

SCENARIO

Title	SPEED LIGHT	
Summary	In this activity the Speed of Light and the constant "c" are revealed.	
Author/s	AIJU	

DIDACTIC OBJECTIVES

- Teach math in a different and attractive way.
- Teach how to calculate speed light based on the time.

Physics **X** Mathematics **X** Information Technology Robotics Programming

Education Level: 10-12 years 12-14 years **X**

PROBLEM STATEMENT

Some students have problems understanding the concept of what the mathematical or physics problem asks, so through a visual example it is intended to facilitate learning and understanding.

BOM (Bill Of Materials needed)

- Arduino Device
- Board
- (x2) Leds (Red and Green)
- (x3) Cables
- (x2) Resistors

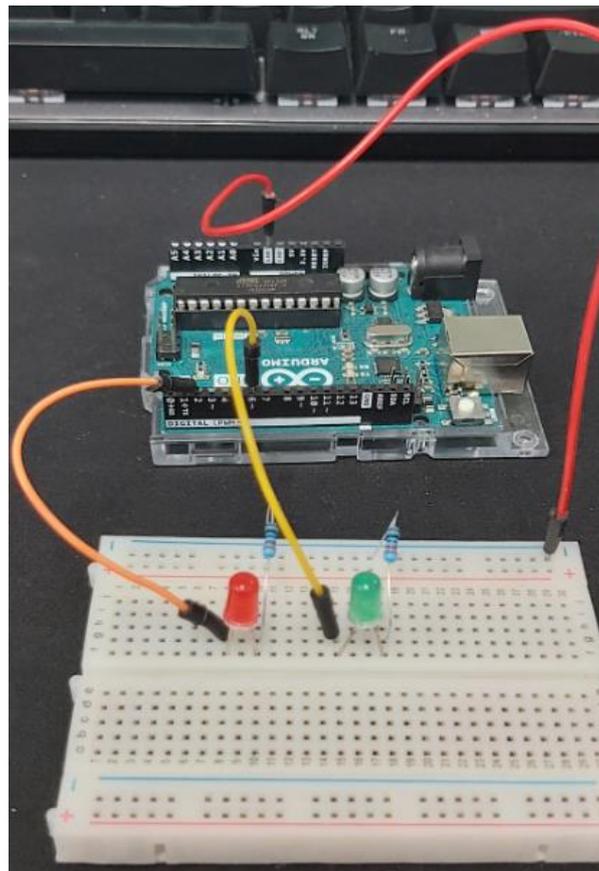
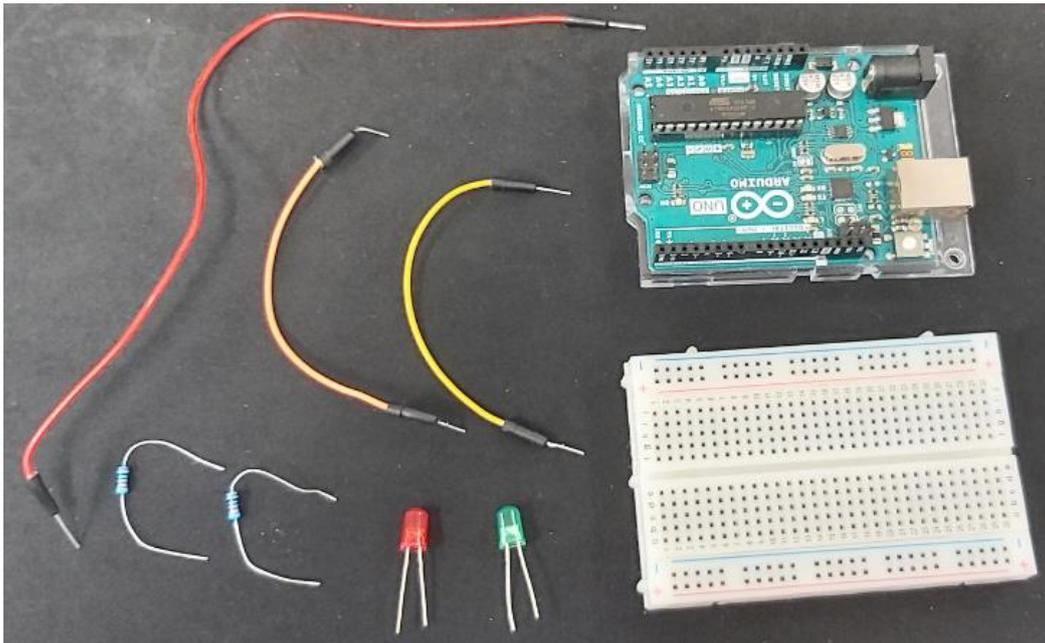


