PIAF - Pedagogical Scenario

(PIAF = Développement de la pensée informatique et algorithmique dans l'enseignement fondamental – Development of computational and algorithmic thinking in basic education)

Title

From Wheels to Robots

Practical Information

(Ideal) Number of students: 16
Age of the students: 9 – 12 years
Duration of the scenario: 4 sessions of 45 minutes each

Main discipline of the Scenario

C 3.1 Repeat a sequence of actions a given number of times
C 3.3 Integrate a simple condition into a sequence of actions
C 6.1 Verify if a sequence of actions reaches a given goal

Description

Students will be able to program the basic functions for a Lego robot car to move, steer, stop and use color sensors. Firstly, students are presented with the challenge of controlling the Lego robot by programming. Secondly, students will learn how to program the Lego robot with the color sensors. In the end, students will define, predict, create, and test action sequences for the robot car while completing certain activities.

PIAF-specific competencies/goals

Specific PIAF Competencies:	
C1	Competency 3: Control a sequence of actions > C 3.1 Repeat a sequence of actions a given number of times > Code the robot to go through the traffic light using loop and switch functions
C2	Competency 3: Control a sequence of actions > C 3.3 Integrate a simple condition into a sequence of actions > Code the robot with if-else condition function and if-else-if condition function.
C3	Competency 6: Build a sequence of actions iteratively > C 6.1 Verify if a sequence of actions reaches a given goal > Code to reach a specific goal (using specific functions) and testing the code

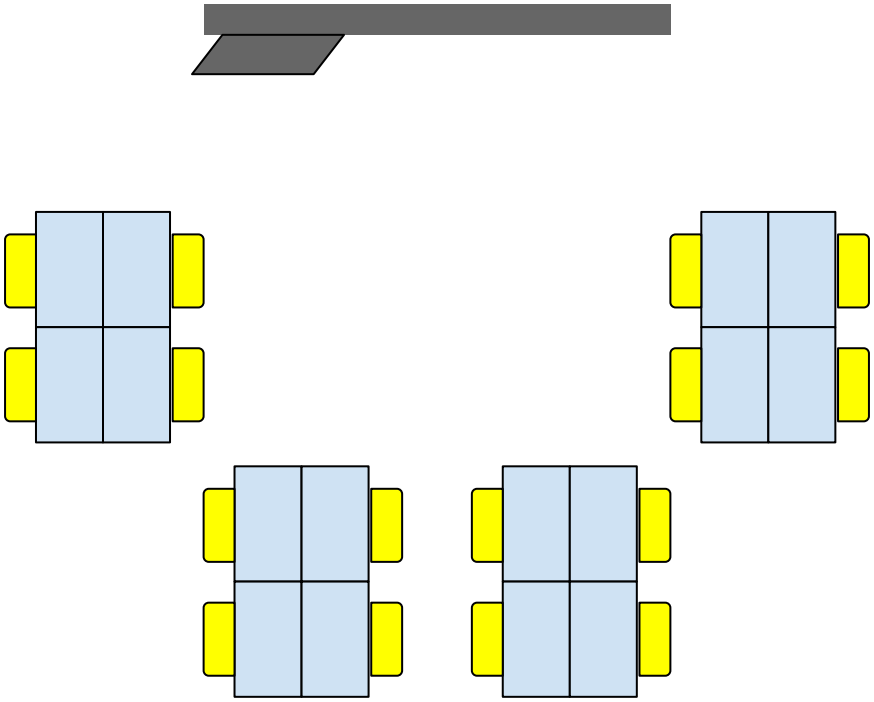
Pre-requisite for the activities

Direction: students could figure our directions, speed.

Digital Resources

Technical	Didactical
3 LEGO® MINDSTORMS® EV3 kits, LEGO® MINDSTORMS® EV3 Home Edition (companion app), projector, computer or tablet for running the EV3 software.	Course notes and attachments

Organization of the classroom



Scenario (Sequence of the activities)

Before the session: Build 3 Drive Bases according to the instruction from Lego Classroom EV3. Instruction is in Attachment.

