Introductory scenarios

Primary school activities

Lesson scenarios for older students

Author: Tomasz Mikołajczyk

Early childhood education | Grades: 1–3

Cardinal Directions

cognitive development • programming

Duration time:	Robots:	Programming interface:	Accessories:
45 min.	×1	Photon Badge	–

Goals (for the children):

- To learn and use cardinal directions
- To program the robot

Required items:

- A physical map of your country
- A pointer (standard or laser)
- Paper cards with city names – one set per group (Appendix).

Preparations:

Recall the concept of the cardinal directions introduced earlier (depending on the group's level, you may refer to the four main cardinal directions only). Then place the map on your classroom floor and indicate the city where you are currently located.

Lesson scenario:

1. **Robot Journey Project**

   Divide the class into groups of three. Give each group a set of three paper cards with names of different cities. Each group has to find the cities on the map and place/attach the city names in the right places. Each group will then plan the robot's journey – the robot should start its journey in one city, visit the second city along the route, and then finish its journey in the third city. The journey should consist of two stages – the first being a prototype. Students should write instructions on a piece of paper in the form of commands *Go North*, *Go South* etc.

2. **Robot’s journey (programming in Photon Badge)**

   After the prototype is complete, ask one of your students to read the commands aloud and another student to point out the direction of movement on a map. A third student should program the robot’s movement in the Photon Badge app. Before programming, you can remind students that they can adjust the robot's step length accordingly using a ruler. Each time the robot reaches the intermediate or final destination (city), it should communicate its arrival with a sound or a change in the color of the ears. Ask the entire class to validate the prototype, correct any errors, and then begin the robot’s journey. Open the application. Ask each group to present their work one by one.

Interesting facts:

- Moss grows on the north side of trees.
- Sunflowers never face north.

Opening Questions:

- Does the order of visiting cities matter to us? Why does it matter?
- In which professions is determining exact directions particularly important?

Examples of city sets

1	New York	Chicago	Charleston
2	Las Vegas	Seattle	San Francisco
3	Washington	New Orleans	Philadelphia
4	San Diego	Houston	Los Angeles
5	Honolulu	Miami	Boston
6	Austin	Orlando	Dallas

Author: Joanna Król-Mazurkiewicz

Early childhood education | Grades: 1–3

Addition to 10. Equations

mathematics • programming

Duration time:	Robots:	Programming interface:	Accessories:
45 min.	×1	Photon Draw	Educational mat

Goals (for the children):

- To learn the mathematical signs + and =
- To name numbers in the range 0 to 9
- To practice addition up to 10, using fingers or selected items
- To be able to read mathematical operations, i.e. addition

Required items:

- building blocks
- ×4 flashcards with numbers from 0 to 5 (Appendix 1)
- ×2 cards with numbers from 0 to 9 (Appendix 2)
- cards with the following signs: “+” and “=” (Appendix 2)
- magnetic board (optional)
- worksheets (Appendix 3) – one for each child

Teaching methods:

- explanatory talk
- demonstration
- practical activity

Type of exercise:

- individual
- collective

Lesson scenario:

1. **Introduce the children to the concept of mathematical operations – addition: what does it mean to add something up (sum up)?**

   - Ask the students to give an example of adding, such as an extra serving of soup or cake. You can give them the following example: *I want to build a tower. But I only have three blocks, and I need more. What do I do?*
   - Place three blocks on the floor, then count together with the children. Put a card with a number 3 underneath this stack of blocks. Place a stack of four blocks next to it, count them together with the children and label them with the number 4 card. Ask how many blocks are there now. Arrange seven blocks next to the other two stacks and label them with the number 7.
   - At this point, you can introduce the kids to the following signs: “+” and “=”. Ask the children for their associations with these signs (any idea is good!). Then name the signs and tell the children that those signs allow us to write down the mathematical operations. Then place those signs between the numbered cards (stacks) accordingly (3 + 4 = 7).
   - Showing the numbers one by one with your finger, read aloud the mathematical operation by yourself and then together with the children.