Erasmus+



InnoExperiment

INNOVATIVE APPROACH TO TEACHING THROUGH EXPERIMENT



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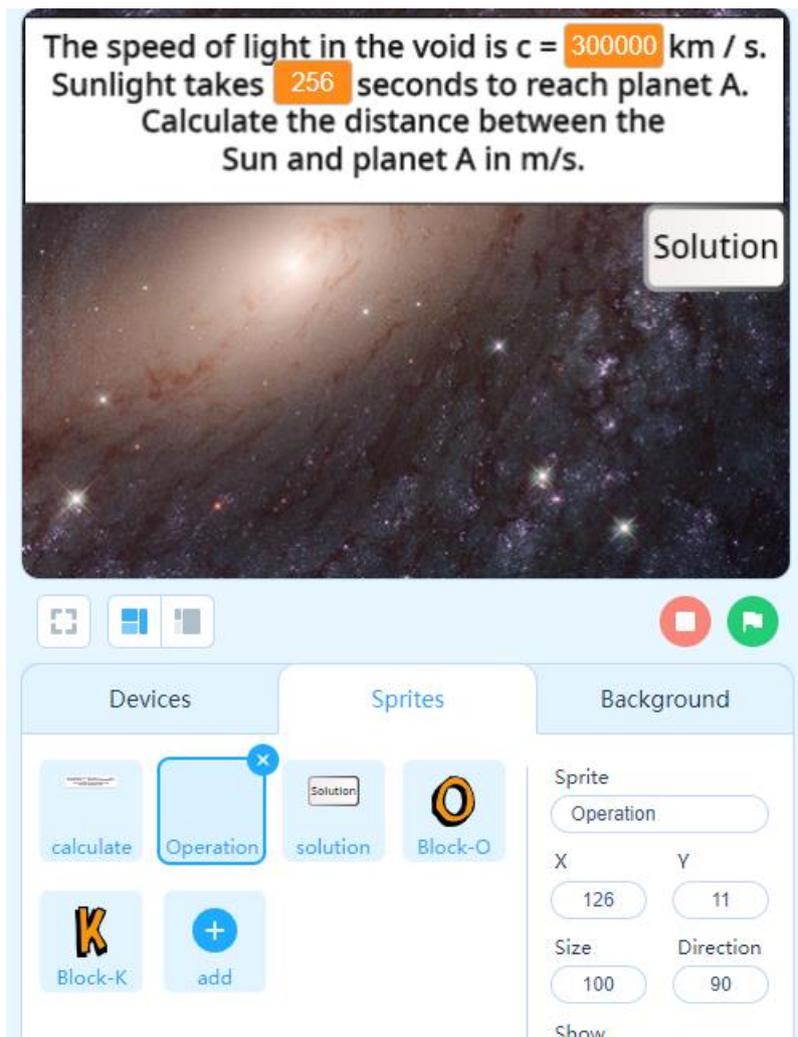
Project Leader: Zespół Szkolno – Przedszkolny w Goniądzu (ZSP)



ACTIVITY DESCRIPTION

For the development of the activity, we will use software that allows us to unify the game developed in Scratch with the use of the Arduino board. In this case, we have used the mBlock software: (<https://mblock.makeblock.com/en-us/>)

First of all, we will make the graphic composition of the activity:



The speed of light in the void is $c = 300000$ km / s.
Sunlight takes 256 seconds to reach planet A.
Calculate the distance between the Sun and planet A in m/s.