Activity 1- Get to know about Drive Base Robot.		
1.Introduction - The Drive Base (5')	Group Format: whole class Instruction: "*Today we will be working with robots. Do you know what robots are? This is a Drive Base robot, it's a simplified version of the car. Could you list what kind of moves a car can do?"* Students task: Interact by responding to questions Instructors role: Prompt students to describe the functions of a car. Expected response: Students will name the basic function of the car: move, stop, turn, drift, honk, light on and off	
2. Introduce the item of Drive base (10')	Group Format: whole class Document: Teacher's attachment A (Share the screen to display the video). Instruction: *"Now let's have a close look at a moving car."* Students task: Watch the video and answer the questions. Instructors role: 1.Help students connect the people (i.e. car drivers) with Intelligent Brick. 2.Review the knowledge of speed, direction, and speed differences between two wheels when turning a car.	
3. Briefly introduce the program interface (5')	Group Format: whole class Document: Teacher's attachment B. (Share the screen of the program software) Instruction: *"Now let's take a closer look at the brain of the car."* Students task: Get familiar with the basic layout of the program interface. Instructors role: Ensure that the students get familiar with the software interface.	
4. Illustrate 3 parameters of Large motor: Power, and time setting. (10')	Group Format: whole class Document: Teacher's attachment C. (Share the screen of the program software, have the robot activated) Instruction: *"Let's make our robot move!"* Students task: Get to know the 3 parameters which affect the movement of the car.	5.2

	Instructors role: Help students to recode the real movement of the car.	
5. Illustrate 3 parameters of Move Steering: Steering, power, rotation. (10')	Group Format: whole class Document: Teacher's attachment D. (Share the screen of the program software, have the robot activated) Instruction: *"Let's make different functions with our robot!"* Students task: Get to know the 3 parameters which effected the movement of the car. Instructors role: Help students to recode the real movement of the car.	5.1
6.End of session: finalize activity and summarize (5')	Group Format: whole class Instruction: *"What did we learn today?"* Students task: Verbal description of what has been learned during this session Instructors role: Guide the students with questions for obtaining the expected answers Covered topics: -Direction, power, rotation, turning function in programming language.	

Activity 2 -Be familiar with Color Sensors and Switch function.		
1. Review last class (10')	Group Format: whole class Instruction: *"Do you remember how could we make this robot move forward? How could we make this robot move for 3 seconds?"* Students task: Make their robot move forward for 3 seconds Instructors role: Help students to get familiar with the program interface for next activity.	
2. Introduce the color sensor and show how does it works with examples (15')	Group Format: whole class Document: Teacher's attachment E (Share the screen of the program software and active the robot) Instruction*: "Today we will program the robot to recognize a color."* Students task: Interact by responding to questions and observe teacher's code process. Instructors role: 1. Help students to decode the real scenarios of traffic light. 2. Illustrate the color sensor with examples.	

3.Introduce the switch function in program.(If- else condition) (15')	Group Format: whole class Document: Teacher's attachment F (Share the screen of the program software and connect to the robot) Instruction*: "For the coming activity, you will design the movement and then code it. I will then test your program to see if your prediction was correct."* Students task: Get to know the switch function (if-else condition) with the teacher and practice with their own robot. Instructors role: Help the students get familiar of the if-else condition.	3.3
4.End of session: finalize activity and summarize (5')	Group Format: whole class Instruction: *"What did we learn today?"* Students task: Verbal description of what has been learned during this session and with a short example. Instructors role: Guide the students with questions for obtaining the expected answers Covered topics: -if-else condition. -color sensors	

Activity 3-Be familiar with Loop function.		
1.Review last class (10')	Group Format: Work in group Instruction*: "Do you remember how we could make this robot move forward? How we could make this robot stop for 3 seconds when it sees red?* Students task: Make their robot stop for 3 seconds when it sees red. Instructors role: Help students to get familiar with the robot and programming interface.	
2.Practice the if-else condition programing language(10')	Group Format: Work in group Instruction: *"Now let's imagine, you are driving from Paris to Frankfurt. You will meet traffic lights a lot of times on the way. What will you do? Could you make the car go through 5 traffic lights in a row?* Students task: Make their robot *go through 5 traffic lights in a row* Instructors role: Help students to get familiar with the concept of if-else condition and prepare the students for later loop concept.	3.1 3.3
3 Introduce the loop function in	Group Format: whole class	3.1 3.3

program and show it with examples (20')	Document: Attachment G (Share the screen of the program software) Instruction: *"As you just practiced, the driver will drive through traffic lights many times. If we don't want to repeat the same code all the time, we could use loop function. Now let's have a look at this new function."* Students task: Program the robot with loop function. Instructors role: combine the loop and if-else together.	6.1
4.End of session: finalize activity and summarize (5')	Group Format: whole class Instruction: *"What did we learn today?"* Students task: Verbal description of what has been learned during this session and with a short example. Instructors role: Guide the students with questions for obtaining the expected answers Covered topics: -Loop function, -if-else condition.	