2. **Programming the robot and arranging mathematical operations – adding randomly selected numbers**

   - Place the cards with numbers from 0 to 5 (four sets) on the Photon educational mat (with the robot’s image facing up).

Remember!

Do not put any cards on the Rocket field. The rocket field is the robot’s launching field – it always starts there. Lay down large cards with the numbers 0–9 (two sets) next to the mat, on the carpet.

- Select the first child. Ask the child to program the robot in such a way that it travels to a flashcard of their choice. When the Photon Robot stops on it, ask the child to pick up a card from that field, name the number on the card, and show it to the others. Ask the child to put down the card with the number facing up and place the robot on the Rocket field. Then, ask the child to choose a card that was drawn from the larger cards set with numbers spread out on the carpet and attach it to your classroom board as one of the elements of addition. Ask the next person to repeat and do the same.

⚠ Important!

The children can choose cards from any uncovered fields, i.e., those where you have a card with the image of the robot.

- This way you select elements for your addition operation. Count together as a group (remind them to use fingers too). Then attach the result (the number) in the appropriate place on the board (you can read the whole addition operation together).
- Repeat the steps. This will allow you to create more mathematical calculations.
- Make sure to set up this activity so that every child has a chance to program the robot.

3. Summarize the activity by reminding the students what the "+" and "=" signs are called and what addition/summation are.

- Hand out the worksheets to the children.
- If the children like the activity, you can instruct them to complete the worksheets as their homework. Working in a kindergarten, you can use the worksheet the same day or the next day.

⚠ Please note!

These activities could also be conducted with older children in the first grades of primary education to introduce counting beyond 10, additions, and other number-related operations.. You might want to consider writing down completed mathematical operations on the cards (face down) and explain such topics as multiplication, division, etc., then ask students to analyze them together.

Appendix 1

0	1	2
3	4	5
		
		

Appendix 2

1 2	3 4	5 6
7 8	9 0	+ =

Appendix 3

1. Write the addition activity in numbers. Read it to your mom or dad:

2. Practice addition (you can use your fingers) and write the result.

3 + 4 = ...

2 + 2 = ...

5 + 3 = ...

Author: Mariola Fik

Early childhood education | Grades: 1–3

Photon Robot in a maze

creative activities • technology

Duration time:	Robots:	Programming interface:	Accessories:
90 min.	×2	Photon Blocks Photon Joystick Photon Badge	–

Goals (for the children):

- To understand the concept of a labyrinth (or maze), to learn how to design a simple maze
- To learn how to build an already designed maze
- To be able to write and test a program using blocks in the Photon Blocks application
- To improve teamwork skills
- To learn how to take a task-oriented approach to the problems

Required items:

- tablets (to operate the robots)
- blocks, boxes, rulers (to build a maze)
- A4 paper sheets, colored pencils, pencils (to design the maze)

Teaching methods:

- exploring
- brainstorming

Type of exercise:

- individual
- group

Preparations:

Before the class, read the Wikipedia article:

https://en.wikipedia.org/wiki/Labyrinth

Find sample pictures of a labyrinth or maze on the Internet to show to the children.
For example: https://www.pexels.com/photo/aerial-photography-of-maze-bush-1904204/.

Lesson scenario:

1. What do we see?

- Begin your class by showing the children an image of a maze.
- Initiate a discussion:
    - What do you see on this image?
    - Have you ever visited a real maze?
    - Why would someone build a maze?
    - Is it hard to get out of a maze?
- Summarize the children's statements by saying that a labyrinth is a complex structure consisting of many paths, dead ends, and turns to make it difficult to reach an important place (usually hidden in the center of the maze). Nowadays, labyrinths are built in parks, gardens. Labyrinths or real-size mazes are often tourist attractions.

2. Let's design a maze

- Ask the children whether building a maze is a difficult task. Allow the children some time to answer this question. Ask them what can help with it's construction and what could be difficult. Lead the conversation to the point where the children say it is necessary to create a maze design first.
- Suggest that the children design their own maze on a piece of paper. Children can work individually or in groups (adapt the form of work to the group you are working with). Allow some time for this task.
- Later, encourage everyone to show their projects. Ask about the most challenging part of this task and things they consider easy. Congratulate the children on their maze ideas. Each maze will most likely be different – you might want to highlight this fact in your feedback.

