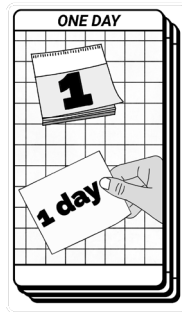


# SCRIPT 2

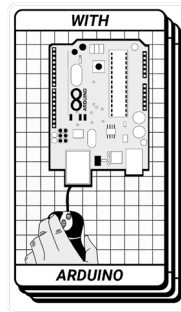
Constraints:



Space

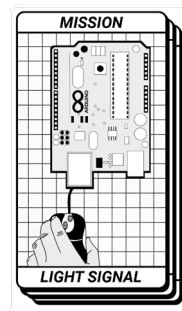
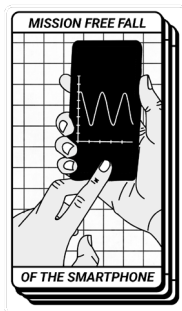


1 day



with Arduino

Tasks:



## 1 The story in two words

**The students** embody a team from the European Space Agency. They discover that they must remotely assist a spaceship that has just landed on an unknown comet.

## 2 INTRODUCTION

Show the students this "MO I1" video: someone from the space agency explains the situation and their mission.



Then give the students a way to communicate with the ship (ex: via the minnit.chat site) or a Whatsapp channel or a Discord that the supervisor will consult and use in secret to respond by playing the crew of the ship.

Then let the participants start chatting with the ship, the ship (you) must tell them that it is in the middle of exploring an unknown comet and asks them to wait for instructions.

**The morning**

*The test consists of making a protection to be able to drop a fragile object from above by following the GH12 protocol. Frugal materials are provided, and students work in groups.*

The ship sends them this message (*adjust the height of the fall and the duration of the test if necessary*):

"ok, we just continued exploring, and we spotted a hole. Yes ! A real hole in the ground. It is one or two meters in diameter, and a depth of 5 meters roughly. It is surrounded by a very acid zone that you cannot cross and is probably toxic. But we want to see what's in this hole at all costs!

We have thought about it, and what we can do is send one of our smartphones into it in camera mode. As it falls, it will be able to film what is around and below, then we will recover the signal via bluetooth. Too bad if we sacrifice one, it's worth it. In short, we need you to help us! Be careful, we have little autonomy, we cannot stay more than 2 hours on the comet. So send us within 1h30 a protocol to follow to protect the smartphone and allow it to fall and film what is around it. Attention, it is not possible to use a rope because of the acid zone. We can just come near the hole, throw the smartphone, and run back into a protected area.

We suggest you follow a GH12 protocol, that's what seems the most reasonable to us and we have all the material here from the C2309 kit so if you can do it on Earth, we will do it here too!

Good luck, we're counting on you!"

Choose from 2 versions of the GH12 protocol to give to students:

- a simple version, the only instruction is that the egg resists the fall.
- a more advanced version, which requires students to do a video analysis of the fall to assess the frictional forces of the air.

GH12 protocol (pptx)

GH12 protocol (pdf)

advanced GH12 protocol (pptx)

advanced GH12 protocol (pdf)

Do not hesitate to adjust the constraints according to your students and your objectives, for example:

- the camera must be able to film the fall, which forces the students to slow down the fall (set a minimum duration)
- once the device is on the ground, you have to be sure that the camera has a precise orientation (to film in the right direction).

This activity can be more or less advanced depending on the constraints you impose:

- tracking of the fall by video analysis (use the Fizziq application for example)
- impose a minimum time and orientation constraint during the fall in order to film it.

**Typical process :**

**Device manufacturing time: 1h30** – The students design a device in groups, test it, improve it.

**Final test: 20 to 30 mn** : all the groups, one after the other (or all at the same time if time is short), test their device in real size (drop it from a height of about 5 m) and check whether the conditions emitted by the protocol are verified. For this test, the smartphone is replaced by an egg: the egg must be intact at the end of the fall. All the students must then agree on the device to be sent to the astronauts (take a photo of the plan and the device that is sent to the spacecraft).

