



PHOTON'S C LESSON PLANS



"Programming teaches you how to think"

Steve Jobs



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Dear Teacher!

We have prepared a set of lesson plans for conducting classes with the Photon robot so that you can get the most out of the lessons with your pupils. These lesson plans are designed based on the guidelines of the **core curriculum introduced by the Ministry of Education**.

This publication consists of three levels: A, B and C. Each of them is tailored to the age and skills of the children at each grade. There are 10 lesson plans for each level. Each teaches you how to conduct and develop your own lessons using the robots.

To control Photon, you will need the **Photon EDU application**, which can be downloaded for free from the GooglePlay store (on Android mobile devices) and the AppStore (on iOS mobile devices). The application was developed to work with a large group of children.

Special codes included in this publication give access only to the necessary functions used in a given scenario. In each lesson, we learn more about the robot's capabilities, which means that Photon is developing together with your pupils.

Cooperating with teachers from all over the world, we are constantly trying to broaden the database of lesson plans.

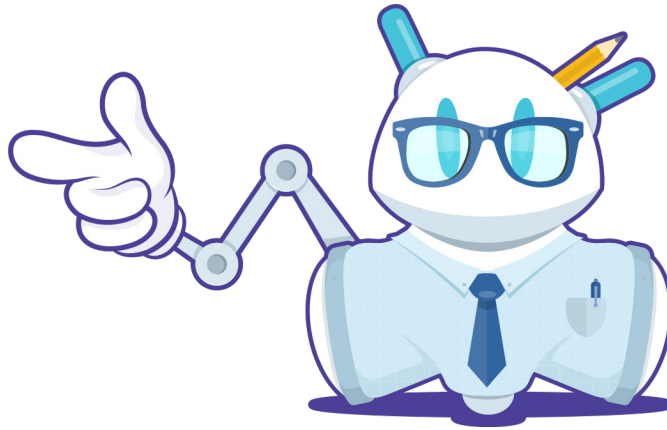
If you would like to share your ideas on using Photon at school or in kindergarten, please contact us by e-mail at edu@photonrobot.com (in English or Polish). All additional lesson plans will be available on our website **www.photonrobot.com** in the **Education** tab.

We wish you fruitful play with Photon and lots of smiles on your children's faces!

The **Photon** team



PRINTABLE PDF ATTACHMENTS AVAILABLE
AT: www.photonrobot.com/lesson_plans/



The approach is important!



We know that not every child will become a programmer, but the knowledge of technology will help children in their adult life and future career.



Programming develops logical thinking and teaches creativity and how to find solutions to problems.



Programming is not the goal we are pursuing. It is a tool that we want to use in children development.

Realise the full potential of your Photon!
The only limit is your imagination and imagination has no limits...

1. Light sensor

Photon can distinguish between light and dark!

2. Touch sensor

Touch Photon's forehead and it will feel it..

3. Range sensor

Photon detects obstacles up to 100 centimetres away!

4. Communication with other robots

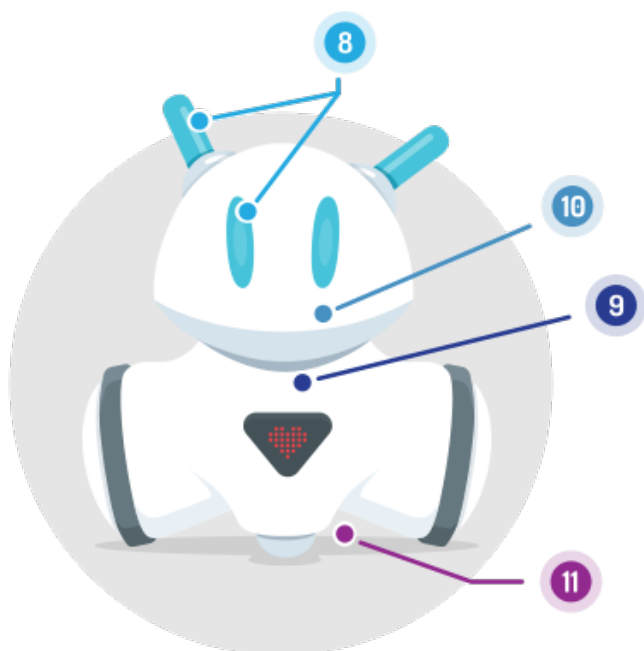
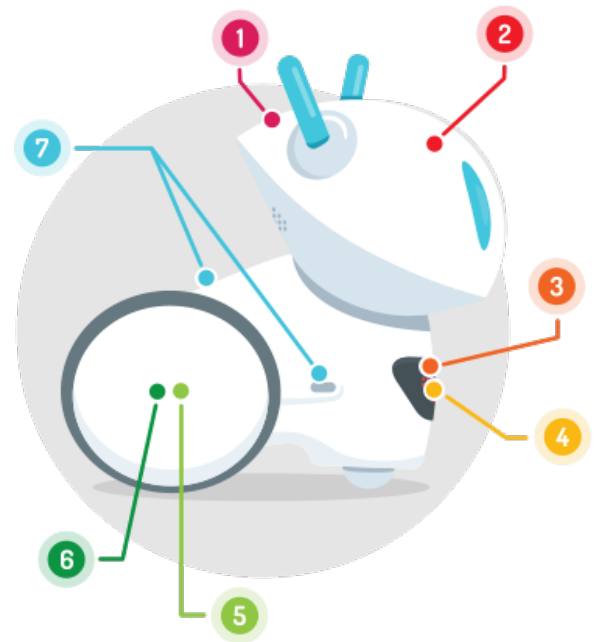
Photon is able to communicate with other Photons.

5. Distance measure

Photon measures the distance travelled in centimetres.

6. Angle measure

Photon can also rotate with very high accuracy.



7. Magnetic attachments

Additional accessories increase its abilities.

8. LED backlit eyes and antennae

Photon can change the colour of its eyes and antennas, independently!

9. Speaker

Photon communicates in its own, emotional way.

10. Sound sensor

Reacts to loud sounds such as clapping, stomping or shouting..

11. Surface contrast sensors

Using four contrast sensors, Photon detects the colour of surface it moves on..

Dear teacher,

All scenarios presented in this publication are based on an educational mat with a checkerboard. In order to help you prepare scenarios we have designed a dedicated educational mat with this pattern. This educational mat is available for sale on our website: <https://photonrobot.com/product/education-mat/>



Graphics on the mat have a universal meaning and were designed to help you with the scenarios. In many cases the images on the mat could help you create your own additional scenarios without the need to print out separate placeable icons. This mat gives you many possibilities, allows using symbols, colors, directions, illustrations, and coordinates in your scenarios.

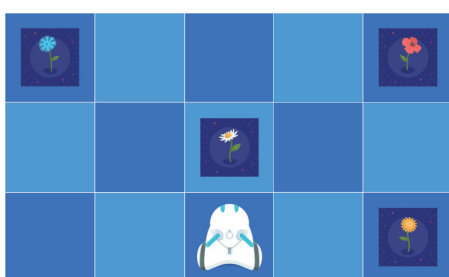
Scenarios presented in this publication were designed with a 4x6 mat in mind. Attachments in the sample scenarios are only guidance on the mat size, and are to help indicate the number of required fields and how to spread the attachments.

Sample:

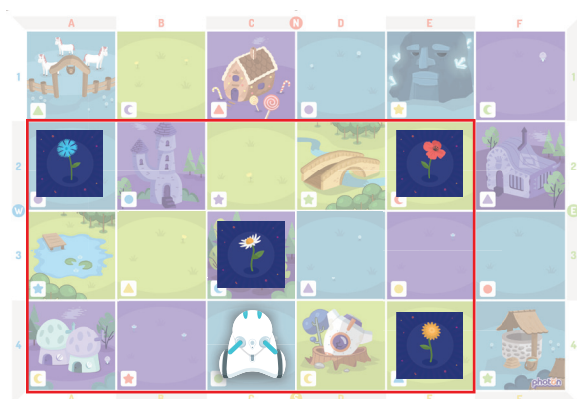
BOUQUET FULL OF FLOWERS

„Teacher (...) **Lay down the educational mat and place icons of previously discussed flowers.** Ask children to create flower bouquets to brighten up the room.”

MAT IN THE SCENARIOS



THE DEDICATED MAT



ACCESS CODE - LEVEL C:



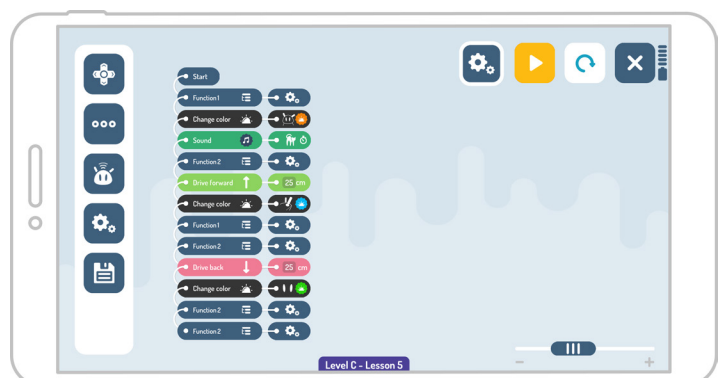
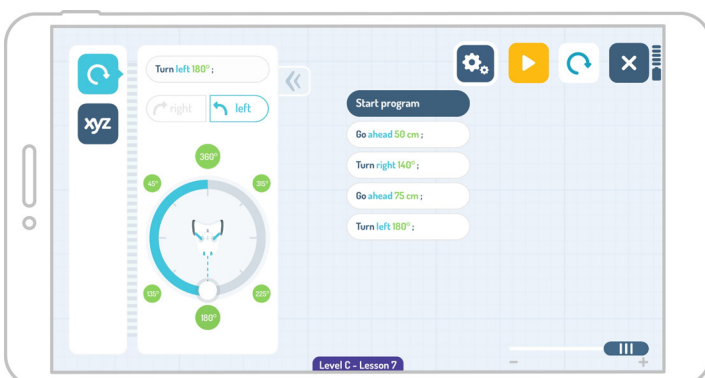
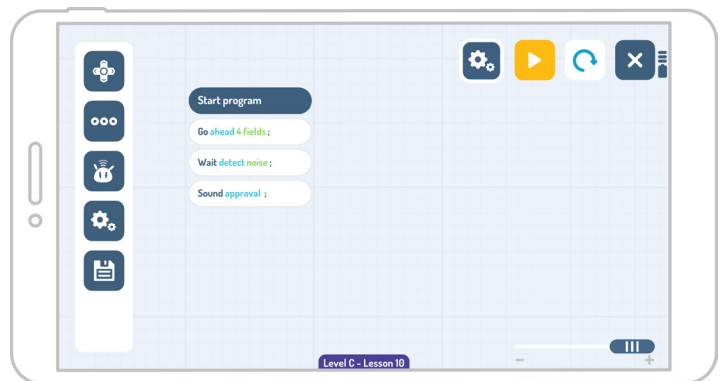
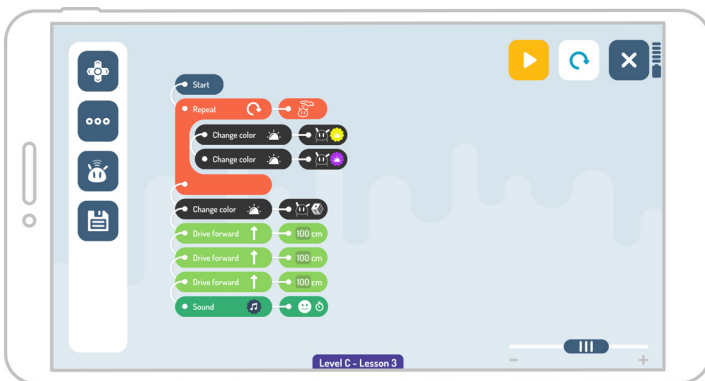
LEVEL C

Level C was developed using the most advanced of the available **Photon Blocks** and **Photon Code** programming interfaces. It is suitable for pupils in P3 onwards.