3. **Let's test**

- Ask the children to exchange their projects with each other and try to go through their friend's maze. Encourage the children to talk about their mazes (what did they like about the maze, was it easy to find the way out, can the design be improved?)

4. **From design to construction**

- Announce the next challenge: building a maze according to their projects.
- Divide the children into teams (adjust the number of teams according to the space you have and available resources).
- Each team can choose one of their own projects or you can hand out projects prepared by you.
- Give the children time to build the maze (hint: in order for the robot to move freely through the maze, the distance between the walls should be no less than 25 cm – use a ruler).
- When the structures are complete, analyze the compliance of the constructed labyrinth with the design. While doing this, you can compare your task to the cooperation between an architect and a construction company.

5. **The Photon Robot is testing our maze**

- Introduce the children to the next task: the Photon Robot wants to try out our labyrinths, but it needs to be programmed first.
- Suggest using the Photon Badge or Photon Blocks interface. Give the children time to write and test the program.
- If you do not have enough time or are working with a younger group, you can use the controller in the Photon Joystick.

Lesson Summary:

- Discuss with the children what they enjoyed most in today's activity.
- Did they enjoy working as a group?
- Is it easy to build according to a design?

Author: Karolina Frąckiewicz

Primary School | Grades: 4–8

Improving your attention span

maths • creative activity

Duration time:	Robots:	Programming interface:	Accessories:
45 min.	×1	Photon Draw, Photon Badge, Photon Joystick	Educational mat

Goals (for the children):

- To increase attention span
- To develop spatial imagination
- To train their memory
- To stimulate creativity

Required items:

- tape and scissors

Type of exercise:

- individual
- group

Preparations:

Tell the children that today they will train their observation skills, memory and patience.

Lesson scenario:

Prepare a grid on the floor as if playing tic-tac-toe (3×3). You can use scotch tape attached to the floor or use the Photon educational mat (plain grid). Place/stick an extra element in the middle, i.e. a "fly" (it could be a picture of a fly, a dot, a magnet or any point). Explain that this “fly” can move up, down, right, and left on their grid. Tell the children that you will give instructions to the fly, and they need to imagine its moves (you can tell up to 10 commands in one go). Whenever the fly “goes outside” of the 3×3 grid, they need to shout: “out.” The child who notices it first is asked to map the entire path of the fly using the robot. The rest of the group stands by to verify the accuracy of the track. Repeat this activity several times. You can scale up the grid to 5×5, etc., group the movements (sample instruction: the fly moves three fields down, etc.), add obstacles (place printed images prepared in advance), e.g., a spider – your fly becomes trapped on that field for two moves (you provide further instructions, but only the third one in the sequence will be doable and takes fly back on its track); an image of water, which flushes the fly one field down (the next move starts from a field below). Encourage your students to provide even more creative ideas. They can come up with different obstacle ideas and quickly draw them on cards/flashcards. You can suggest that students take turns in re-creating the fly’s track. Please adjust the pace of giving instructions accordingly after each turn.

Lesson Summary:

Ask the students whether they liked the activity, if they would like to participate in it again later and if they would like to add any other obstacles to the game.

Author: Karolina Frąckiewicz

Primary School | Grades: 4–8

Train their memory

cognitive development • creative activity

Duration time:	Robots:	Programming interface:	Accessories:
45 min.	×1	Photon Draw, Photon Badge, Photon Joystick	–

Goals (for the children):

- To develop their imagination
- To improve their memory
- To increase attention span
- To learn mnemonic techniques

Required items:

- large sheet of paper
- marker
- tape and scissors (optional)

Teaching methods:

- brainstorming

Type of exercise:

- group
- individual

Preparations:

Present the topic of this activity and talk to the students about memory: what they know about it and what they think about their own memory. Tell them that they will be able to test their memory and practice it during the class.