Activity 4-Use your robot to solve problems!		
1.Review last class (5')	Group Format: whole class Instruction: *"Do you remember how to see the color? Do you know how to make a robot react to different colors? Let's make my robot go through the traffic light with loop function together!"* Students task: Help the teacher to reset teacher's robot with switch and loop function. Instructors role: Help students to refresh the knowledge about if-else case and loop function.	
2. Comprehensive activity 1: Combine more colors and movement together and solve the problem together (15')	Group Format: whole class Document: Teacher's attachment H and student's attachment 1 Instruction: *"Thanks for all of you to make my robot work again! In some special work filed, robot needs to walk the path as human designed. How could we reach this goal?* Students task: Solve the problem in attachment 1 with teacher's instruction. Instructors role: Help students combine the knowledge of movement, color, loop, if-else.Help students to code the paths for the robot to complete.	3.1 3.3 6.1

	Expected response: Design the paths Define the movement for each color Help the robot to complete the path	
3. Comprehensive activity 2:Help the students to solve the problem in group. (20‘)	Group Format: in group Document: Student’s attachment 2 Instruction: *“Here is your own task, try to solve it with your team mate!”* Students task: Solve the problem in attachment 2. Instructors role: Help students to solve the problem when they need.	3.1 3.3 6.1
4.End of session: finalize activity and summarize (5’)	Group Format: whole class *Instruction: “So what we have learned in this project? Could someone remember how we get to know the robot? And then what we did with the robot?* Students task: Verbal description of what has been learned during 4 sessions. Instructors role: Guide the students with questions for obtaining the expected answers Covered topics: -Movement -Decode -if-else -loop -color sensor -program	

Assessment

Competencies/ PIAF-Goals	Activities for the assessment	Assessment criteria
3.1 Repeat a sequence of actions a given number of times	Understand the combination of loop and switch function to reach the goal.	Code the robot to go through 3 traffic lights using a loop
C 3.3 Integrate a simple condition into a sequence of actions	Understand the if-else function and if-else-if function.	Code the robot to go through 1 traffic light with both if-else condition function and if-else-if condition function.
6.1 Verify if a sequence of actions reaches a given goal	Understand the combination of loop and switch function and design a certain path for the robot.	After coding the robot, test the result of the robot's movement.

Received Feedback on the created Scenario

If you have had the opportunity to experiment with the scenario presented here, suggest some feedback on it: what worked well, the obstacles encountered, the learner's feedback, your feelings, possible ways to improve it.

Bibliography

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Speed | *WeDo 2.0 Lesson Plan*. (n.d.). LEGO® Education. Retrieved November 10, 2020, from https://education.lego.com/en-us/lessons/wedo-2-science/speed#1-preparation

Attachments

Attachments Overview

Activity	Teacher Attachment	Student Attachment
1.2	A	
1.3	B	
1.4	C	
1.5	D	
2.2	E	
2.3	F	
3.3	G	
4.2	H	1
4.3		2

Teacher's Attachments

Teacher's Attachment: A

Used in activity:	1.2: Introduce the item in DriveBase
Along with Student's Attachment(s):	none

Instruction:
Play the video for the students. Video of turning cars

Instruction: *"How do we make a car to move forward in the real world? Can a car move by itself, that is, without a person by the driving wheel?"*
Expected response: The car can't move by itself. There must be a person in the car to give the instructions to move forward or backward. So in our drive base robot, our robot also needs a brain to tell the car what to do which is this Intelligent Brick. We could write code inside of this brick to lead the car what to do just like how the human beings control cars.

Instruction: *"How to make the car faster?"*
Expected response: There are many factors that can influence the speed of a car. Size of the wheels, motor power, gears, aerodynamics, and weight would be the most common ones. In the drive base robot, we could go to the Intelligent Brick to change the setting for the speed.

Instruction: *"What happened when the car turns left?"*
Expected response: When there is a driver in the car, the driver turns the steering wheel to the left. If we want our robot to steer, we also need to give the steering code in the Intelligent Brick.