At this stage, the children will become familiar with the basics of creating code similar to programming in a console. By using the “pseudo-code”, they will learn the concept of variables, increment and decrement operations, advanced program progression or dependence of program components on external conditions around Photon.



Good luck!



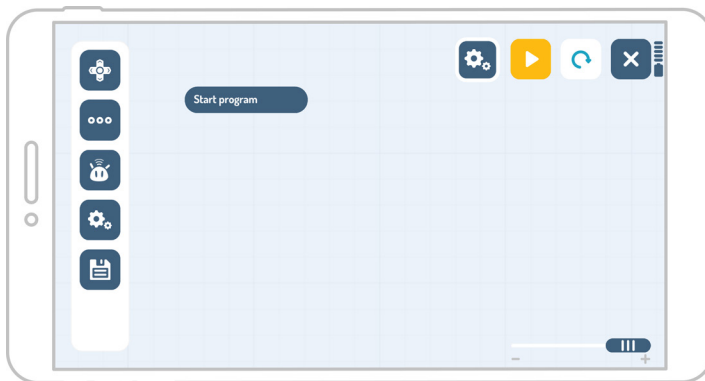


PHOTON CODE

Photon Code is intended to be an introduction to the world of “real programming”. The programming interface is in English and simulates the classic look of a coding console. The children can arrange ready text blocks in order to create their own programs.

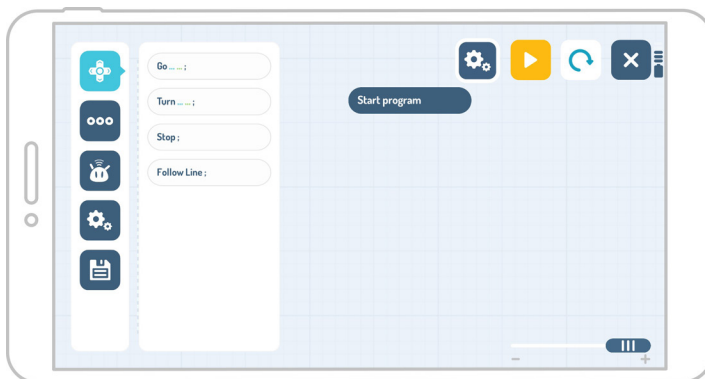
Presented activities help children to:

- Understand the structure and syntax of the real programming code,
- Develop analytical skills,
- Understand complex algorithms.



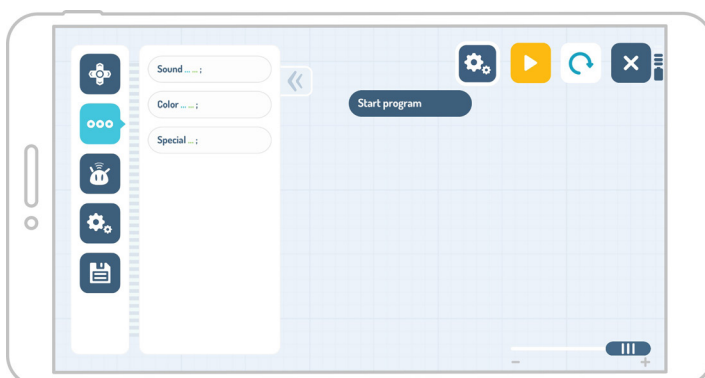
Main Screen

The concept of programming is simplified to moving blocks with instructions and arranging them in a sequence below the first block “Start”. The whole programming interface is in English.



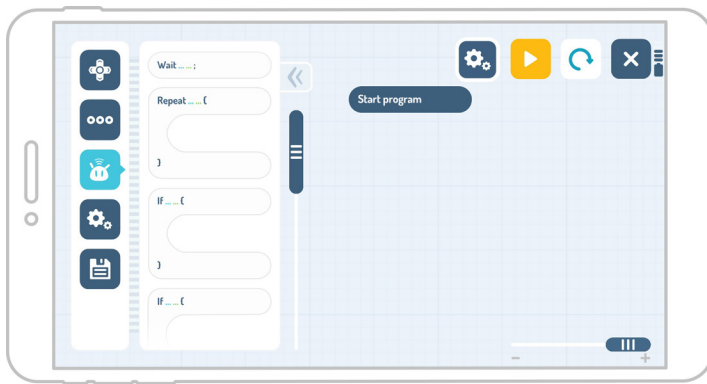
Movement

This category contains the blocks necessary to program the robot's movements.



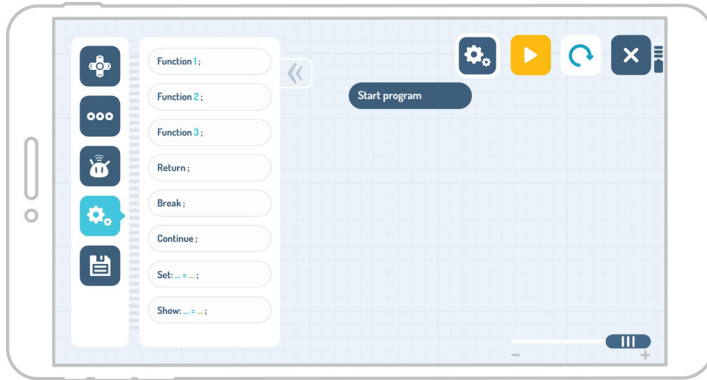
Actions

This category contains blocks allowing Photon's ears (antennae) and eyes to change colour and for Photon to make sounds.



Interactions

Blocks from this category allow for robot interactions with the surrounding environment.



Special features

Here you can find special programming features, such as adding functions.



Program saving

Options on this screen allow you to save created programs. The program is being saved continuously if the application is installed on the device.



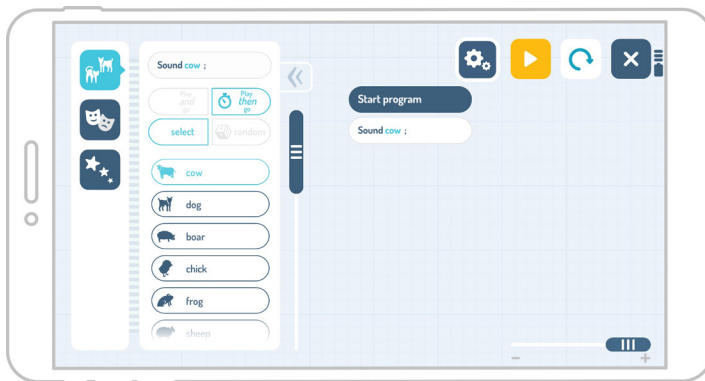
Go

Here you can choose whether the robot should move forwards or backwards. You can also define a specific moving distance (cm, infinity, number of fields, variable).



Turn

Here you can choose a direction in which the robot should turn: right or left, and the angle of that turn.



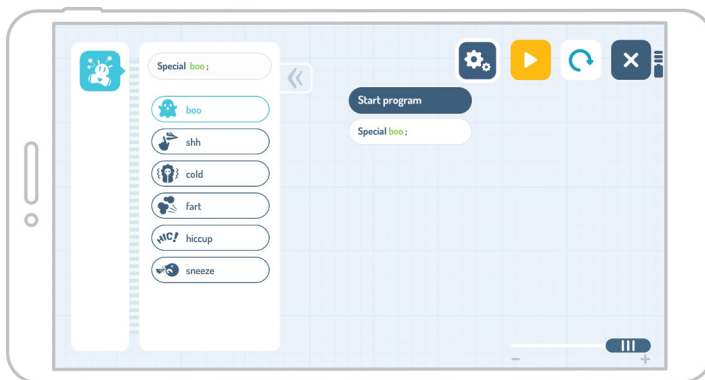
Sounds

Sounds can be played during execution of the next command or after a short pause, i.e. the robot can wait to perform the execution of the next command until the end of a played sound.



Colors

Options on this screen give you a chance to randomly draw colours, for example you can select the “dice” and then specify a range of colours for Photon to randomly pick from.



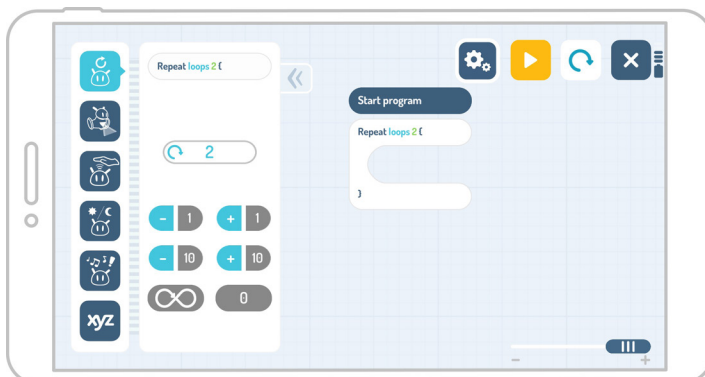
Special actions

Here you can select special robot behaviours, which might prove useful during creative programming. For example – sneezing.



Wait

As explained in the previous interface, the robot waits for a specific action, e.g. stroking, and then performs an action specified by the block.



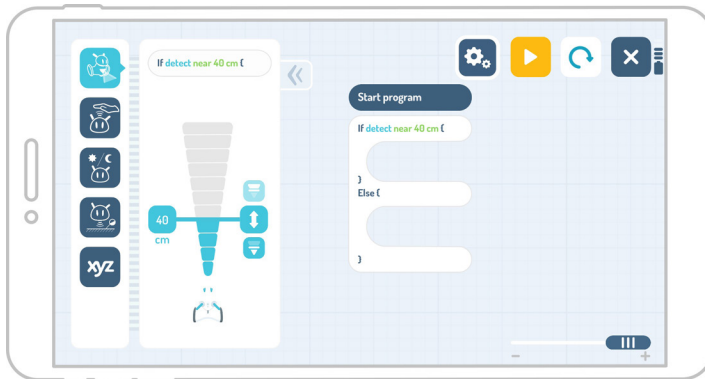
Repeat

The robot repeats a given operation as many times as specified or repeats it until it detects a trigger signal from one of the sensors specified in a program. Additionally, in this interface we introduce variables, e.g. the robot repeats a given activity until $x < 4$.