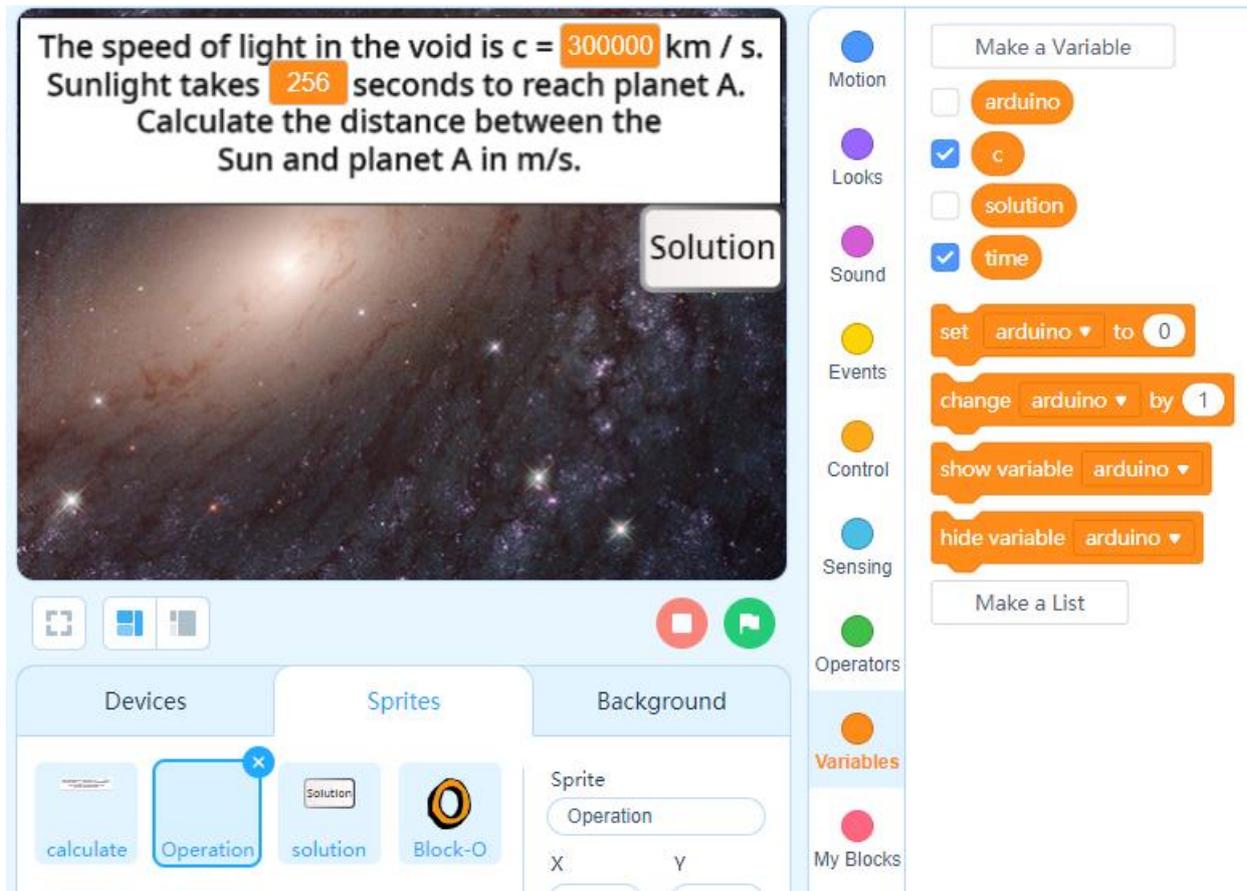
Solution

The screenshot shows the mBlock software interface. At the top, a text box contains a physics problem: "The speed of light in the void is $c = 300000$ km / s. Sunlight takes 256 seconds to reach planet A. Calculate the distance between the Sun and planet A in m/s." Below the text is a background image of a galaxy. A "Solution" button is visible in the top right corner of the image area. The interface includes a toolbar with icons for zooming, a "Devices" panel with "calculate" and "Block-K" blocks, a "Sprites" panel with "Operation" and "Block-O" blocks, and a "Background" panel with "Sprite" settings (Operation, X: 126, Y: 11, Size: 100, Direction: 90) and a "Show" button.

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We add the “c” and “time” variables for the problem statement:



The screenshot shows the Scratch programming environment. The main stage displays a physics problem: "The speed of light in the void is $c = 300000$ km / s. Sunlight takes 256 seconds to reach planet A. Calculate the distance between the Sun and planet A in m/s." Below the problem is a "Solution" button and a background image of a galaxy. The right sidebar shows the "Variables" category with two variables: "c" and "time", both checked. Below them are blocks for "set", "change", "show variable", and "hide variable" for the "arduino" variable. The bottom of the screen shows the "Sprites" area with a "Block-O" sprite selected.