Teacher's Attachment: B

Used in activity:	1.3: Introduce the program interface
Along with Student's Attachment(s):	none

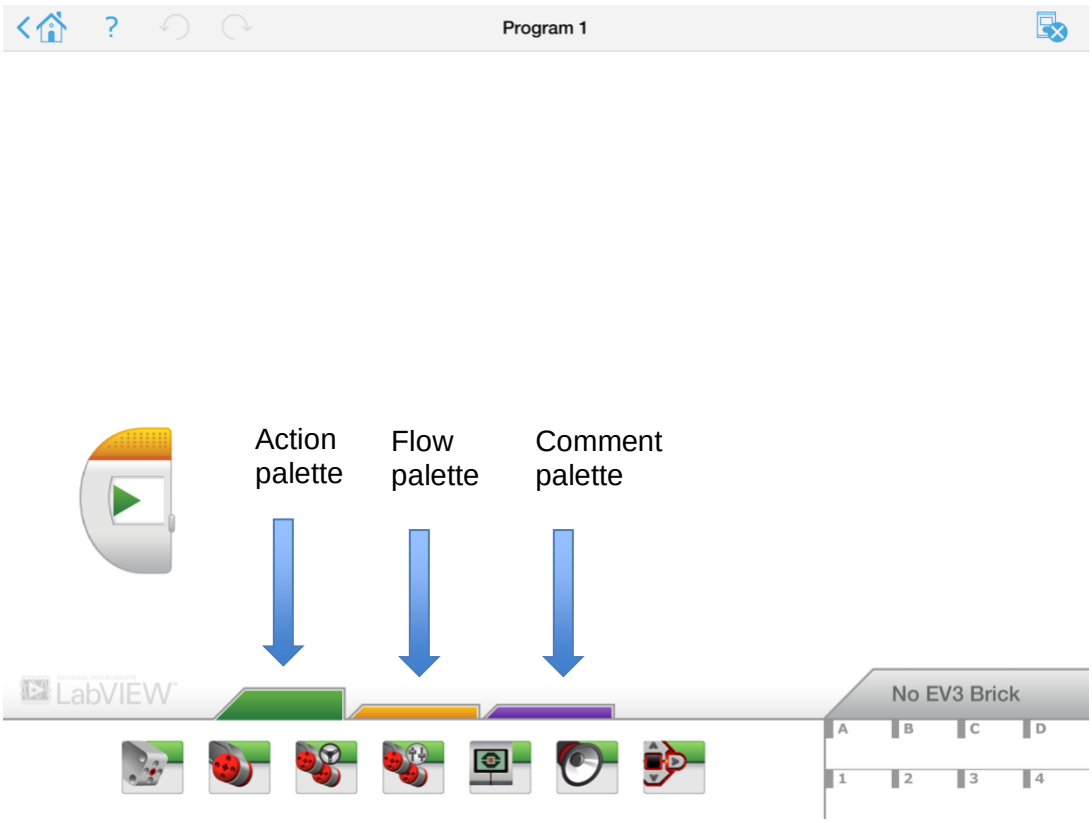
Please go to the Lego Programming Application for the LEGO® MINDSTORMS® EV3.

Instruction: "Now let's go to the brain of the car! There are 3 palettes. The green one is an action palette, the yellow one is the flow palette and the purple is the comment palette."

Instruction: "Let's look at the action palette. This palette could allow us to control the movement of the car, for example: go forward, turn left, and change the speed. We will have a look later."

Instruction: *"The yellow palette allows us to manage time and action. For example, if we want to drive the car for 10 seconds and then stop for 3 seconds, we need to use the yellow palette to manage these two actions."*

Instruction: *"The purple palette is the comment palette. We could write sentences and words in here and stick it around our code. Since the code we need in our class is not so long so that we don't need this palette in our class. But it will be very helpful when you have complicated codes or if you want to share your code with other programmers because on this palette you can add extra information or explanations about what your code does. You could try this palette after our class."*