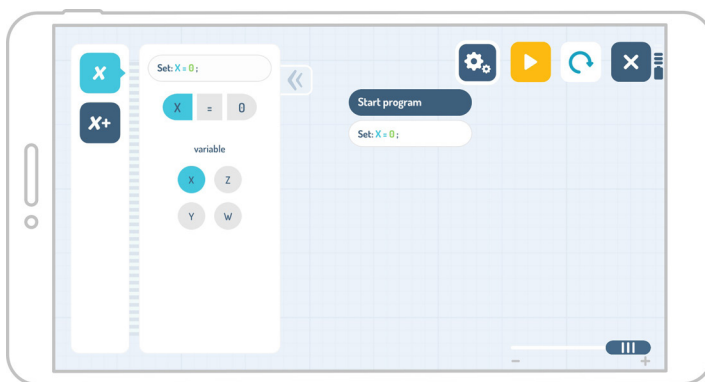
If

A command triggering a single check of input signal on a specified sensor. If a triggering signal is detected, the robot performs an action specified by a block. If not, the robot skips this command. Variables could prove useful here too, e.g. If $x < 3$, go forward.



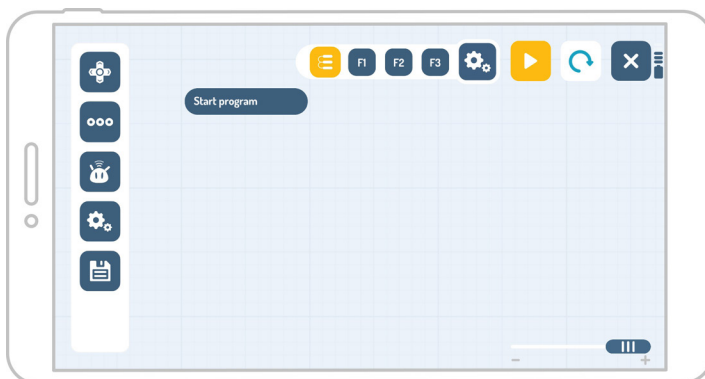
If / Else

There are 2 options to choose from, e.g. if the touch sensor receives a signal (a touch), the robot will change its colour. If it does not, the robot will make an audible sound.



Variables

Photon can count and the If program makes use of variables. You can set values of x, y, z and change them (increase or decrease) with the use of sensors, e.g. $x = 0$, but if you pat the robot on the head, then $x = x + 2$. Each time you pat the robot on the head, the value of x increases by 2.



Functions screen

The first square icon at the top is linked to the main window.

F1 takes you to the screen where you program Function1. F2 takes you to the screen where you program Function2.



Subject: The Photon Lottery. Photon Blocks.

Aims:

- To consolidate knowledge from various subjects thought at school (maths, history, biology),
- To learn the rules of team work with elements of gamification,
- To master the skill of random color drawing by Photon,
- To introduce the concept of probability.

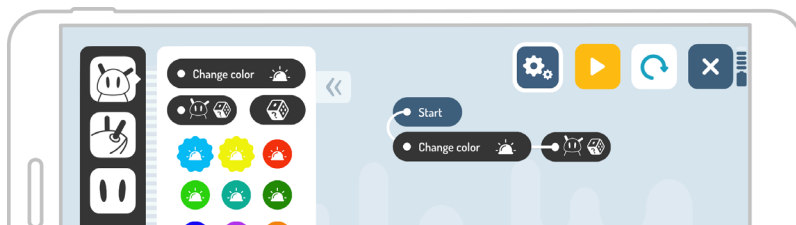
Educational aids:

- Photon the Robot,
- Tablet,
- Educational mat,
- 3 color-marked bags with questions,
- Printed questions from various categories.

Sample scenario:

INTRODUCTION

Lay down the educational mat and put control cards on several selected fields. Divide the group of children into two teams. Attach three different colour labels to the bags with questions. Present new features of Photon, i.e. changing colours of its ears and eyes using the random draw method. Then explain the rules of the game.



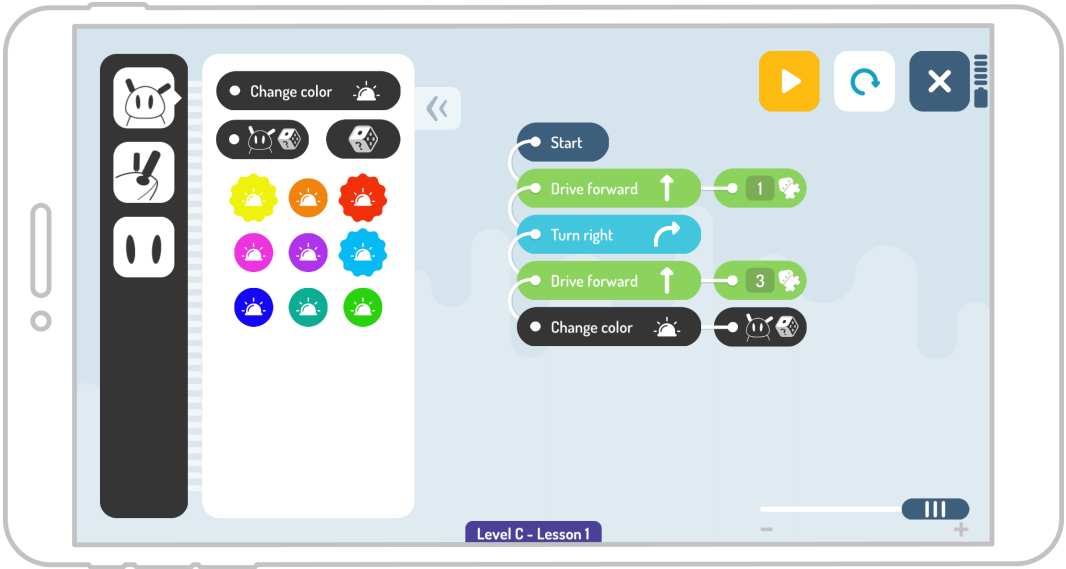
PROGRAMMING

The first child from team #1 indicates a field for Photon to drive to. The second child from the same team programs the robot so that it drives to the indicated field. The main aim of this task is to program the robot so that it reaches the field indicated by the child and to choose a colour for one of the three bags i.e. yellow, blue or red. Each bag contains questions from a different category e.g. red = maths, blue = biology, yellow = history. Once ready, one of the children runs the program. Photon picks a random colour. Then, the next child from team #1 picks a question from the corresponding bag, i.e. marked with a colour chosen by Photon. If the team provides the correct answer to the question, you will award a point and take the control card off the mat. The teams program alternately, one after another.

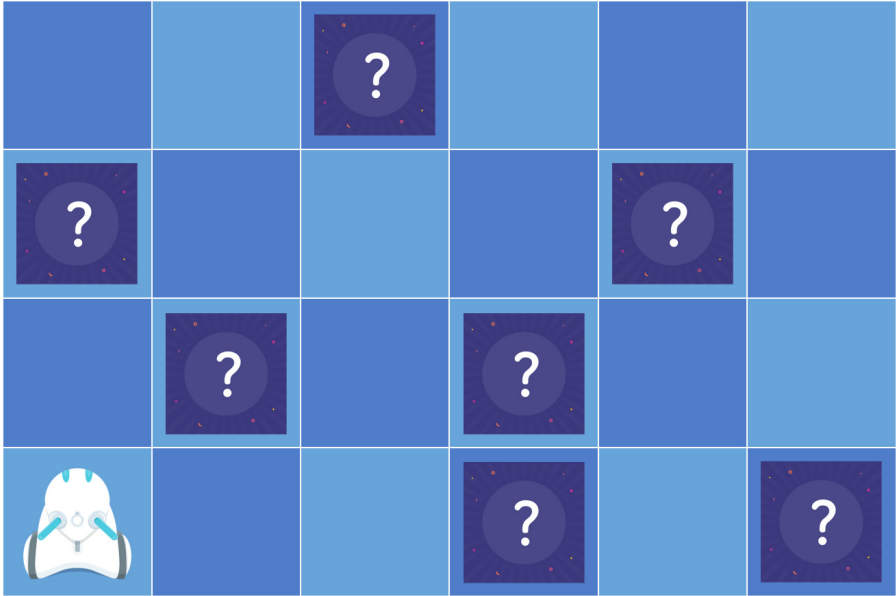
CONCLUSION

At the end of the game, add up the points for each group. The team with the most points wins the game.

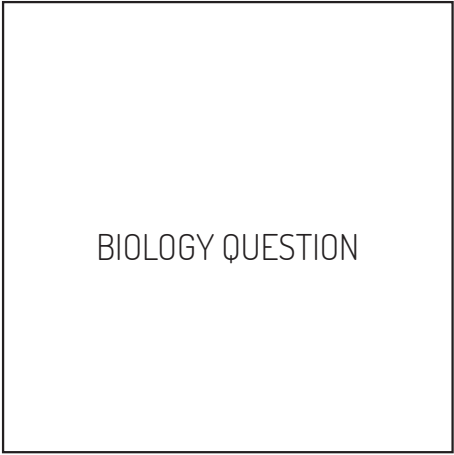
Sample program:



Attachments:



On the other side of the card there is a place for teachers to enter questions





Subject: Learning about angles with Photon. Photon Blocks.

Aims:

- To consolidate knowledge on recognizing and drawing angles,
- To learn how to measure distance and angles,
- To learn how to correctly use geometry equipment,
- To develop spatial imagination.

Educational aids:

- Photon the Robot,
- Tablet,
- A4 sheets of paper,
- Colored pencils,
- Measuring tape / ruler,
- Large triangle (set square).

Sample scenario:

INTRODUCTION

Divide the children into teams of 3. Ask them to prepare drawings of places Photon would like to visit, i.e. house, school, shop, etc. Each team should prepare one drawing. Once done, place the drawings on the floor in any order.