In addition, we will create the "Solution" variable, which will be the one that calculates the solution to the problem, and the "Arduino" variable, which will be in charge of sending to the Arduino board when and that the corresponding LED lights up.

Once we have the graphic composition and the variables created, we will start with the programming:

1. We will start by setting the visual background that we want to appear while the mathematical/physics problem is being posed and we will set the “Arduino” variable to 0, so that the LEDs are off. In addition, for the “time” variable, random value will be created, so that whenever the Activity starts, different values come out:

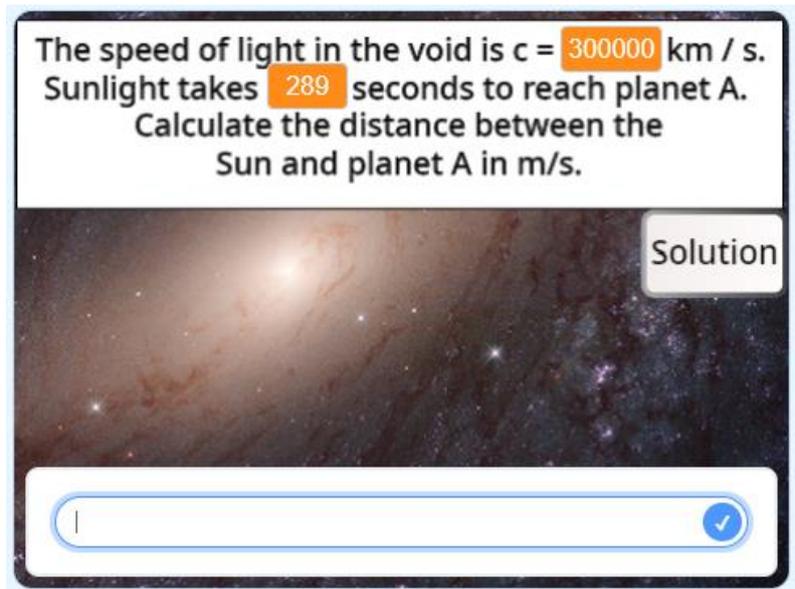
```
when clicked
set arduino to 0
switch backdrop to Galaxy
hide variable solution
set c to 300000
show variable c
set time to pick random 1 to 600
show variable time
```

2. Then, we apply the formula that will calculate the problem:

```
set solution to c * time
```

3. Next, the system wait for the user to write the result:

```
ask answer and wait
```

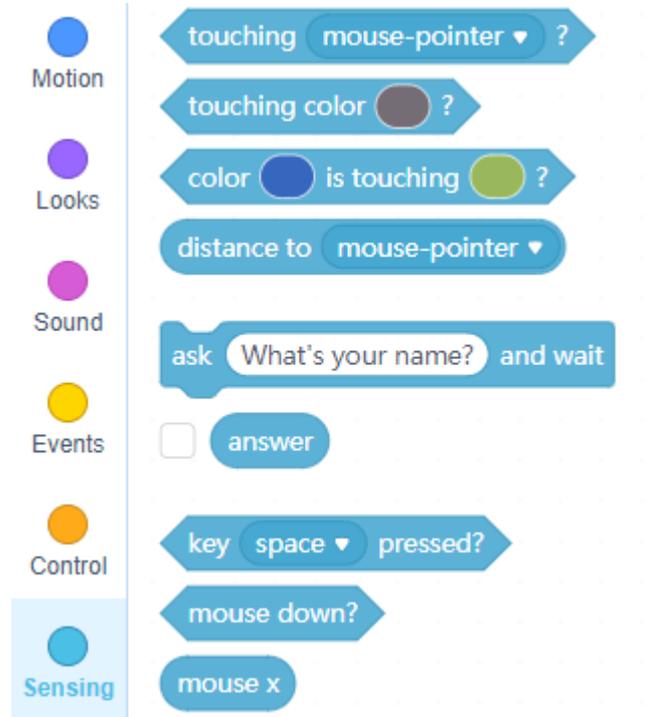


The speed of light in the void is $c = 300000$ km / s.
Sunlight takes 289 seconds to reach planet A.
Calculate the distance between the Sun and planet A in m/s.