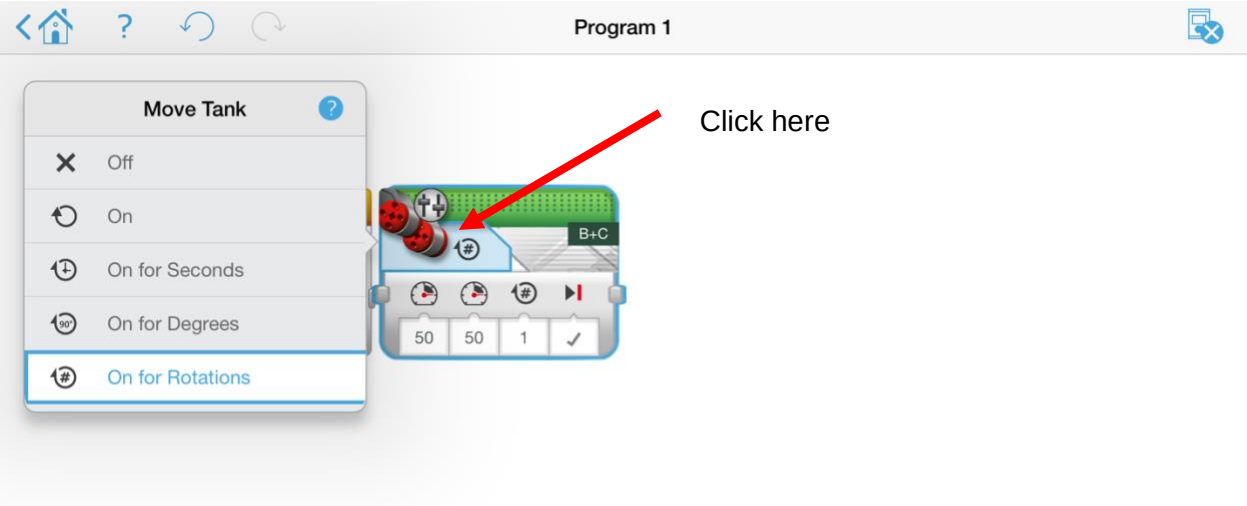

Program 1
Action palette
Flow palette
Comment palette
LabVIEW
No EV3 Brick
A
B
C
D
1
2
3
4

Teacher's Attachment: C

Used in activity:	1.4: Illustrate 3 parameters of Large motor: Power, and time setting
Along with Student's Attachment(s):	none

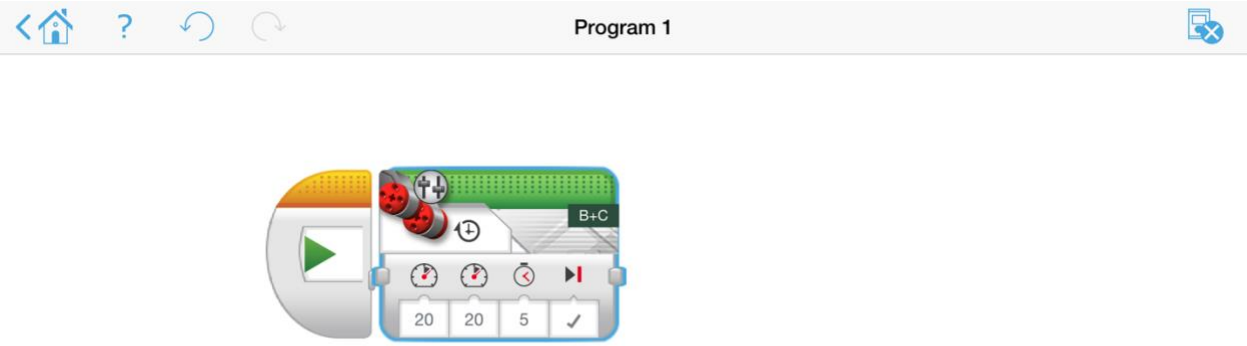
Instruction: "Let's make our robot move! We will use the Move Tank in the green palette. There are 4 icons here. The first two buttons on the left (inside the red rectangle) can adjust the power of both wheels."