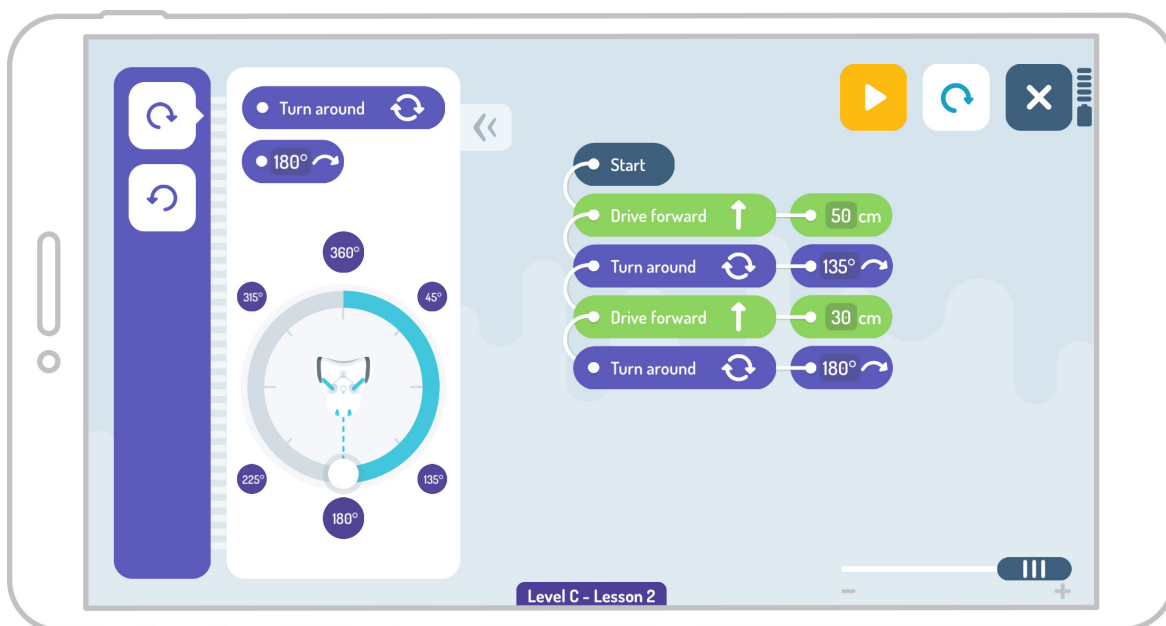
PROGRAMMING

Ask the children to measure distances and angles between drawings using a measuring tape and a triangle. This way the children will try to find out by what angle the robot has to rotate in order to reach all the places. The main aim of this task is to lead Photon from the first to the last drawing. Each team is responsible for programming a different part of the route.

CONCLUSION

When Photon reaches a place on the route, ask the children whether Photon likes this place and why.

Sample program:





Subject: Mathematical games with Photon. Photon Blocks.

Aims:

- To develop analytical thinking,
- To improve mathematical skills,
- To learn how to work in a team,
- To introduce the concept of loop in programming.

Educational aids:

- Photon the Robot,
- Tablet,
- Mathematical tasks.

Sample scenario:

INTRODUCTION

Divide the children into two teams. Explain the rules of the game.

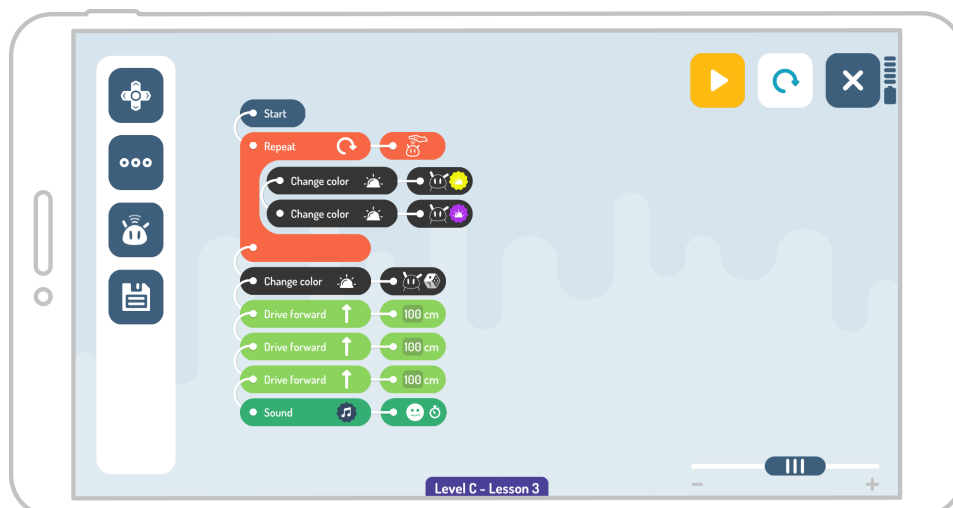
PROGRAMMING

Ask the teams to perform the assigned tasks alternately, one after another. Tell child #1 to program Photon to keep changing colours when it feels a hand on its head (touch sensor). When the hand is taken off, the robot has to choose one colour randomly from blue, green, red or yellow, drive 300 cm forward and make a sound. In this scenario child #2 holds their hand on the robot's forehead while child #1 runs the program. After a while, child #2 has to take their hand off the robot and check the colour Photon has chosen. Knowing this colour, the child should go to the table with 20 mathematical tasks spread on it, e.g. $2 \times 2 =$, $100 - 92 =$, $12 / 3 =$. If Photon draws blue, ask the child to collect all tasks, where the result is 5, if yellow, the child should collect all tasks where the result is 4, if red: 6, if green: 8. When the time is up, Photon plays a programmed sound. Check that the answers to the tasks brought back by the child are correct.

CONCLUSION

Points are assigned for each correct answer brought back. Only then can teams swap their roles. Continue until all children have participated in the game.

Sample program:





Subject: Explore the Solar System with Photon. Photon Blocks.

Aims:

- To learn about planets and their order in the Solar System,
- To learn the correct order of mathematical operations and how to use basic mathematical tools,
- To learn how to work in a team,
- The learn how to use conditional instructions in programming.

Educational aids:

- Photon the Robot,
- Tablet,
- Images of planets,
- Pieces of paper with mathematical tasks focused on correct order of operations.

Sample scenario:

INTRODUCTION

Divide the children into 4 teams. Explain the rules of the game. Provide each team with 2 images of planets with their names and 2 paper sheets with mathematical tasks.

After solving each mathematical task, the children put down the tasks in one place on the floor. Ask them to arrange them in ascending order, by results, and to match each one with one planet in the Solar System in the correct order. Using a measuring tape, the children should space out the images of the planets on the floor according to set distances (results of their calculations).

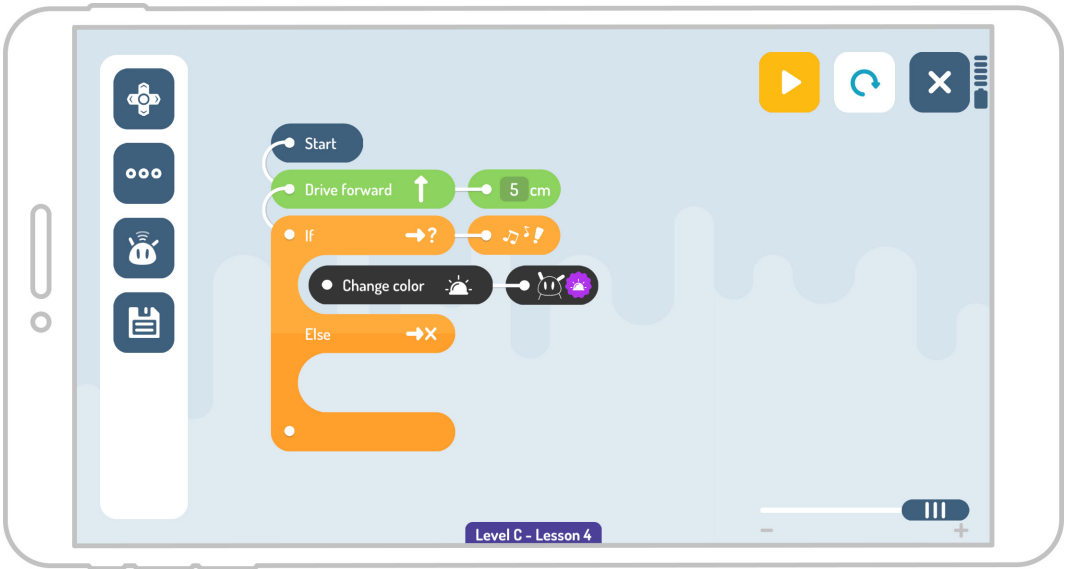
PROGRAMMING

Then ask the children to program the robot's route so that it stops by each planet. They have to apply calculated distances. When reaching the planets, Photon has to use the sound sensor and change colour, e.g. if Photon hears clapping, it will change the colour of its ears. In this example, you can teach the children to recognise different types of numbers. If the distance between the planets is an even number, the children clap their hands when the robot reaches one of the planets. If the travelled distance is an odd number, the children do nothing.

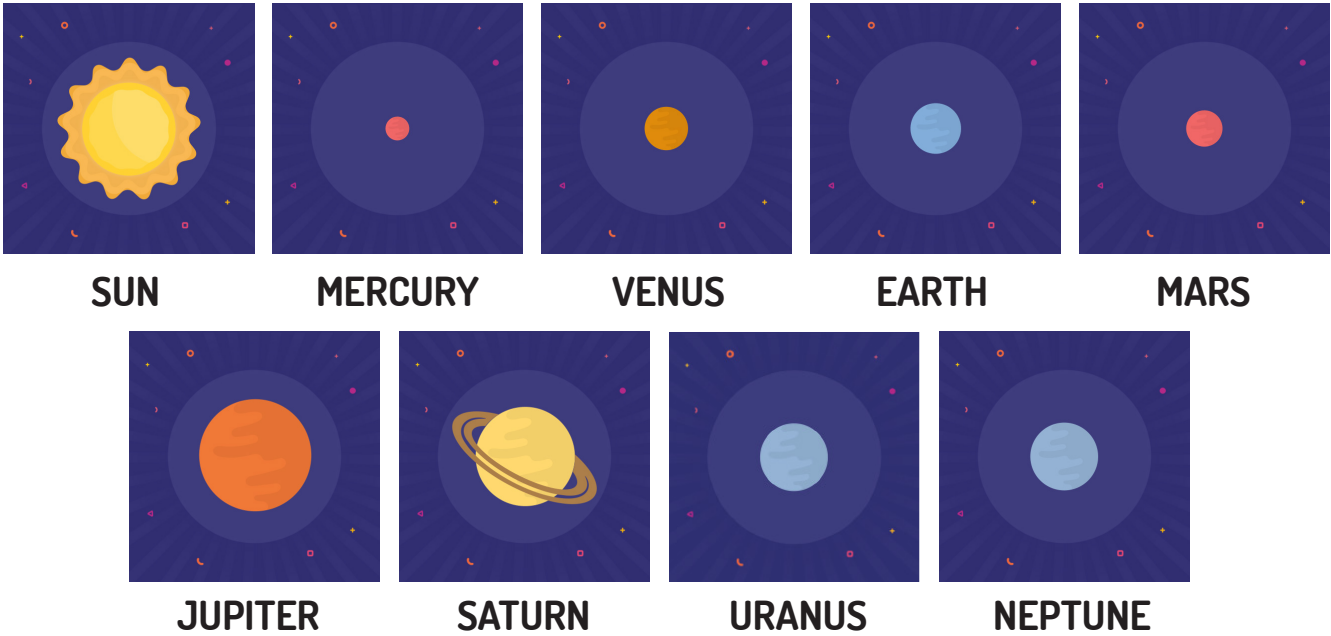
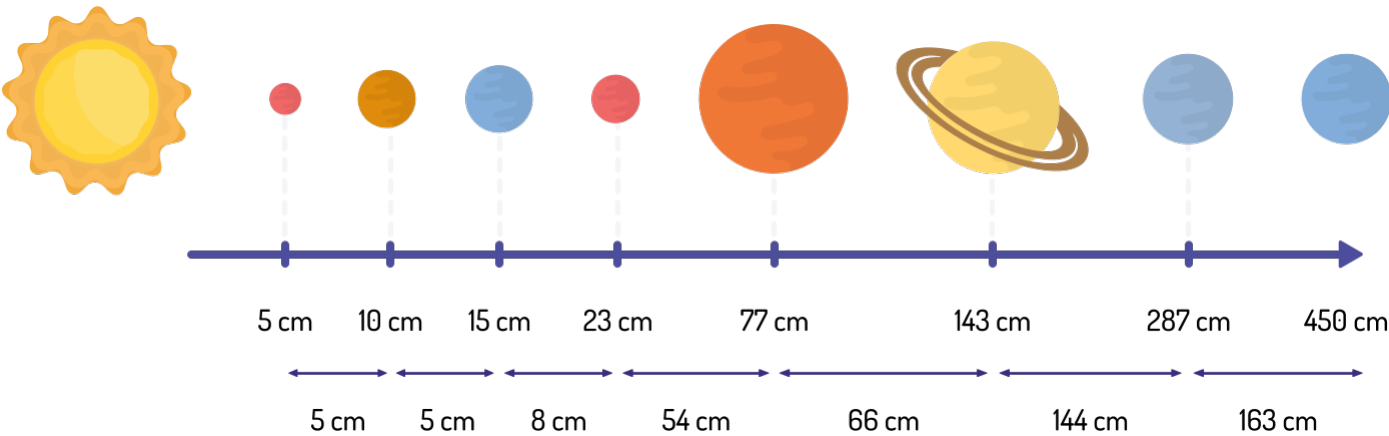
CONCLUSION

At the end of the lesson, the children create their own programs, which consist of "if...else..." blocks.