**Optional:** if we want to avoid having to choose between the different devices (to avoid competitive tensions), we send the plans of all the devices to the astronauts as well as their test results, and we say that they will be the ones who will choose according to their constraints local (equipment, space suits, etc.)

**If you have many students:** groups of 3/4 students work well. If the groups are larger, we can provide tutorial writer functions: some students take charge of writing instructions for making the device. We can insist on the important nature of this document and its duty of clarity. Otherwise, photos are enough to communicate with the astronauts. If the groups are larger, plan a trajectory analysis activity that is supported by a few students

**Equipment:** The C2309 kit

These are what astronauts have. It can be modified according to your stocks. This is small DIY material, the list offered (in pd and ppt format) has been tested and works but can be changed easily. Ideally, each group should have a C2309 kit at their disposal, but in practice the easiest way is to make the equipment available in the room. The quantities available are then greater than what is indicated in the kit (you can have 100 straws, even if the kit indicates that the astronauts only have 10): the groups must be careful not to exceed the quantities in their device (but several groups can use 10 straws).

DIY equipment: in addition to the kit, provide cutters, scissors, glue guns, pliers, protective and cleaning equipment: cutting mat, plastic sheeting, garbage bags, brooms... Eggs must also be provided for the final test.

C2309 kit (pptx)

C2309 kit (pdf)

labels (pptx)

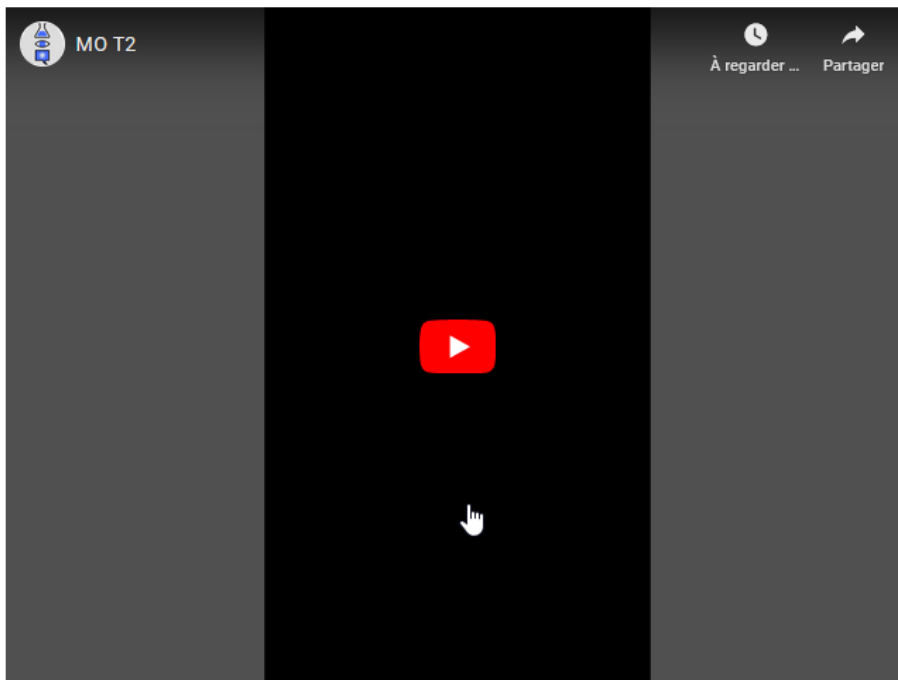
labels (pdf)

## 4 | TRANSITION

The ship indicates after a certain time (good time for a short break or tidying up):

"That's it ! We managed to do the editing you recommended. We left and launched the camera. It worked !!! Cheer ! Too strong guys on Earth! We're sending you the film we got back."

Show the video "MO T2" <https://youtu.be/2Llr90TkvhE> fall in the first person of a smartphone, then arrived at the bottom, we guess an external presence which seizes the smartphone (we even hear a few words in extraterrestrial ).



Then, communication with the ship:

"Have you seen and heard??? Unbelievable ! Someone took the camera! There is a living presence down there that seems to be speaking. We absolutely have to try to communicate. We don't really know what or how. If it's a human or an intelligent living presence, the easiest is light and morse code, hopefully they know Earth enough to know this basic protocol.