Instruction: "We could click here (see image below) to change the condition of the movement. You could control the movement by time (seconds), rotations of the wheel, and degrees. The last button is to define the default setting of the move, we could leave this like now. "

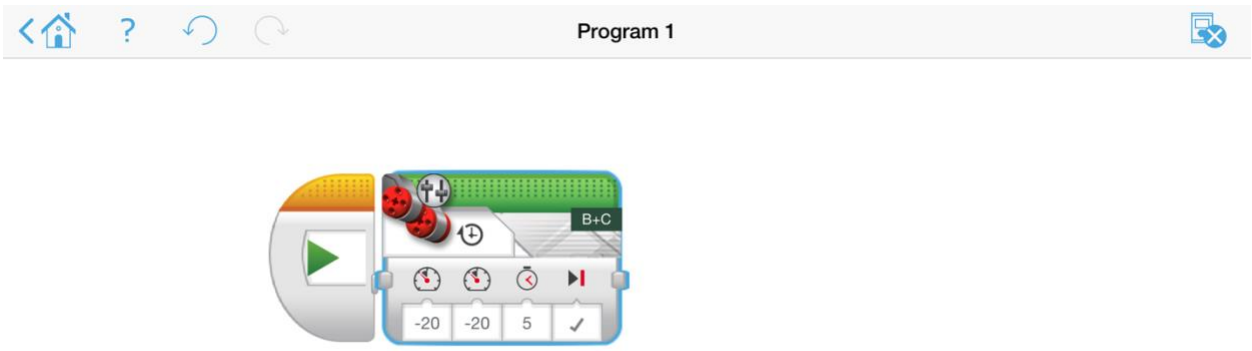


Instruction: *"Now let's make our robot move*" (Practice this activity with the whole class, each group using their robot.)

Instruction: The robot will move forward with the power of 20 for 5 seconds.



Instruction: *" What if we want the robot to move backward?"*
Expected answer: The robot will move backward with minus value of power.



Instruction: *"What does rotation stand for? How could we change the movement of the car by changing rotation?*
Expected answer: The rotation is how many times the wheel will rotate. 1 rotation means the car will move the distance of 1 circumference of the wheel.

Instruction: *"What does degree stand for here? How could we change the movement of the car by changing this parameter?*
Expected answer: The degree shows how many degrees the wheel will rotate. Thus 1 rotation = 360 degrees.

Instruction: *"Please try it with your robot. How do you want to robot to move*?".

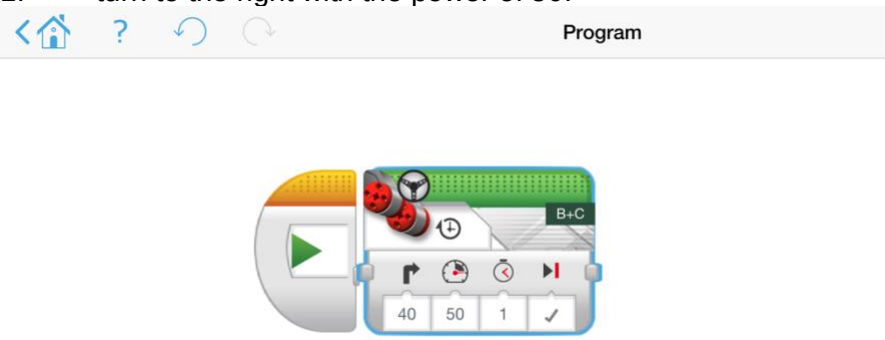
Teacher's Attachment: D

Used in activity:	1.5: Illustrate 3 parameters of Move steering
Along with Student's Attachment(s):	none

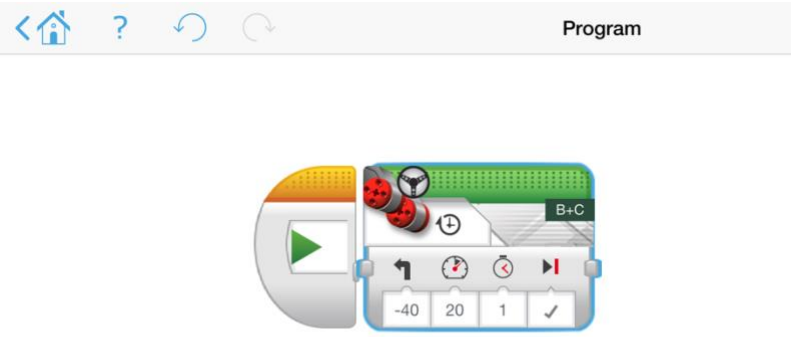
Instruction: *"Let's try to make our robot turn to another direction. Let's go to the Move Steering. Compare to the Move Tank, there is a special setting to change the direction. Let's try together."*

Example: (Practice it with students' robot.)