Sample program:



Attachments:





Subject: Optimizing code with Photon. Photon Blocks.

Aims:

- To develop analytical thinking,
- To learn how to work in a team,
- To learn code refactoring ,
- To learn how to use functions in programming.

Educational aids:

- Photon the Robot,
- Tablet,
- Program you have prepared in advance.

Sample scenario:

INTRODUCTION

Explain the new Photon programming feature – a function. Then present them an extremely long program. The main task here is to make the sample program as short as possible using the new feature – a function. Divide the children into teams. Ask each team to find a way to shorten the sample program.

After a specified time, ask each team to explain their simplified solutions. After all presentations, the class should talk about the best ways to shorten the code even further.

PROGRAMMING

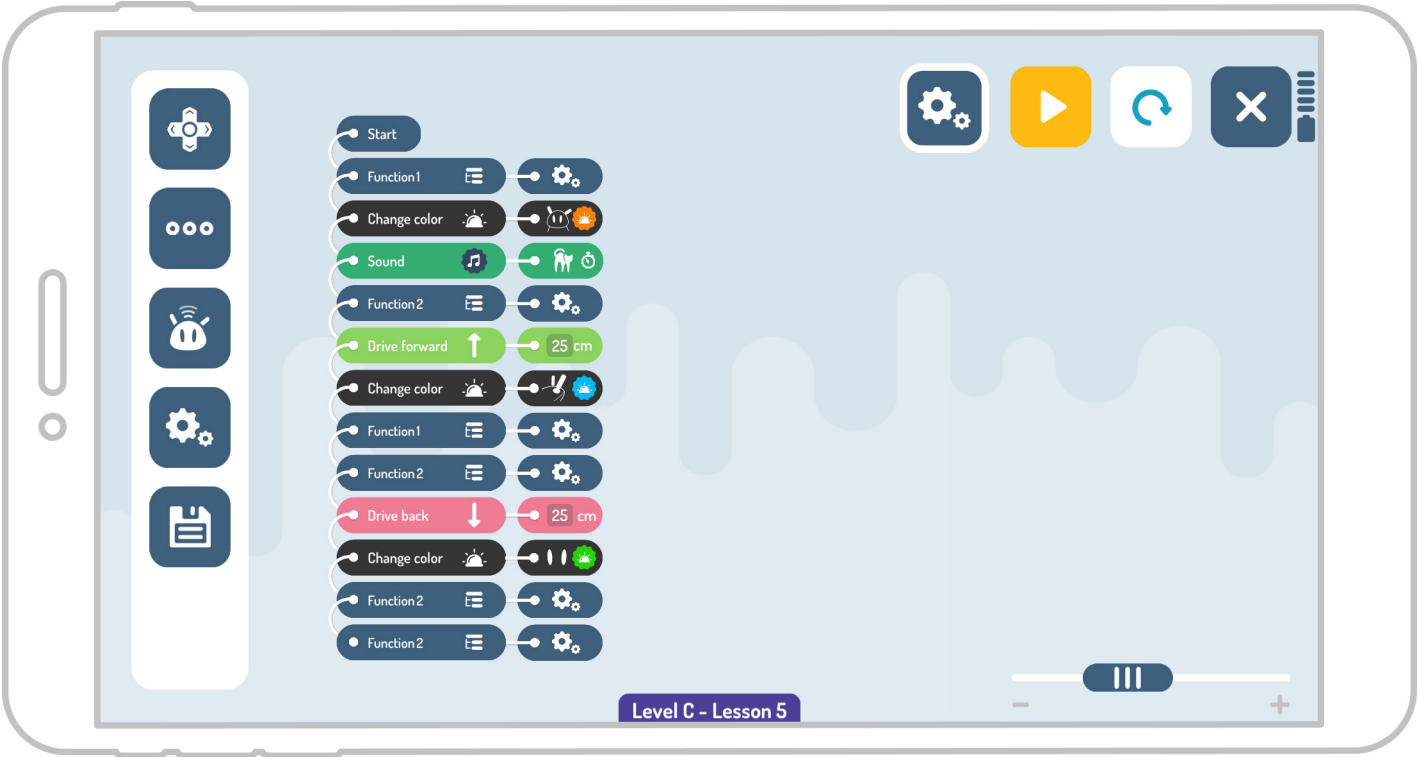
Select one child to enter the long sample program without modifications and to run it twice. Then, each team should input their own simplified program. The class must verify that the entered program contains all of the elements of the long program on the board.

The teams should present their programs to the class one after another.

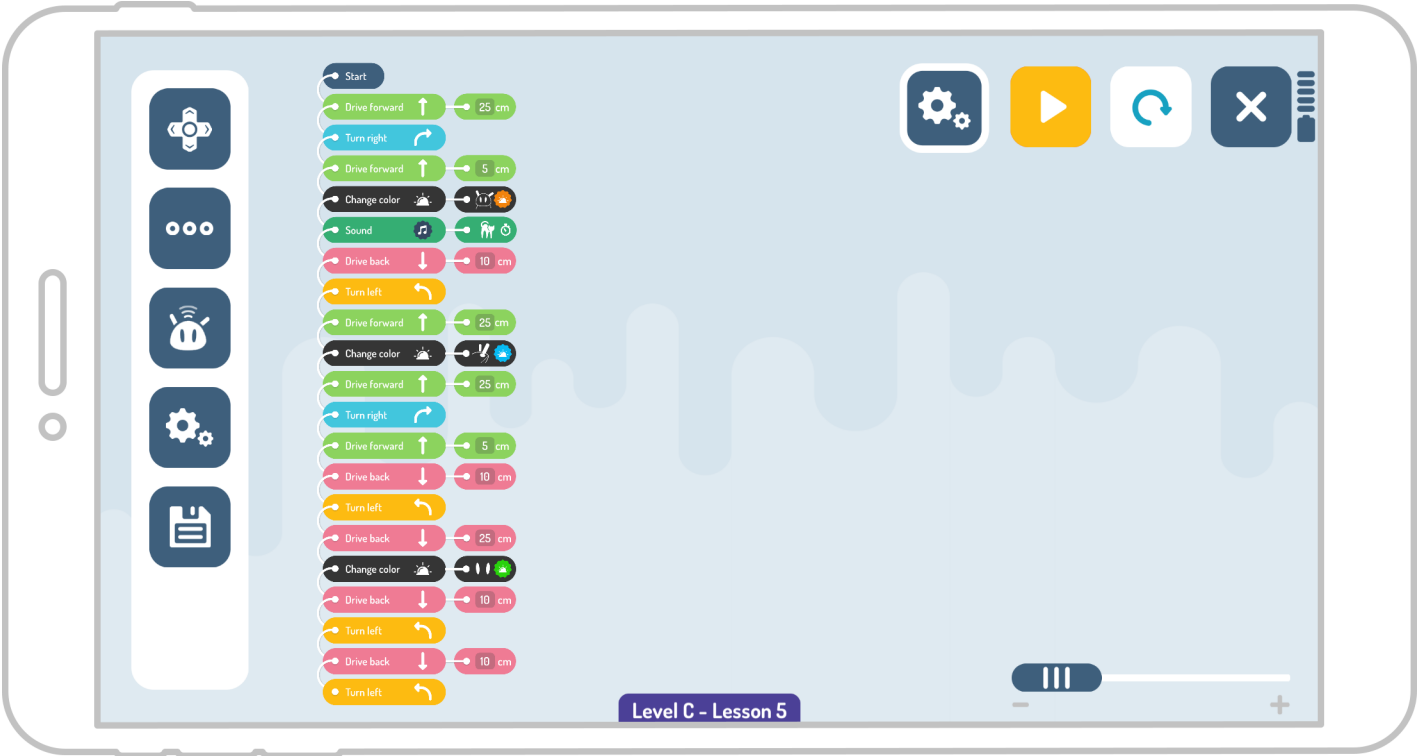
CONCLUSION

At the end of the lesson, the children give real-life examples in which simplification may be useful.

Sample program:



Attachments:





Subject: Storytelling with Photon. Photon Blocks.

Aims:

- To learn new vocabulary and correct sentence constructions ,
- To increase creativity and imagination,
- To learn rules regarding story building,
- To learn how to work in a team,
- To learn how to modify conditional instructions and use functions in programming.

Educational aids:

- Photon the Robot,
- Tablet,
- Adhesive tape,
- Signed straws with: a place, time period, characters etc.,
- A4 sheets of white paper,
- Colored pencils.

Sample scenario:

INTRODUCTION

Explain the rules of using blocks with functions “return” and “break”. Divide the class into 3 teams. Use adhesive black tape to create a line (robot’s path) on the floor.

