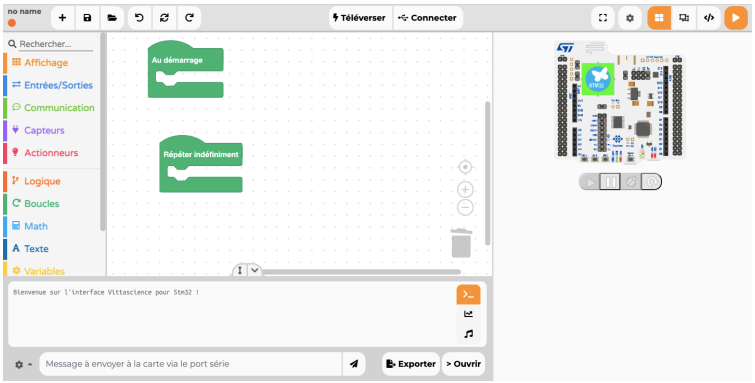
You can also program the board using Arduino software (C++ language). Tutorials for this software are available in the resources library of our website Vittascience.com.

### 1 • Creating an account

First of all, we advise you to create an account on our website. It is not mandatory to get the kit, but it will allow you to save and share your programs, resources and feedback.

Visit our website Vittascience.com and click on the green icon at the top right to sign up.

### 2 • Interface




The interface allows you to program in bloc with a simultaneous transcription in Python.

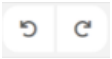
**Caution :** The ST NUCLEO-WB55RG board is necessary in order to run the program once the sensors are in position.
You can find resources and programs on our website Vittascience.com to help you learn how to program the board.

**Select the port:**

when you connect the board to the computer the interface will automatically detect to which port it is connected. The drop-down menu allows you to select the correct port if several cards are connected to the computer.

**Transfer the program to the card:**

the code will run on the card as soon as the transfer is completed.

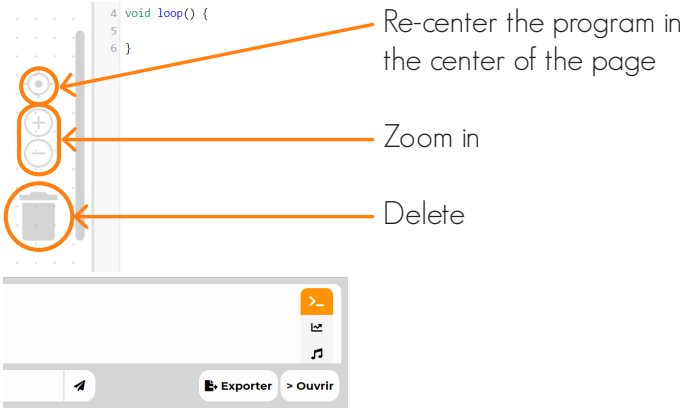
**Undo or Redo:**  the previous or next actions.

**Start a new project:** to start a new blank project, click on this button.

**Save the project :** to save your project, click on this button. For those who have an account, it is possible to share the program with the community.

**Open an existing project:** if you want to open programs you have already built, or get your students towork on a framework you have created, they can access it by clicking on this button.

**Code in Python:** if you want to code directly in Python.




**Tip :** This programming interface is designed to be very easy to use, do not hesitate to test it and suggest it to your students.

# Workshop • 2 ⏱ 30 min to 2 h
# Activities and programming of the microcontroller

The objective of this second part is to guide you in programming the board and connecting the sensors. We propose to you six activities.