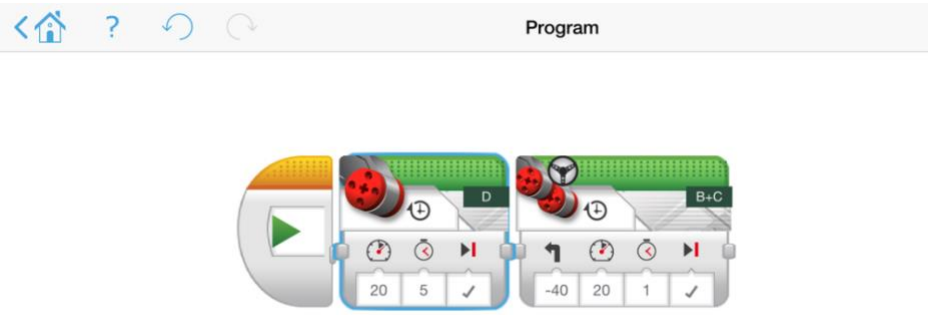
1. turn to the right with the power of 50.



2.Turn to the left with the power of 20.

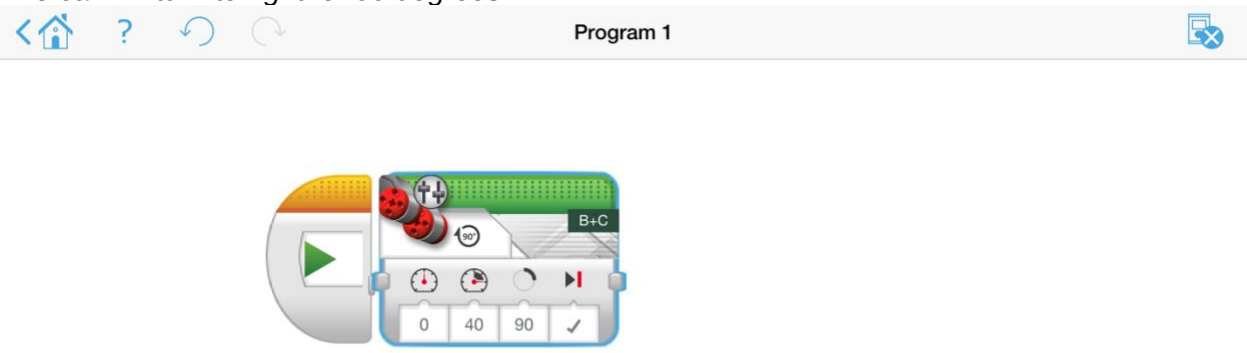


3.Move forward for 5 seconds and turn to the left.



Instruction: *"How could we change the direction of the car with Move Tank? Could we change the direction by manipulating the speed of two wheels?*
Expected Answer: We could change the speed of each wheel to control the direction.
Example:

The car will turn to right for 90 degrees.



Instruction: *"Please try it with your robot. How do you want the robot to turn*?" (Practice with the student)

Teacher's Attachment: E

Used in activity:	2.2: Introduce the color sensor and show how does it works with examples
Along with Student's Attachment(s):	none

Instruction: *"When we drive, what rules do we need to pay attention to? Could we just drive until our destination?"*

Expected response: when the driver sees a pedestrian, the car should stop. When the driver sees the red light, the car should stop for a while and drive again. When the driver sees a green light, the car will drive through it.

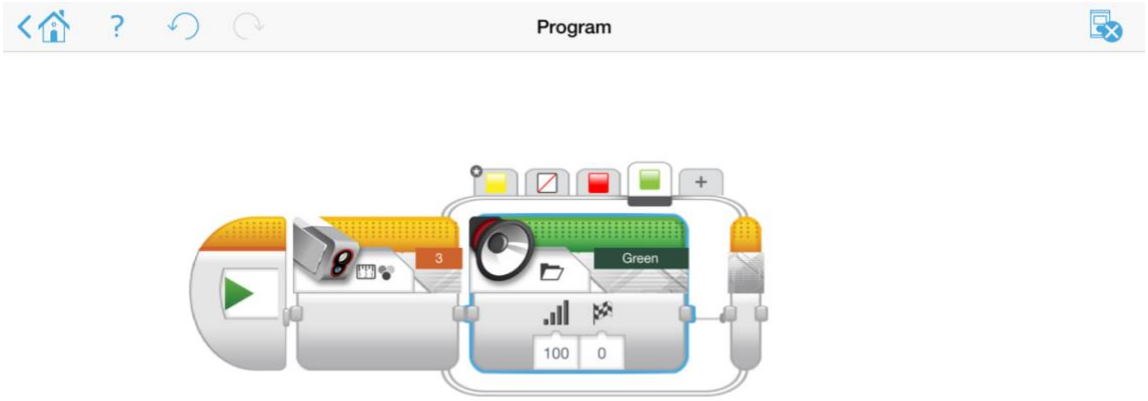
Instruction: *"Yes, in order to make the robot see the world, the color sensor has been invented. The drive base robot with a color sensor could distinguish the color. Consequently, we could say: "the robot can see the color".*