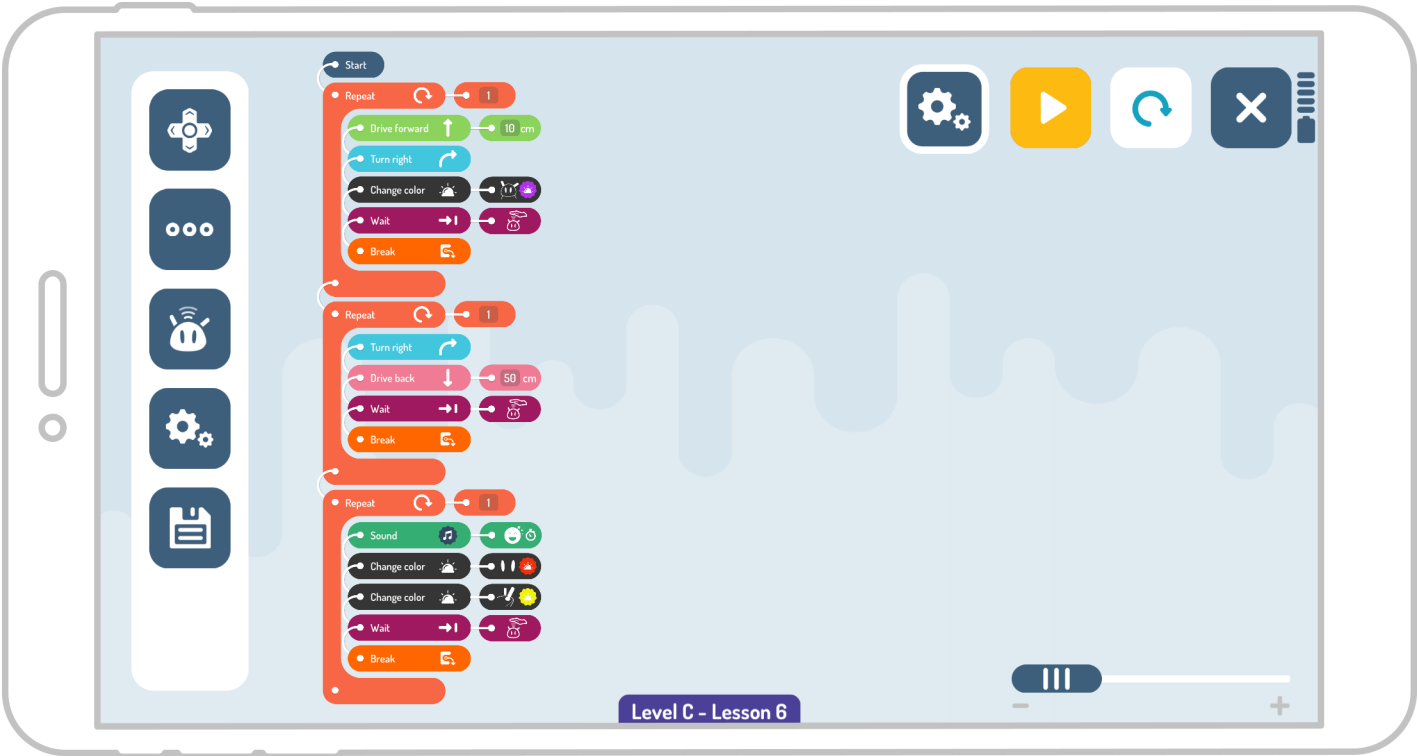
PROGRAMMING

Ask the children to prepare a short story about the robot. The children should create a program that will help them to present their story. Each team has to prepare a story and write it down. Tell the children to draw straws with story settings assigned to them, e.g. place, time, main characters, etc. Next to the path on the floor, place sheets of paper with the children’s drawings, i.e. their story backdrop, e.g. place – space, time – year 2193. The route should be divided into 3 parts to represent the introduction, the plot and the conclusion. Each part should be included in the programming loop. To exit the loop, add the “wait for the touch” instruction. Photon may stop on the way, change colours, respond to sounds, etc. Each team presents one story.

CONCLUSION

At the end of the lesson, the children indicate a route and test the capabilities and limitations of the robot.

Sample program:





Subject: Photon Code – advanced programming with Photon.

Aims:

- To learn how to work in a team,
- To introduce text-based programming interface,
- To learn basics of programming language.

Educational aids:

- Photon the Robot,
- Tablet,
- Printouts of screenshots,
- A4 sheets of white paper,
- Colored pencils.

Sample scenario:

INTRODUCTION

Attach printed screenshots of Photon Blocks and Photon Code to the board. Show the differences and similarities between the interfaces and explain how the new interface works. Divide the children into 3 teams. Ask them to prepare drawings of places where they would like to take Photon. Each person in each team has to prepare one drawing.

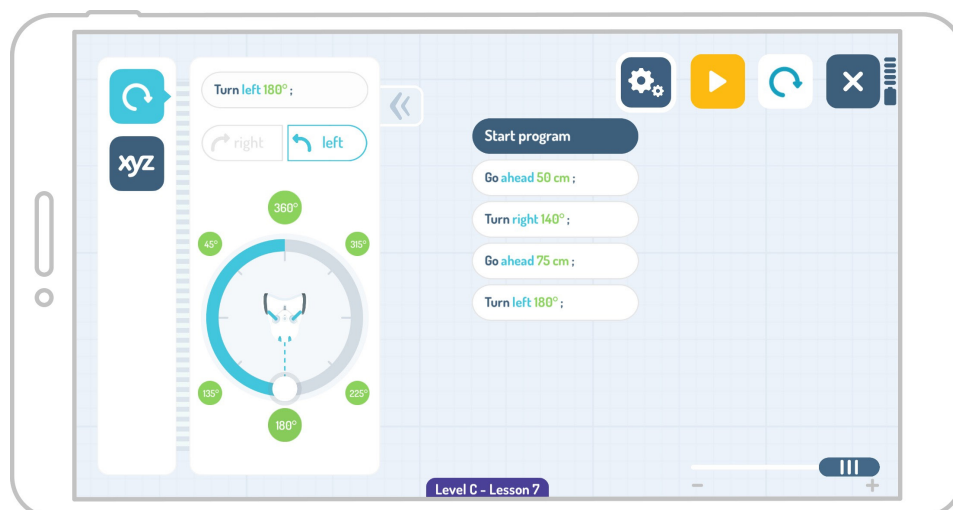
PROGRAMMING

Ask the first team to lay down the drawings on the floor in any order. The next step is to program Photon in such a way that it drives over each drawing. To do this, the children will have to measure the distance between each image. They need to measure angles between images too so that they can program the correct turns. Ask the teams to present their created routes by running their programs. While Photon drives through the path, the children should tell you why Photon would love to visit these locations. Teams should present their work one after another.

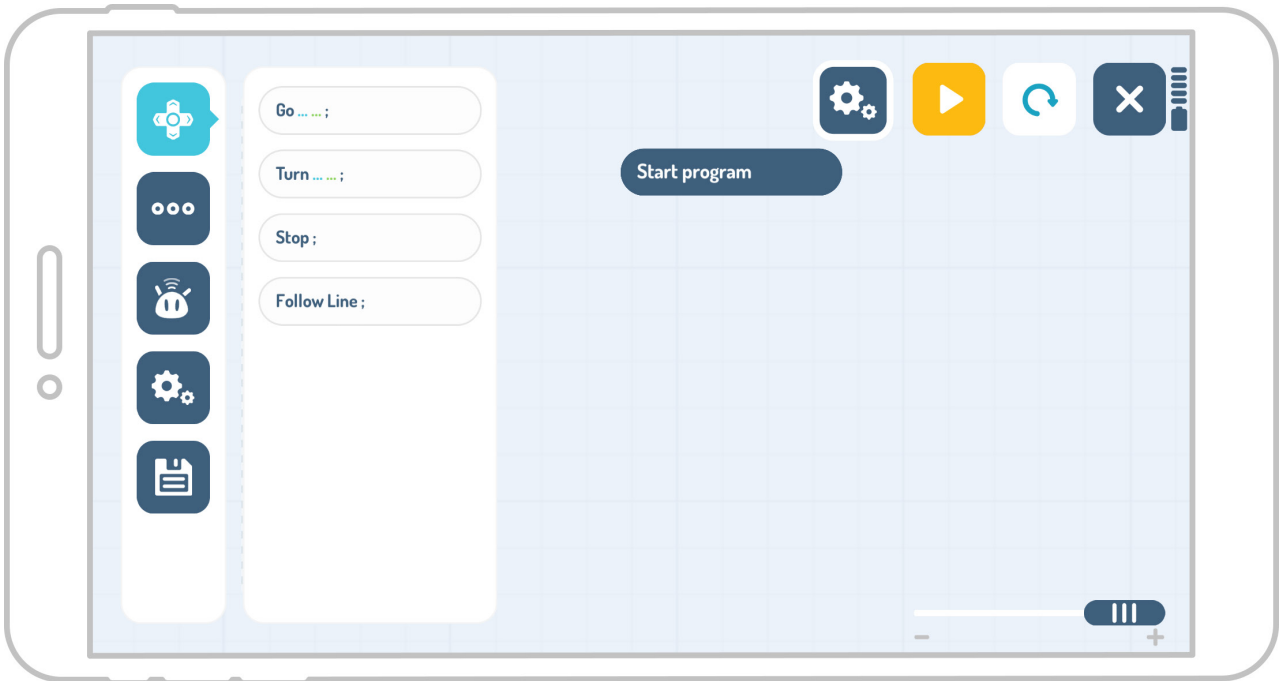
CONCLUSION

At the end of the lesson, the children choose together the most interesting pictures and create a program. Every child adds one block.

Sample program:



Attachments:





Subject: Counting with Photon.

Aims:

- To learn how to work in a team,
- To improve key math skills (counting money),
- To practice reasoning and drawing conclusions,
- To learn how to use mathematical operations in programming.

Educational aids:

- Photon the Robot,
- Tablet.

Sample scenario:

INTRODUCTION

Explain the concept of variables and how to use them in programming. Divide the children into two teams. Assign each team different tasks.

PROGRAMMING

Photon goes shopping. The children's task is to create a program that checks whether Photon has enough money to buy an unplanned purchase – a treat. Each product must be linked to one of Photon's sensors to allow interaction, e.g. stroking Photon subtracts the price of one apple, clapping subtracts the price of one carrot.

Group #1:

Photon has \$22 in the pocket.

Photon has to buy some fruit from the shopping list (3 apples and 4 pears). On the way to the checkout, it sees delicious lollipops. Does Photon have enough money?

The prices for these products are:

One apple: \$2 One pear: \$3 One lollipop: \$3

Group #2:

Photon has \$23 in the pocket.

Photon has to buy vegetables from the shopping list (3 carrots and 5 tomatoes). On the way to the checkout, it sees delicious chocolate muffins. Does Photon have enough money?