Well, we have arduinos and enough to make a long cable here. But we don't know anything about Arduino. Can you, within 2 hours, send us a user manual on how to do it? We clearly started with an AR22 protocol. Hurry, but test everything before sending it to us.

Good luck, time is running out, and the destiny of humanity may be in your hands..."

## 5 TASK : ARDUINO AND LIGHT CODES

## The afternoon

In this test, students must first design an LED system that emits any succession of ON and OFF and if possible another system that detects it.

Then they have to test that they manage to transmit and decode a secret code like SOS in Morse code among themselves (no need to program the Morse translation by default, the students tell the LED directly when to light up or not).

Optional: we choose the prototype that works best and we wire it with a longer cable distance (5 meters) and we separate the students (two different rooms, or at the top and bottom of a window) and we give a code to one of the groups, the other to decode it.

Give participants the link to the AR22 protocol.

AR22 protocol (pptx)

AR22 protocol (pdf)

labels (pptx)

labels (pdf)

**Practical course of the test:**

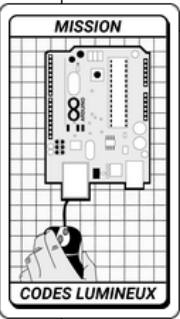
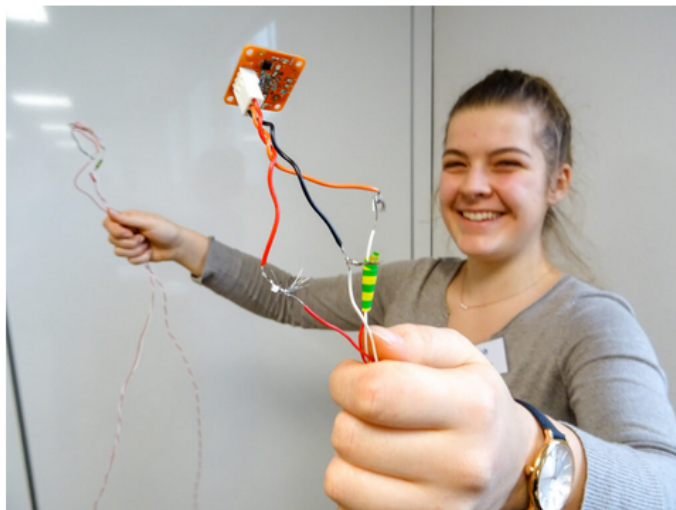
A sufficient number of Arduino kits must be provided: Arduino card (Uno for example), LED, resistor, light sensor (preferably analog, it's simpler). Also provide a reel of wire (prefer cables with several wires, to facilitate handling of long lengths), and welding equipment and cutting pliers.

If the students have never used microcontroller boards, they should be given an introductory lesson. A teacher plays the role of "Arduino specialist" and comes to train the team at the bare minimum: he quickly explains the principle of a microcontroller board, and gives the boards the task of "testing your board", "turning on a led" and "measure voltage" from the opentp.fr website (<http://opentp.fr/card/>). For students who have knowledge of programming and have done some electricity, 30 minutes is enough.

Depending on the students and the objectives, additional constraints can be added ("additional constraints issued by the operational team"):

- change the length of the cable
- impose a fast flow in transmission and reception of light signals
- impose a coding / decoding in morse by the microcontroller

The event ends with a collective session of tests and demonstrations. The students must then agree together which is the best prototype and the supervisor announces that he will send the plan and photos to the ship immediately.



## 6 EPILOGUE

The ship indicates after a certain time (good time for a short break or tidying up):

"That's it! We managed to make the Arduino assembly that you recommended to us. We were able to send the cable to the bottom of the hole. Here is what we recovered as a signal. Incredible..."

show video MO E2: <https://youtu.be/Xt4diAMGIAU> we see at the start a kind of light signal on the bottom of the crater, and it continues with a message from E.T. who greets them then end credits (you can add the names of the participants, students and teachers to the credits).