## • Activity A: Display a message on a screen

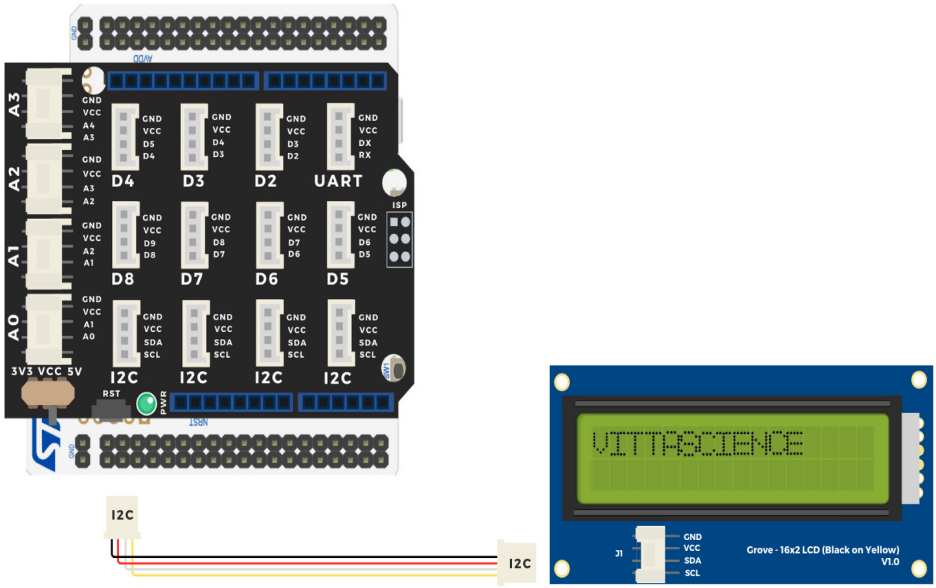
In this first activity, you will learn how to display a message on the LCD screen connected to the board.
This screen will allow you to display information from the sensors.

Equipment needed:
- board + Grove shield
- LCD screen

The screen must be connected to the I2C port of the shield.

Program example:

**Caution :** This screen is limited to 16 characters per line. So you have two lines: line 0 and line 1 that you can select in the block.
You can also select the position, i.e. the place where the first character will be displayed.




Circuit from activity A

## • Activity B: Measuring soil moisture

Now that you know how to display a message on the LCD screen, you will learn how to display the measurement sent by a sensor. To begin, you will measure the soil moisture of your plant.

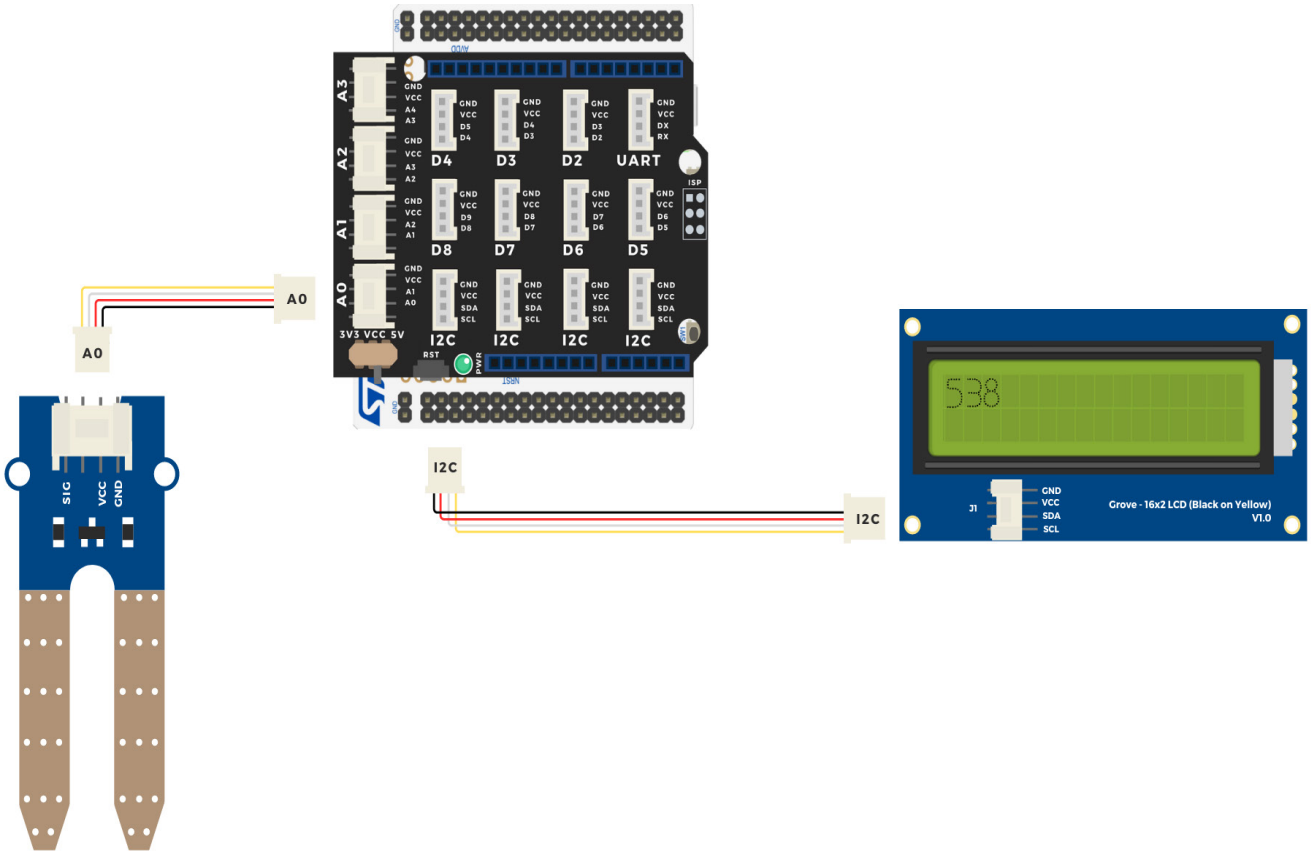
Equipment needed:
- board + Grove shield
- LCD screen
- soil moisture sensor