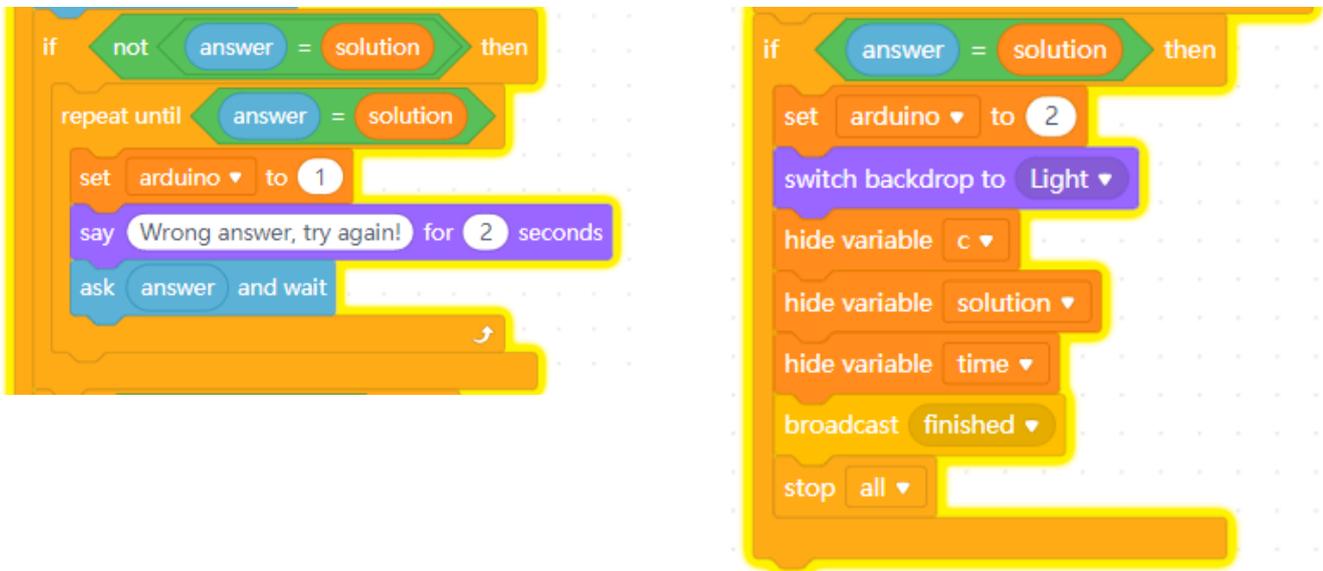
Solution

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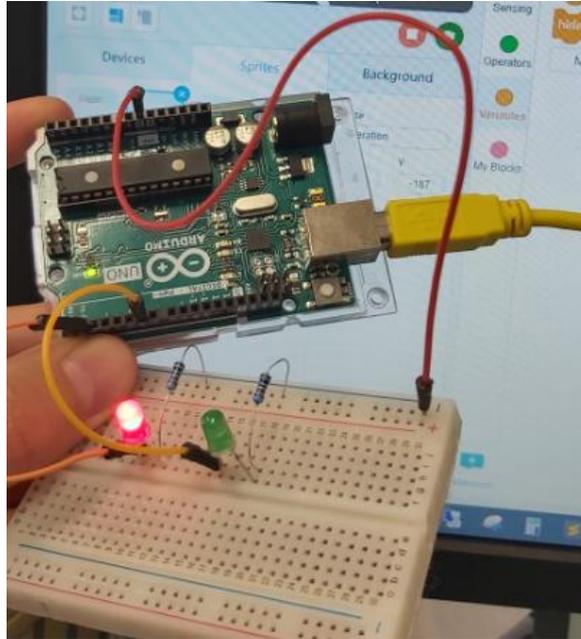
4. The result indicated by the user will be saved in a variable called “answer”, which will be created in the “Sensing” section:



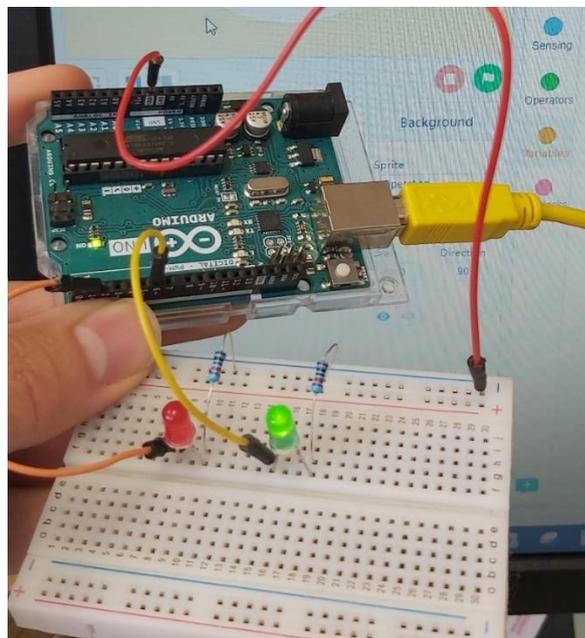
5. Once the answer has been inserted, the programming will check to verify the result:



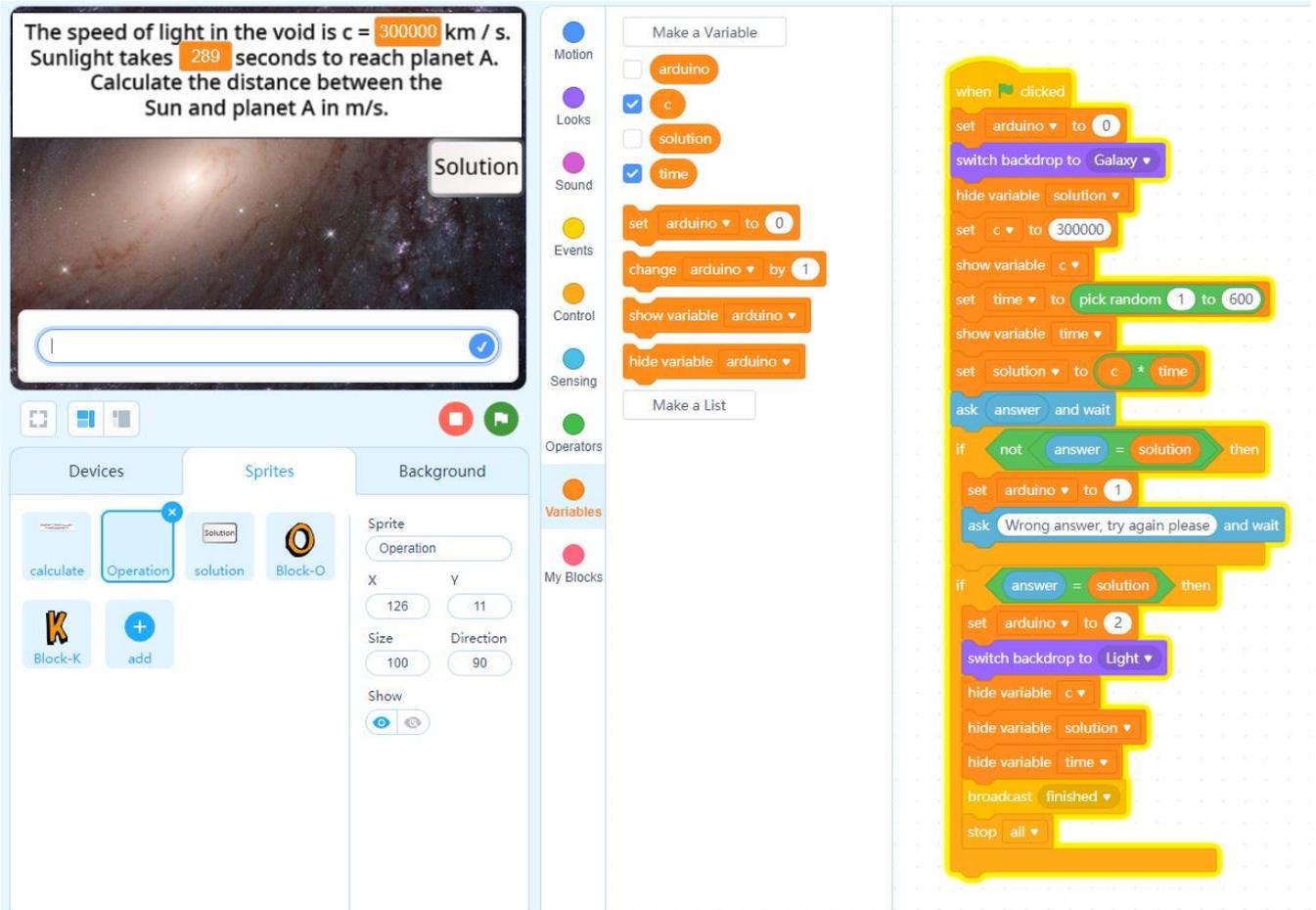
6. If the entered result is wrong, the game will display "Wrong answer, try again!" and will prompt the user to retype the answer. In this block the Red LED of the Arduino will light:



7. If, on the contrary, the user types the correct answer, the Green LED will light up and the variables will be hidden and the background will change:



8. The main Code would be as follows:



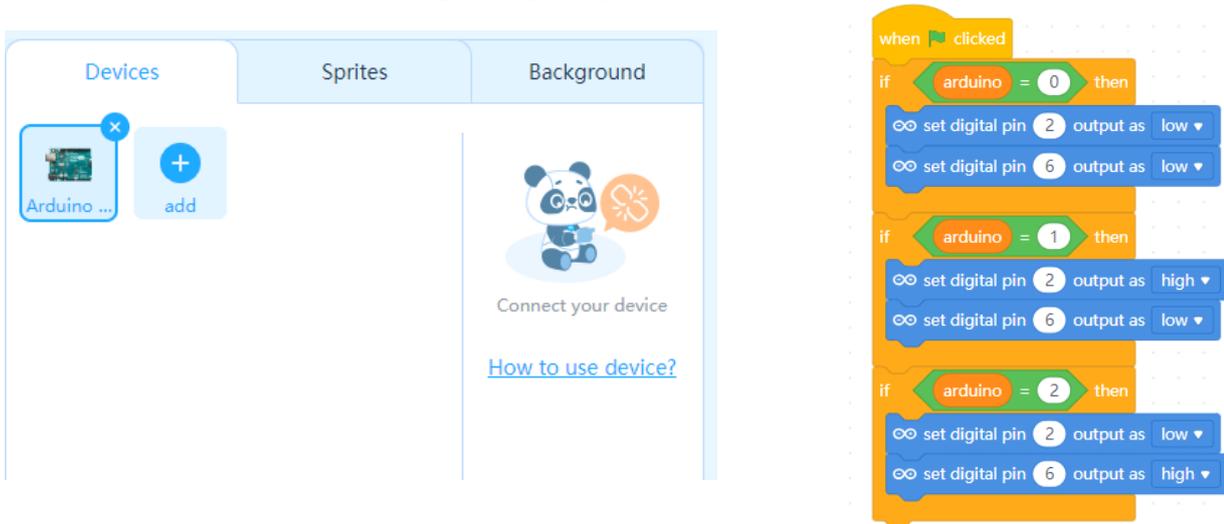
The speed of light in the void is $c = 300000$ km / s. Sunlight takes 289 seconds to reach planet A. Calculate the distance between the Sun and planet A in m/s.

Solution

```

when clicked
  set arduino to 0
  switch backdrop to Galaxy
  hide variable solution
  set c to 300000
  show variable c
  set time to pick random 1 to 600
  show variable time
  set solution to c * time
  ask answer and wait
  if not answer = solution then
    set arduino to 1
    ask Wrong answer, try again please and wait
  if answer = solution then
    set arduino to 2
    switch backdrop to Light
    hide variable c
    hide variable solution
    hide variable time
    broadcast finished
    stop all
  
```

9. The code that would be in charge of lighting the LEDs on the Arduino board would be as follows:



Devices: Arduino ...

Connect your device
[How to use device?](#)

```

when clicked
  if arduino = 0 then
    set digital pin 2 output as low
    set digital pin 6 output as low
  if arduino = 1 then
    set digital pin 2 output as high
    set digital pin 6 output as low
  if arduino = 2 then
    set digital pin 2 output as low
    set digital pin 6 output as high
  
```

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STUDENTS' EVALUATION

The way to evaluate the students would be for them to demonstrate on paper how they have developed the exercise and to use the program / game to check the solutions.

SCALABILITY

Regarding the concept of scalability, the exercise could be extrapolated to other branches of physics.

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