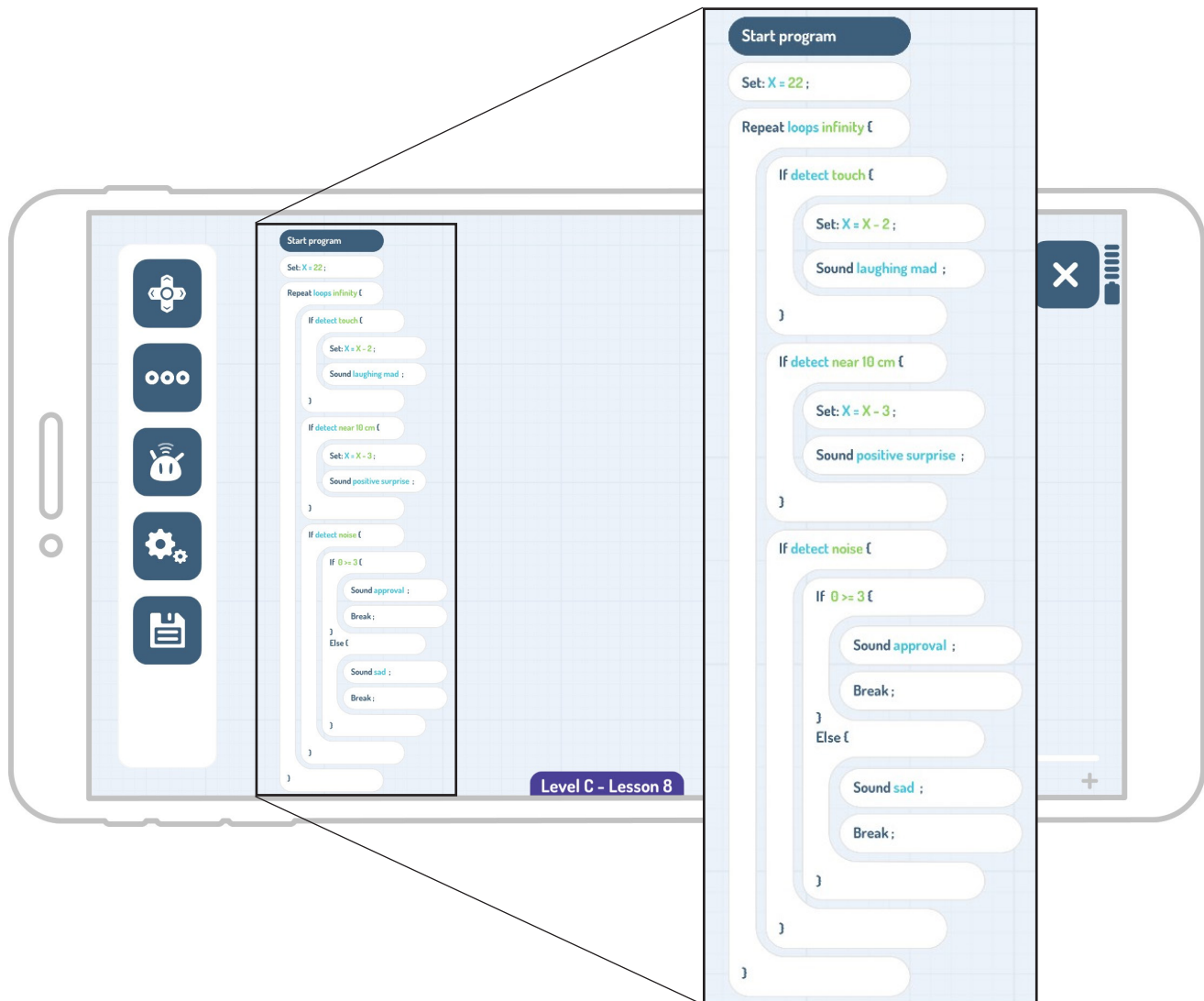
The prices for these products are:

One carrot: \$2, One tomato: \$3, One muffin: \$3

CONCLUSION

Finally, the children change the data in the program and test various cases, for example, Photon buys 4 apples and 1 pear, etc.

Sample program:





Subject: Photon awards points.

Aims:

- To learn how to work in a team,
- To develop analytical thinking,
- To improve mathematical skills,
- To consolidate knowledge on how to use mathematical operations in programming.

Educational aids:

- Photon the Robot,
- Tablet,
- Educational mat.
- 4 control cards (numbers from 1 to 4)

Sample scenario:

INTRODUCTION

Place the dedicated educational mat and 4 control cards on several selected fields. Divide the children into 3 or 4 teams.

PROGRAMMING

Ask the children to program the robot in such a way that it drives over to the control cards (where the children will receive a mathematical task to solve, e.g. $17 + 23 = ?$). At each control card, Photon has to wait 10 seconds and check its touch sensor. If the children solve the task correctly, they will put a hand on Photon's head. This action should add 10 points to their score and the robot should emit a sound of approval. If Photon does not detect the touch, it drives to the next field.



Note: If the task is solved correctly, tell the children to keep their hand on the robot's forehead until it makes a sound.

CONCLUSION

At the end, Photon should add up all rewarded points. If all tasks were solved correctly (max number of points), Photon should make a sound of joy.

Sample program:

Program part I

The image shows a Scratch-like programming interface. On the left, a vertical toolbar contains icons for a cursor, a palette, a robot head, a Wi-Fi symbol, a gear, and a document. The main workspace is a light blue grid. A zoomed-in view of the code blocks is shown on the right. The code starts with a 'Start program' block, followed by 'Set: X = 0;', 'Go ahead 2 fields;', and 'Wait time 10s;'. Then, there is an 'If detect touch {' block containing 'Set: X = X + 10;'. This is followed by 'Go ahead 2 fields;', 'Turn right 90°;', 'Go ahead 1 fields;', 'Wait time 10s;', and another 'If detect touch {' block containing 'Set: X = X + 10;'. The code continues with 'Go ahead 1 fields;', 'Turn left 90°;', 'Go ahead 1 fields;', and 'Wait time 10s;'. At the bottom, a status bar reads 'Poziom C - Zajęcia 9'.

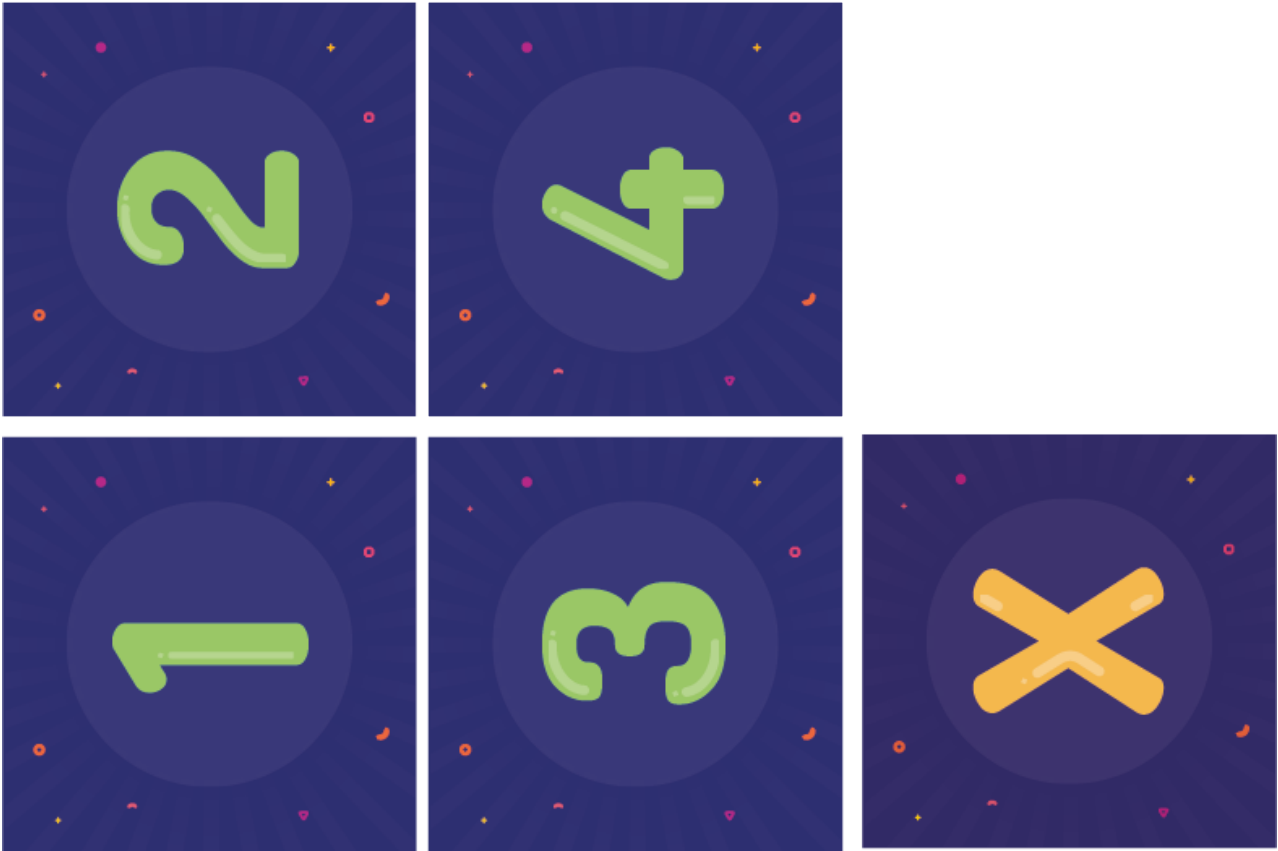
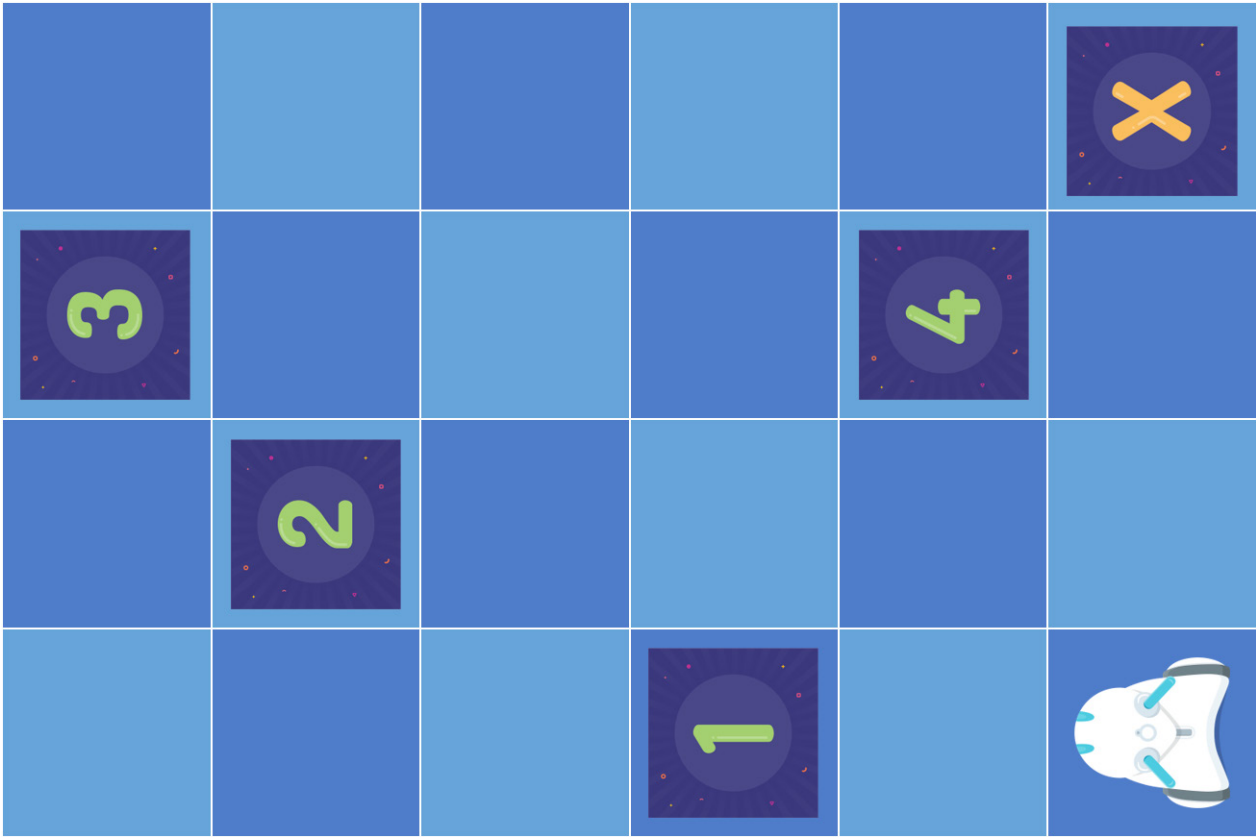
```
Start program
Set: X = 0;
Go ahead 2 fields;
Wait time 10s;
If detect touch {
  Set: X = X + 10;
}
Go ahead 2 fields;
Turn right 90°;
Go ahead 1 fields;
Wait time 10s;
If detect touch {
  Set: X = X + 10;
}
Go ahead 1 fields;
Turn left 90°;
Go ahead 1 fields;
Wait time 10s;
```