The screen must be connected to the I2C port of the shield, the soil moisture sensor will be connected to the A0 port.

Program example:

The information returned by the sensor is a number between 0 and 4095.
In theory, 0 indicates a dry soil and 4095 means the soil is immersed in water.

It is up to you to perform different soil moisture measurement experiments and to record the results!
This will allow you to define your watering needs.




Circuit from activity B

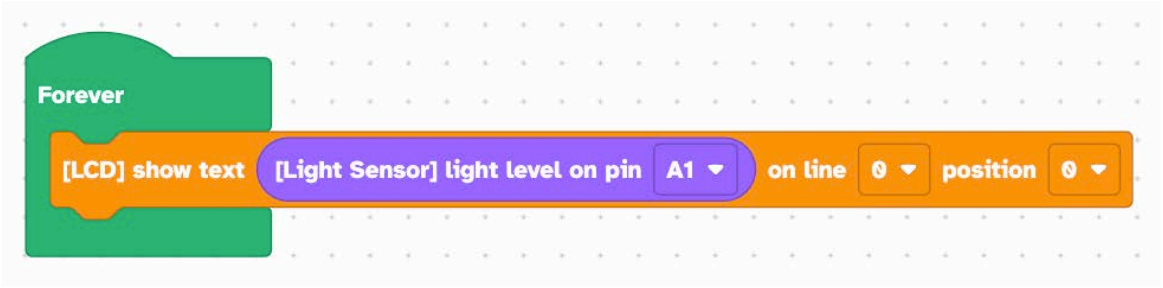
## • Activity C: Measuring brightness

Let's move on to programming the second sensor provided in the kit. You will measure the amount of light received by your plant.

Equipment needed:
- board + Grove shield
- LCD screen
- brightness sensor

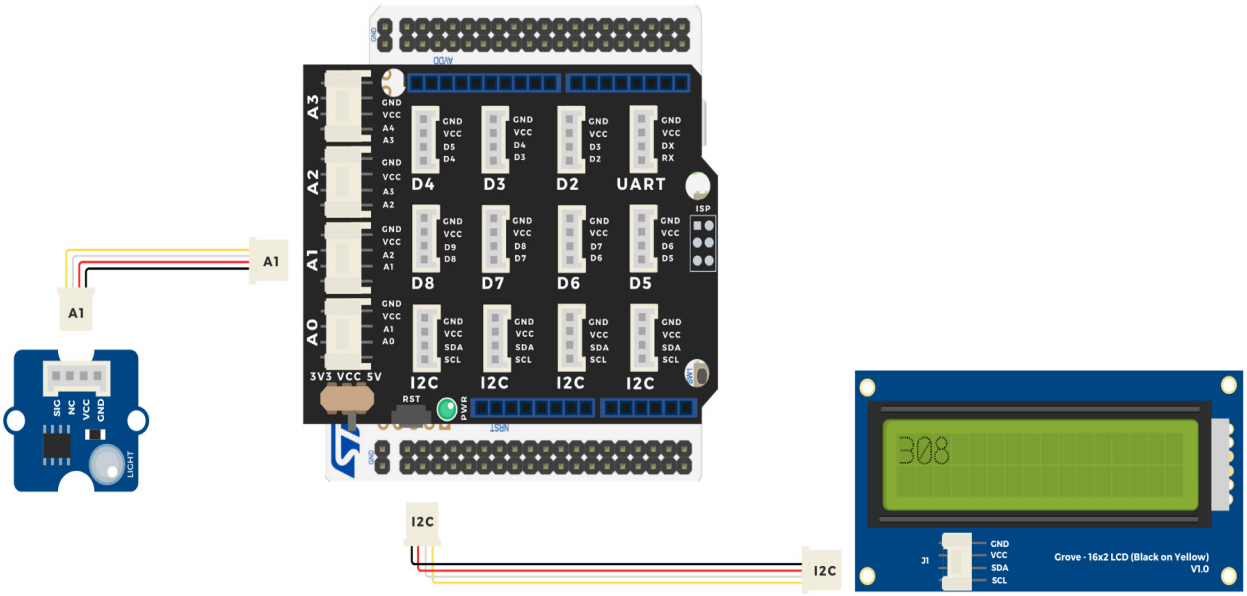
The screen must be connected to the I2C port of the shield, the brightness sensor will be connected to A1.