They will have to memorize as much as possible from a shopping list (10 products), which will be quickly read aloud to them: eggs, four rolls, brown sugar, three-layer kitchen towel, tropical muesli, Swiss cheese, butter, rapeseed oil, apple juice, milk chocolate with nuts. You can make the list even more complex – adapt to the age and abilities of your group, i.e., add more products or more details, e.g., a specific type of butter, number of eggs, or mix items from different store departments: wallpaper glue, power strip with three sockets, etc.). The students have to rely on their memory only. They are not allowed to write down the items. Then ask volunteers to try to repeat the shopping list from memory. Highlight that if they all went to a store together, as a group, they would do all the shopping, but they would miss several products as individual shoppers. Tell them that today they will learn a mnemonic technique that will allow them to remember all of the items on the shopping list, called here as “personal bookmarks”.

Lesson scenario:

Ask your students to draw an outline of a person on a large sheet of paper. Ask one of the children to lie down on the provided paper on the floor so the rest could draw the contours. Instead of drawing it, they could also use tape to put around the child on the floor.

In this exercise, you will teach a memorization technique based on associations.
The students will need to assign subsequent items from the shopping list to individual body parts using associations, i.e., start at the feet to memorize that you need to buy eggs. Ask students about the easiest way to associate eggs with feet (tip: you could crush them with your bare feet and feel the cold white squeezing through them, etc.). Now we go up to the ankles – four bread rolls are next on the shopping list. Ask the children to imagine that they stick bread rolls around their ankles to make organic ankle protectors, this way, you can give “high fives” with your ankles without hurting yourself.

Ensure these ideas are highly creative and funny to make associations easily remembered. You could try to recreate these ideas for fun (e.g., giving “high fives” with ankles or trying to imagine cold stuff, like crushed eggs, on your feet). You might also ask the group for propositions of specific associations and select one that seems the best. The rule in this mnemonic technique is simple – assign all the items from the shopping list to all the body parts, from toes to head, or vice versa. Please be consistent, i.e., don’t move to elbows and then back down to knees.

Once memorized, you or students taking turns, drive the robot to each body part drawn on your sheet of paper or outlined on the floor. Everyone should take part and mention products from your shopping list assigned to each body part. You might want to add sounds of emotions/feelings or change robot's colors at each step. Then you could try to repeat the list, this time starting at the head and moving down to toes. Do it as a whole group exercise or select a volunteer to repeat the list independently.

Lesson Summary:

Ask the students if they enjoyed this activity. What are their thoughts on this mnemonic technique? Are they planning to use it in real-life situations? Would it help them in school to memorize other content?

This is one of the simplest techniques. In order to memorize more elements, use different ones. Emphasize to the children the fact that it is worth learning how our memory and brain work.

Opening Questions:

- How much information can our memory hold?
- What are the types of memory?

Author: Tomasz Mikołajczyk

Primary School | Grades: 4–8

Improving numeracy skills

math

Duration time:	Robots:	Programming interface:	Accessories:
45 min.	×1	Photon Blocks Photon Code	–

Goals (for the children):

- To recognize multiples of two natural numbers
- To practice basic arithmetic operations

Required items:

- a tablet (to operate the robot)
- classroom whiteboard or flip chart
- masking or duct tape
- a set of basic math operations – one per group
- set of number cards

Type of exercise:

- individual
- group

Preparations:

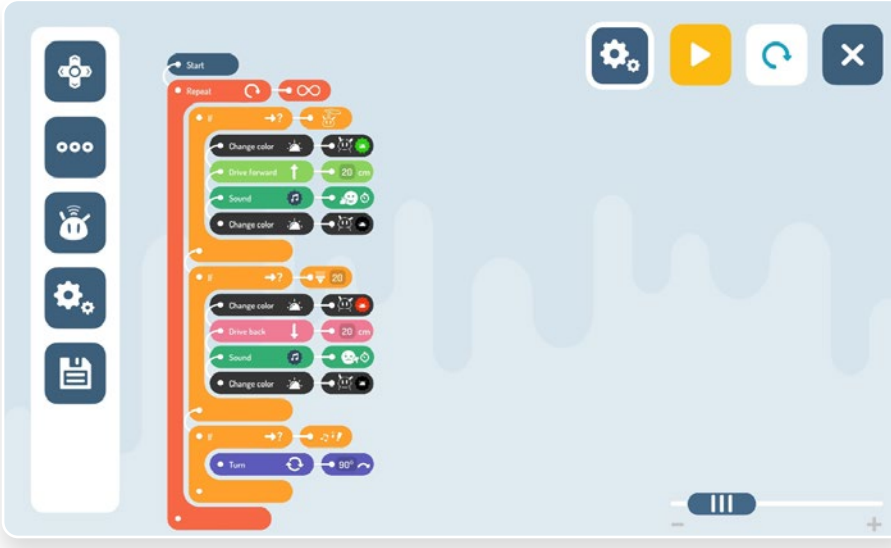
Make sure that the children understand the basic definition of multiple. For this purpose use several examples and write them on the board.

Lesson scenario:

Divide the class into four groups. Select one student to control the robot. Designate a square space using masking or duct tape (recommended size 100×100 cm / 40×40 inches) in the center of the room. Position the robot in the middle of your designated area. Ask each group to sit at one side of the square. The children must stay away from the edge of the tape. You or one of the children should become the robot's operator and program the Photon Robot to react to the following commands/conditions:

- correct answer given: the robot moves one step forward (20 cm / 10 inches) – triggered by stroking the robot,
- incorrect answer given: the robot moves one step backward (20 cm / 10 inches) – triggered by placing a hand in front of the robot's belly,
- Ninety (90) degrees turn to the right – triggered by clapping (you have to clap as many times as required to position the robot in the correct direction).

It's a good idea to add changing colors and sounds to your activity – please ask the children to choose them.



A sample program created in Photon Blocks

Provide each group with a set of activities (example: Appendix B). Select one number at a time (example: Appendix A) and present it to the groups. Ask the groups to check their cards with mathematical operations – the result of this operation must be a multiple of the number shown by you (whichever group comes first, wins the right to present their answer). The children should signal their readiness by raising their hands. Then ask the robot operator to make it rotate towards that group by clapping the appropriate number of times. Check if the result is correct. If the group came up with the right answer, ask the group representative to approach and stroke the robot on the head – the robot should move one step towards the group. If the answer given is incorrect, ask the group representative to place their hand in front of the robot's belly – the robot should take a step back. The group whose division line is crossed by the robot first, wins the game.

Appendix A (Set of numbers for mathematical operations)

2	3	4
6	7	11
5	13	8

Appendix B (Set of mathematical operations)

15 − 9	14 : 2	2 + (12 × 2)	2 + 1	13 + 8
(11 × 5) + 10	28 × 2	5 + 2	15 × 4	3 + 3
(20 × 3) + 6	9 − 1	15 + 3	18 + 3	(3 × 20) + 4
7 × 2	44 : 2	57 − 2	21 + 1	10 + 2
18 − 3	14 − 1	32 : 2	(2 × 5) + 1	40 + 4
(17 × 2) + 5	40 − 1	50 + 2	32 + 3	9 + (2 × 2)

15 − 9	14 : 2	2 + (12 × 2)	2 + 1	13 + 8
(11 × 5) + 10	28 × 2	5 + 2	15 × 4	3 + 3
(20 × 3) + 6	9 − 1	15 + 3	18 + 3	(3 × 20) + 4
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(17 × 2) + 5	40 − 1	50 + 2	32 + 3	9 + (2 × 2)

Author: Karolina Frąckiewicz

Primary School | Grades: 4–8

Foreign language class – Vocabulary consolidation

English

Duration time:	Robots:	Programming interface:	Accessories:
45 min.	×1	Photon Blocks Photon Code	–

Goals (for the children):

- To improve their memory
- To consolidate their knowledge of words and phrases in a foreign language
- To improve language skills
- To improve teamwork skills