Program part II

The image shows a Scratch-like programming interface. On the left, a vertical toolbar contains icons for a cursor, a palette, a robot head, a Wi-Fi symbol, a gear, and a document. The main workspace is a light blue grid. A zoomed-in view of the code blocks is shown on the right. The code starts with an 'If detect touch {' block containing 'Set: X = X + 10;'. This is followed by 'Go back 4 fields;', 'Wait time 10s;', and another 'If detect touch {' block containing 'Set: X = X + 10;'. The code continues with 'Turn right 90°;', 'Go ahead 1 fields;', 'Turn right 90°;', 'Go ahead 1 fields;', and an 'If X == 40 {' block containing 'Sound approval;'. At the bottom, a status bar reads 'Poziom C - Zajęcia 9'.

```
If detect touch {
  Set: X = X + 10;
}
Go back 4 fields;
Wait time 10s;
If detect touch {
  Set: X = X + 10;
}
Turn right 90°;
Go ahead 1 fields;
Turn right 90°;
Go ahead 1 fields;
If X == 40 {
  Sound approval;
}
```

Attachments:





Subject: Crossword puzzles with Photon.

Aims:

- To learn new vocabulary,
- To improve memory and creative thinking,
- To consolidate knowledge on the text programming interface.

Educational aids:

- Photon the Robot,
- Tablet,
- Educational mat,
- Double-sided cards numbered 1-6 with crossword clues on the other side,
- Printed out crossword puzzles,
- Pencils.

Sample scenario:

INTRODUCTION

Lay down the educational mat and place double-sided cards on it. Provide each child with a printed crossword puzzle and a pencil.

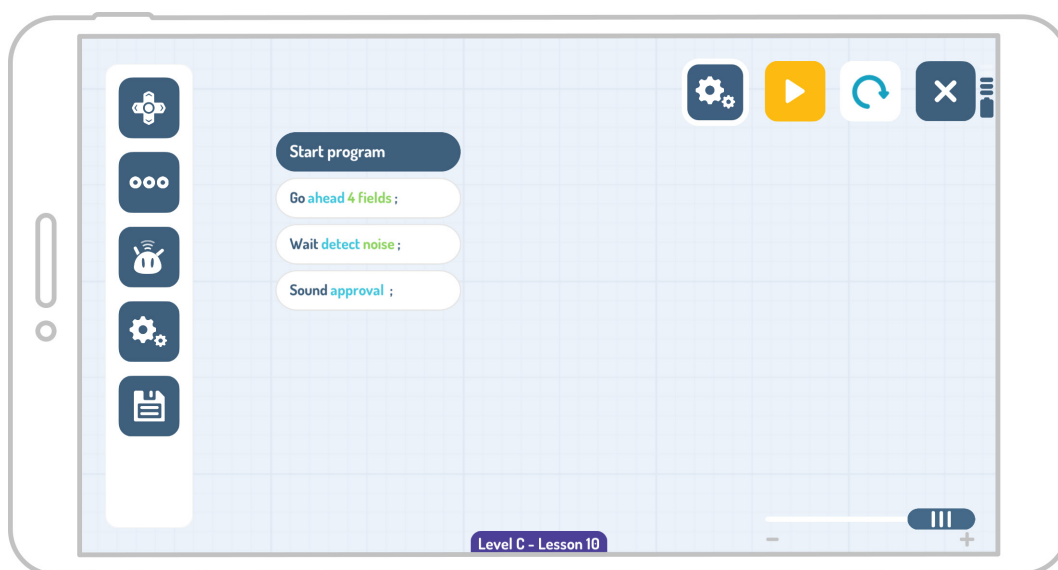
PROGRAMMING

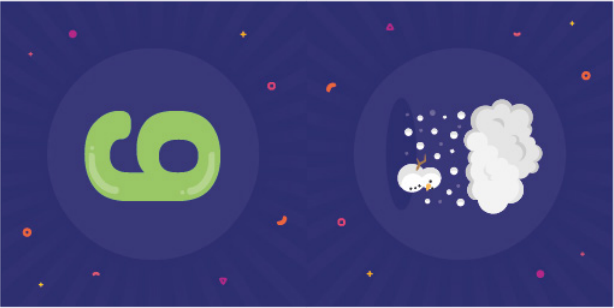
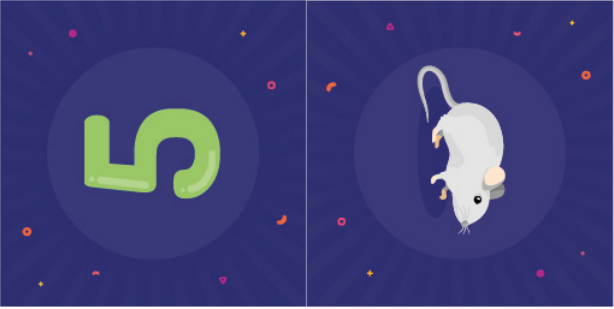
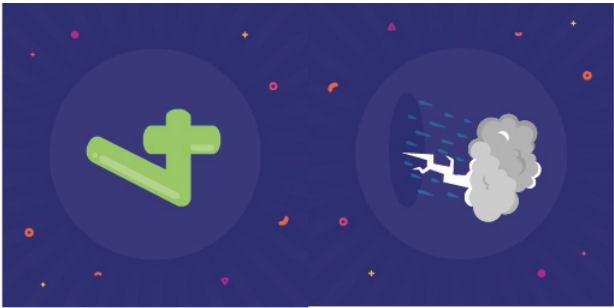
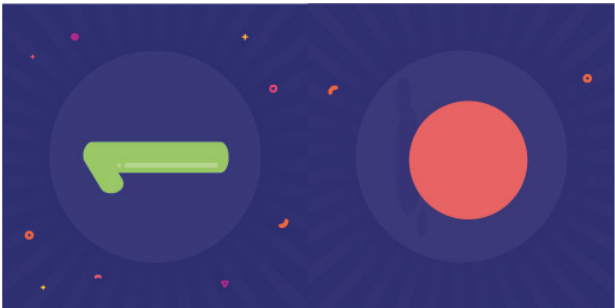
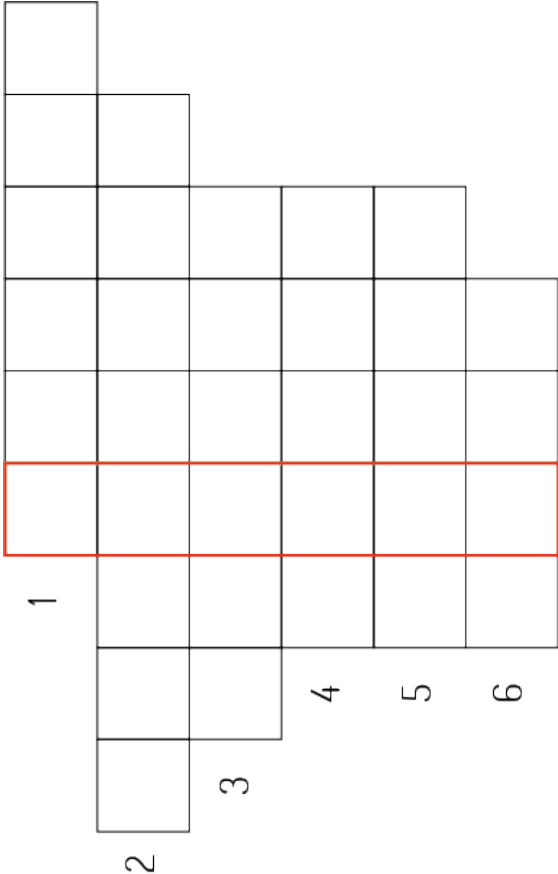
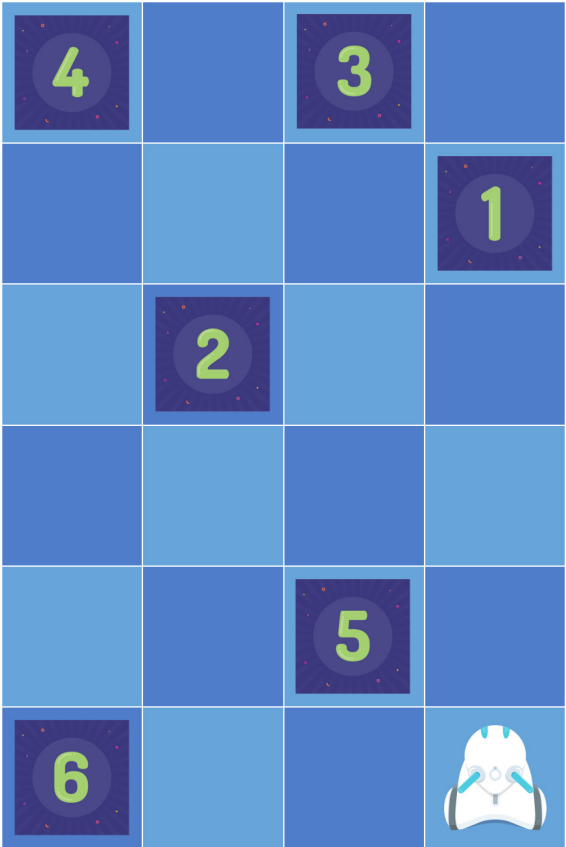
The selected children should program the robot in such a way that it drives to the cards 1-6. Ask the first child to program the robot to drive to card number 1. After turning the card over, the child should provide an answer to the clue. Clues can be in the form of a question or an image. When the child gives the correct answer, ask them to wait for your signal to start clapping their hands. Photon should respond to that with a sound chosen by the programming person. The tablet should be passed to the next pupil. Ask this pupil to program the robot to drive to the next field.

CONCLUSION

After guessing the last correct answer, ask the children to read aloud the final crossword clue.

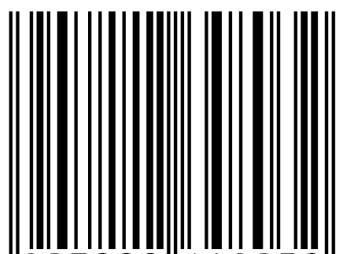
Sample program:







Thank you for learning together!



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