Program example:




Just like for the soil moisture sensor, the information received is a value between 0 and 4095.
In theory, 0 indicates darkness and 4095 the measurement given by the sensor if it is placed in full light.

It is up to you to choose the ideal location for your plant according to its light needs.




**Circuit from activity C**

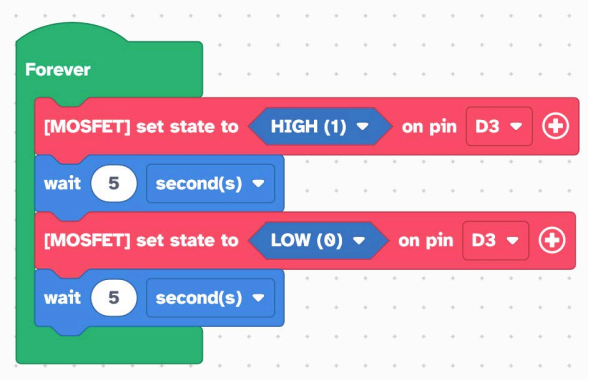
## • Activity D: Activating a watering pump

Now that you have programmed the two sensors, you will activate the watering via the water pump and a MOSFET module that acts as a switch.

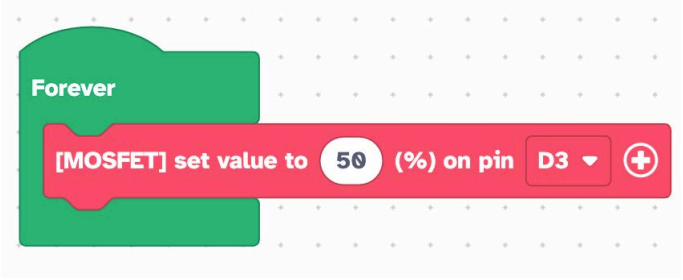
Equipment needed:
- board + Grove shield
- MOSFET
- water pump
- 6V box

The MOSFET is connected to port D3 of the shield, the water pump is connected to the MOSFET, matching the polarity, as for the 6V box.

Program example:

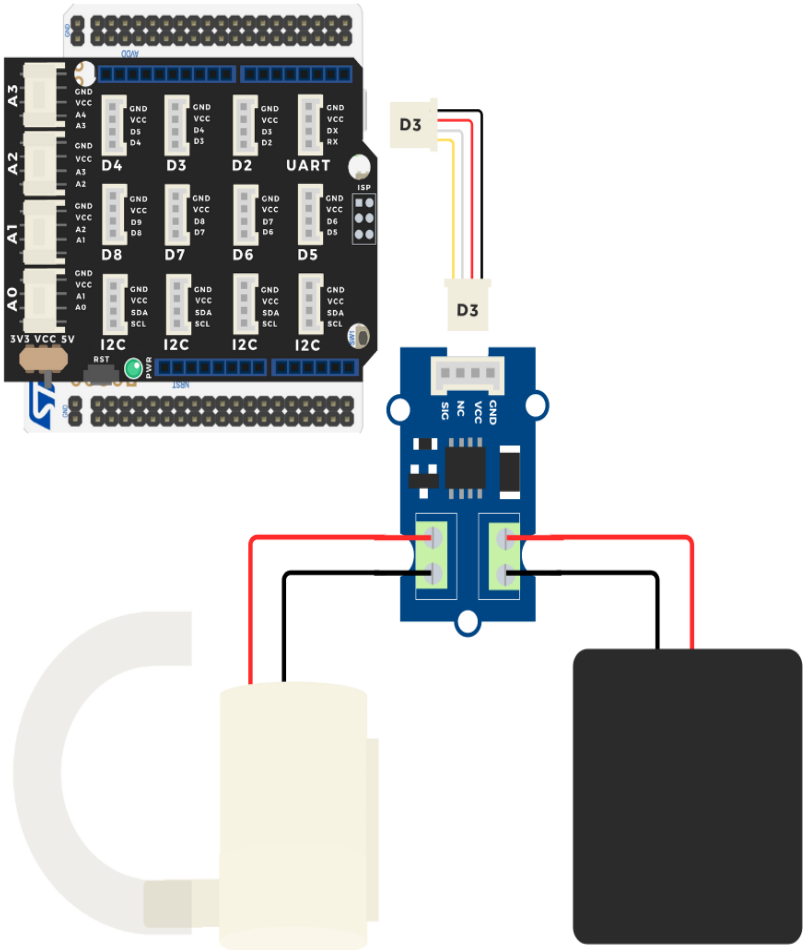



This program allows you to activate the pump for 5 seconds and then to stop it, again for 5 seconds. The program repeats itself over and over again.




The MOSFET module allows you to control the current flowing through it. You will find a block allowing you to control the MOSFET in percentage in the Vittascience interface.

**Caution :** The MOSFET module must not be supplied with a voltage higher than 15V and a current higher than 2A.




Circuit from activity D

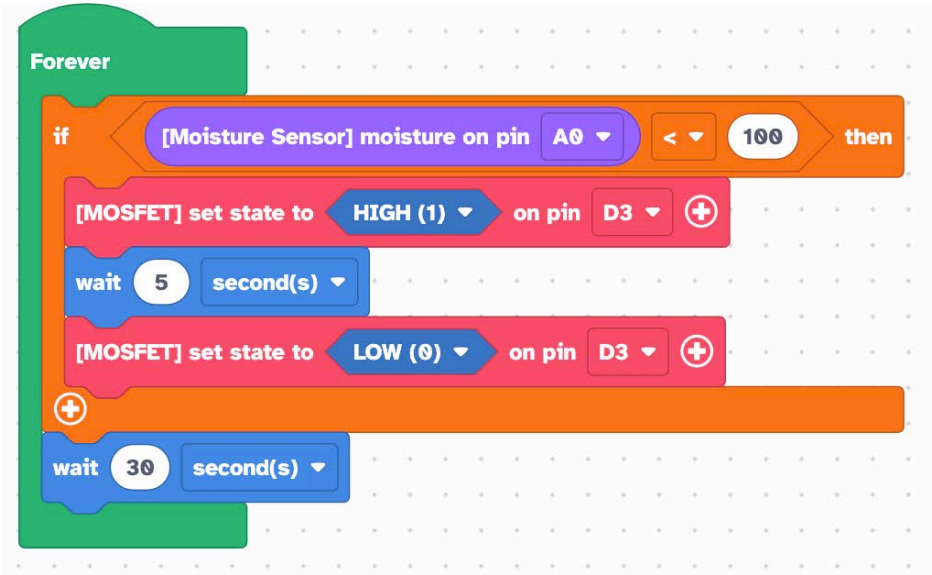
## • Activity E: Activate the pump according to the humidity level

You now know how to program the pump and retrieve information from the sensors. Finally, in this activity, you will activate the automatic watering when the soil is too dry for the plant.