Required items:

- cards in four different colors with words and phrases to repeat (e.g., yellow – road transportation, blue – waterway transportation, green – air transportation, red – verb phrases)
- tape to mark the start and finish line

Type of exercise:

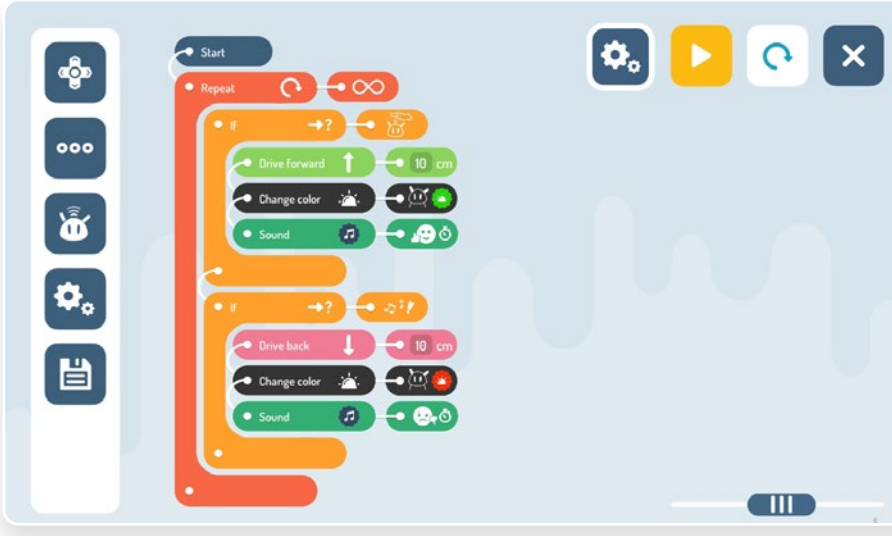
- individual
- group

Preparations:

Explain that this class is focused on foreign language vocabulary related to transportation. The idea described in this scenario can be adapted to many languages, grammar, and other subjects, such as history, where colors correspond to: yellow – dates, red – events, green – characters, etc. The main goal of the task is to drive the Photon Robot from the starting point to the designated finish line. Depending on the size of the room, you might want to set one robot's step to, for example, 10 cm (4 inches). There are 40 cards from four categories; therefore, the distance from the starting point to the finish line is about 4 meters (13 feet). You can, of course, increase or decrease the length of the robot's single step to your requirements. Please remember that the children will not provide correct answers to several questions, which means the robot will move backwards.

We recommend marking distances that could be reached with tape: from 4 to 3.5 meters (11.5-13 feet) – master level, from 3.5 to 3 meters (11.5-10 feet) – expert level. This activity focuses on knowledge revision, so students should know the answers and the material well.

Please program the robot as follows: correct answer given – the robot moves forward 10 cm (4 inches), ears turn green and makes a cheerful sound; incorrect answer given – the robot moves back 10 cm (4 inches), turns red, and makes a sad sound. Approve correct answers by stroking the robot's head and incorrect ones by making a noise (sound detection feature), for example, a clap.



A sample program in Photon Blocks

Lesson scenario:

The students should decide themselves on their order of taking turns; each person must take up the challenge at least once. Ask one of the students to choose the color representing the question category, then ask anther child to draw a card from the questions stack. Pass the card to the student or read the question. Cards have words or phrases written on them in English/foreign language. The student has to provide its equivalent in a foreign language/English. If the answer is correct (verified by you and the whole class), ask the student to come over to the robot and stroke it's head. The robot should then make a joyful sound, turn its eyes and ears green, and move forward one step. If the answer is incorrect – ask the student to make a noise (clap hands) next to the robot. The robot should turn red, make a sad sound and move back by one step. Now, the next student takes turn. The activity ends once you run out of all the questions.

Lesson Summary:

Let the students assess their preparation in the subject matter, whether they were able to cross the expert or the master level line. Ask them if they enjoyed this form of knowledge revision activity.