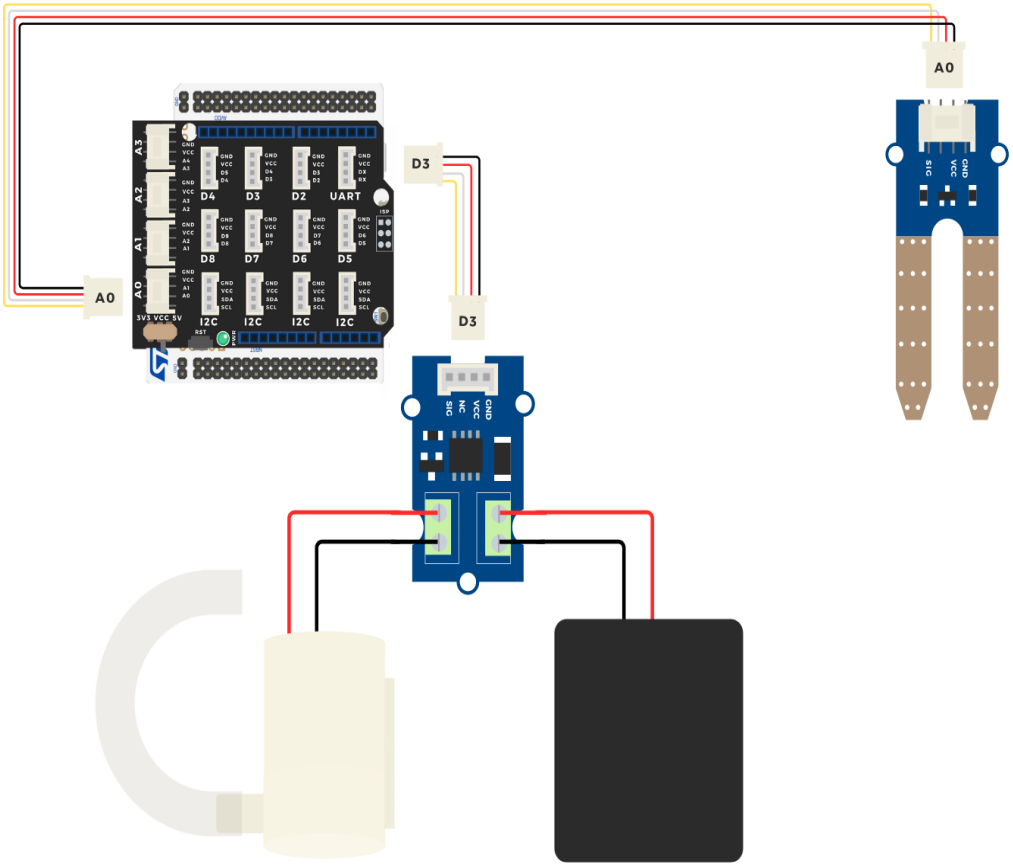
Equipment needed:
- board + Grove shield
- soil humidity sensor
- MOSFET
- water pump
- 6V box

The MOSFET is connected to the D3 port of the shield, the water pump is connected to the MOSFET, matching the polarity, as for the 6V box.
The soil moisture sensor is connected to A0.

Program example:




You need to perform a measurement in three different containers using the soil humidity sensor.
One container has dry soil, the second one has moist soil and the third one has soil that is very wet.
These obtained values are to be determined according to the type of plant: e.g. cactus or tropical plant.




Circuit from activity E

## • Activity F: Retrieve information using an NFC tag and a smartphone

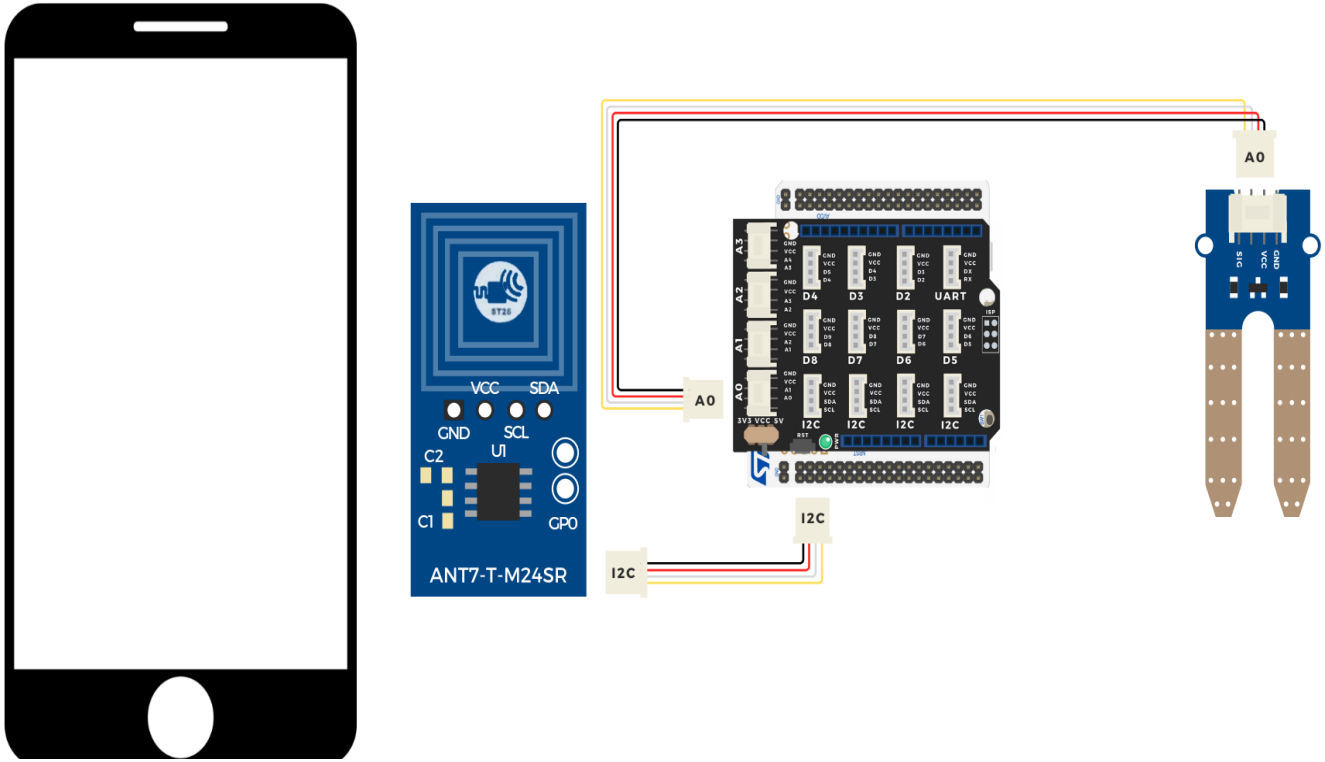
The ST M24SR64 NFC module available in the kit allows you to retrieve information from the sensors using Near Field Communication (NFC) technology. You need a smartphone equipped with this technology or a SIM card supporting NFC.

This technology allows data exchange between a terminal (in this case your smartphone) and a card or a reader (in this case the sensor or a badge).
The data exchange is done without contact between the two elements and this process can be found in many applications such as contactless payment, card-based transportation tickets, device pairing, etc.
Equipment needed:
- board + Grove shield
- ST M24SR64 NFC module
- soil moisture sensor
- a smartphone equipped with NFC technology

The module is connected to the I2C port of the shield and the soil moisture sensor to A0.

Program example:

The purpose of this program is to write the soil moisture value in the NFC module so it can be read from a smartphone. A new value is recorded every minute.




Circuit from activity F

# Furthermore

This "connected plant" kit can be used with all its provided elements. Do you want to improve it, to modify it?
We propose to you in this last part, elements you can add to your kit.

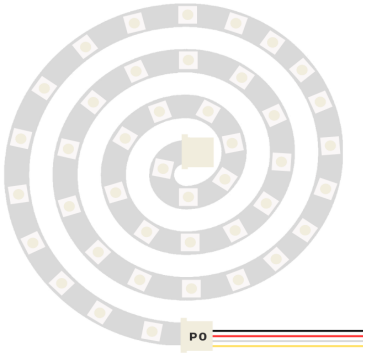
## Identification of seedlings with the NFC badge (elements present in your kit)

Easily retrieve information: date of sowing, plant identification, and number of watering times etc... by inserting a badge in the containers. An application like NFC Tools, available on Android or iOS, is required to program the badges.

## Bluetooth transmission (available with the ST NUCLEO-WB55RG board)

What if you could receive your plant's tracking information on your smartphone? It is possible thanks to the BLE Bluetooth module integrated in the board!
You can also create your own application to receive the data with Thunkable.

## Optimize lighting for plant growth

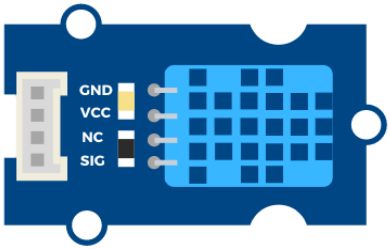



Give your plant extra, optimized light to enhance photosynthesis. The LED strip is programmed to emit blue and red light.

## Creating a 3D printed container

You can create a special container for your plant and print it in 3D. Don't forget to incorporate space for the screen and for the soil moisture sensor.

## Measure humidity and temperature




A temperature and humidity sensor can be added to your setup. It will allow you to measure two additional parameters. This is an ideal sensor if you are considering building a greenhouse for your plants!