Yellow

Bicycle
Rower

Ciężarówka
Track

Scooter
Skuter

Tram
Tramwaj

Trolleybus
Trolejbus

Highway
Autostrada

Car
Samochód

Motorcycle
Motocykl

Korek uliczny
Traffic jam

Bus
Autobus

Train
Pociąg

Underground/subway/ tube
Metro

Autokar
Coach

Wóz strażacki
Fire truck

Traktor
Tractor

Ambulance
Karetka pogotowia

Blue

Plane
Samolot

Łódź podwodna
Submarine

Łódź ratunkowa
Lifeboat

Ferry
Prom

Ship
Statek

Czołg
Tank

Green

Balloon
Balon

Spaceship
Statek kosmiczny

Odrzutowiec
Jet plane

Lotnia
Hang-glider

Red

Travel by plane
Podróżować samolotem

Drive a car
Prowadzić samochód

Get in the car
Wsiadać do samochodu

Wynająć samochód
Hire a car

Wait for a bus
Czekać na autobus

Go by bus
Jechać autobusem

Get off at the stop
Wysiadać na przystanku

Go on a trip
Jechać na wycieczkę

Miss a train
Spóźnić się na pociąg

Take a taxi
Wziąć taksówkę

Podróżować autostopem
Hitchhiking

Ride a bike
Jeździć rowerem

Go on foot
Iść pieszo

Walk
Chodzić, spacerować

Author: Ewelina Soldan

Primary School | Grades: 4–8

Rube Goldberg machine

creative activity • technology

Duration time:	Robots:	Programming interface:	Accessories:
90 min.	×2	Photon Blocks	–

Goals (for the children):

- To program the Photon Robot and its noise sensor
- To improve teamwork skills
- To plan and execute own projects/works
- To build a Rube Goldberg machine

Required items:

- balloon
- pin or thumb tack
- ping-pong ball
- cardboard
- toilet paper cores
- empty bottles
- wooden blocks
- domino, Jenga game
- toy cars
- a piece of string
- adhesive tape
- other materials found in the classroom

Lesson scenario:

1. Introduction

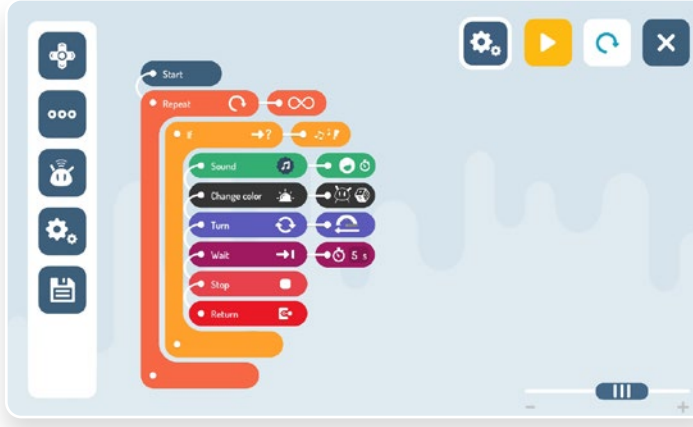
- Show the students a video with the largest Rube Goldberg's machine in the world. Source: the official Guinness World Records channel on YouTube:

https://youtu.be/RBOqfLVCDv8

- Try to define what a Rube Goldberg machine is and what are its main features with your students (you could use some interesting facts as well).

2. Learning activity

- The main goal is to design your version of this machine that would be able to start/run the Photon Robot by making a loud sound.
- Divide your students into groups (adjust the number of groups to the number of resources you have – robots and materials).



A sample program that starts the robot

Tip!

Start this activity by testing a simple one-section mechanism, for example a block falling to the floor. Then add more sections, one at a time, as your students come up with new ideas. Remember to test your machine as often as possible!

Discussion topics:

- What is a cause and effect relationship?
- Where could we use such machines?

Interesting facts:

- Many competitions are organized worldwide, focusing on the construction of Rube Goldberg's machines.
- Rube Goldberg was an illustrator and inventor who used to design highly complex mechanisms based on the execution of very simple tasks.