## Building a greenhouse and controlling the opening servo-motors

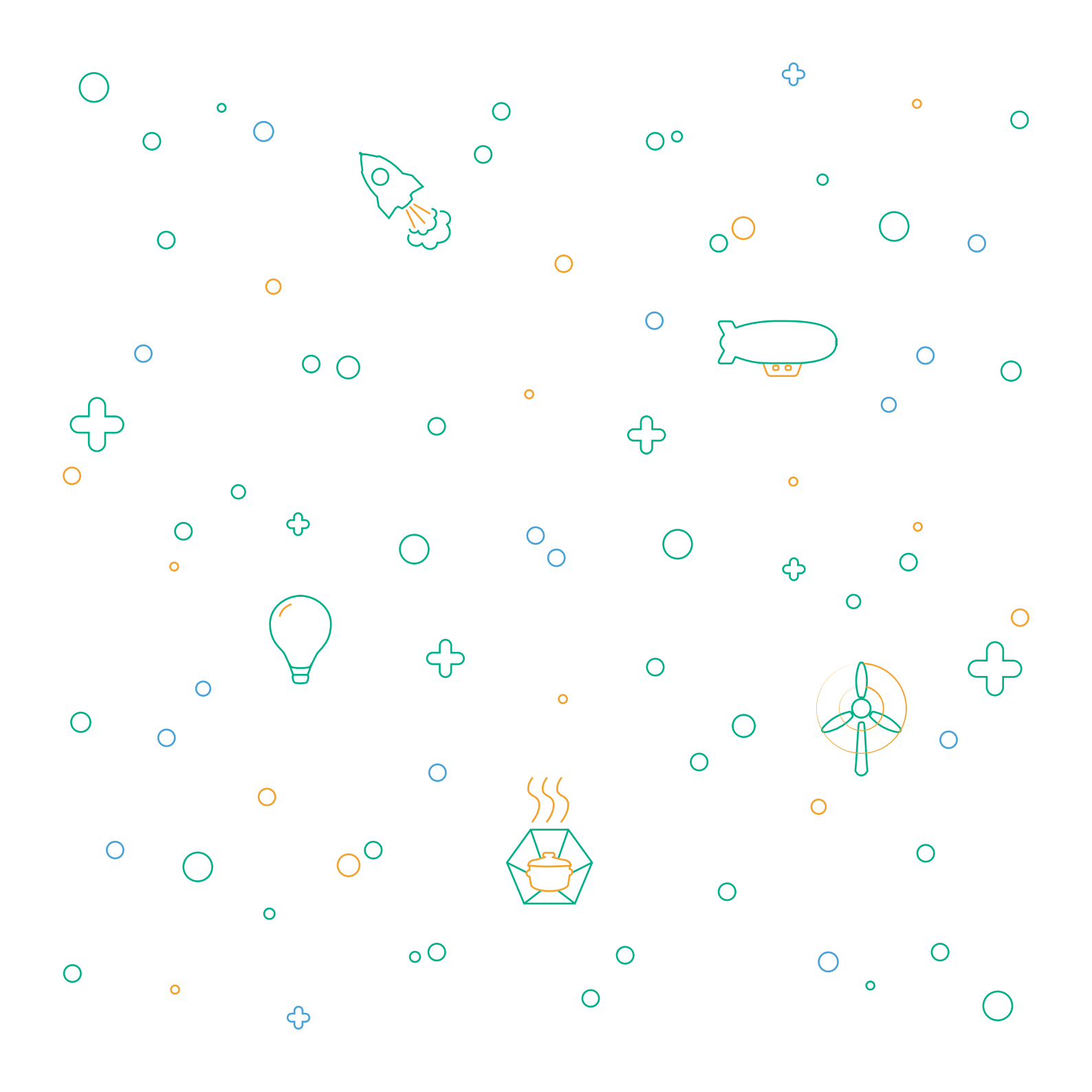
Build a greenhouse to accommodate your plants and add a servo-motor. By coupling it to the temperature and humidity sensor, you will be able to automatically activate the opening of the greenhouse and avoid overheating.

You can find all the necessary resources to program these new sensors in the "Resources" page of the Vittascience website, at this address: https://fr.vittascience.com/learn/

The various elements presented are all available in the store on the website: https://fr.vittascience.com/shop

Got a problem or a question? We are here to help you:- support@vittascience.com

# Notes



Discover the connected plant user guide. It explains in detail each activity necessary to carry out the experiment, step by step. This booklet is not comprehensive, your imagination and the resources available on the site are there to help you enhance the experience.

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