Example:

1. Name the color.

   Function of this program: when the color sensor sees the color, it could speak out the name of the color.
   For example, if students give yellow picture to color sensor, the car will say 'Yellow'.

Program process: choose If-else module, choose Color sensor, create the condition, choose sounds.



Advice:
This activity includes the knowledge if-else condition, the teacher doesn't need to explain this function but focus on the color sensor.

Instruction: *“According to this program we knew that the car could see the color! Let’s move on!”.*

Teacher's Attachment: F

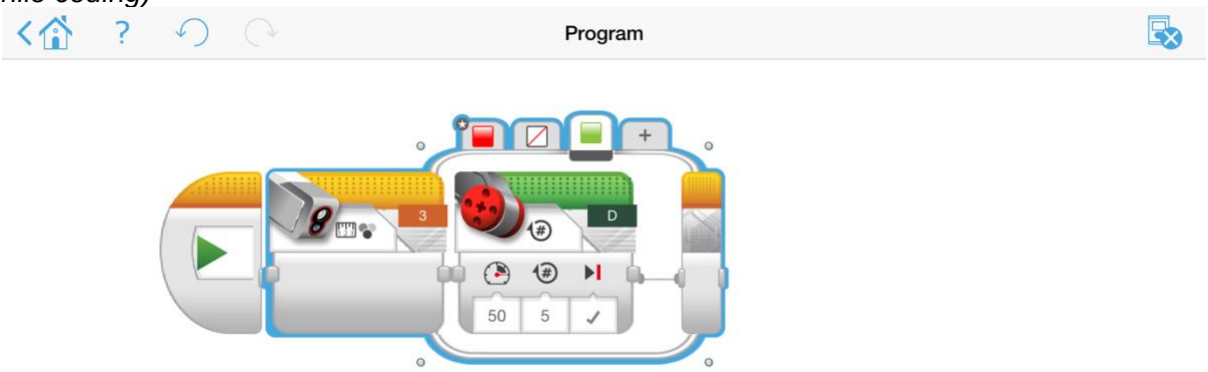
Used in activity:	2.3: Introduce Switch function in program.(If- else condition)
Along with Student's Attachment(s):	none

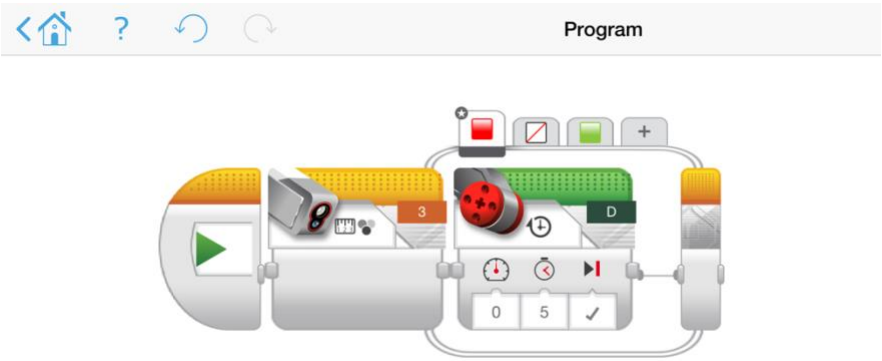
Instruction: *"The robot can see colors, let's go to the brain to tell the robot what to do when it sees colors. This step needs a new palette, the yellow palette. What we need here is the Switch module."*

Instruction: *"This switch could be interpreted as when A happens, we will go to condition 1, and when B happens, we will go to condition 2. Regarding the traffic situation, what will we do when we see the colors?"*

Instruction: *"We could write this function like: When we see a traffic light, if it is red, we will stop. If it is green, we will move forward. If it's neither of red nor green, nothing will happen."*

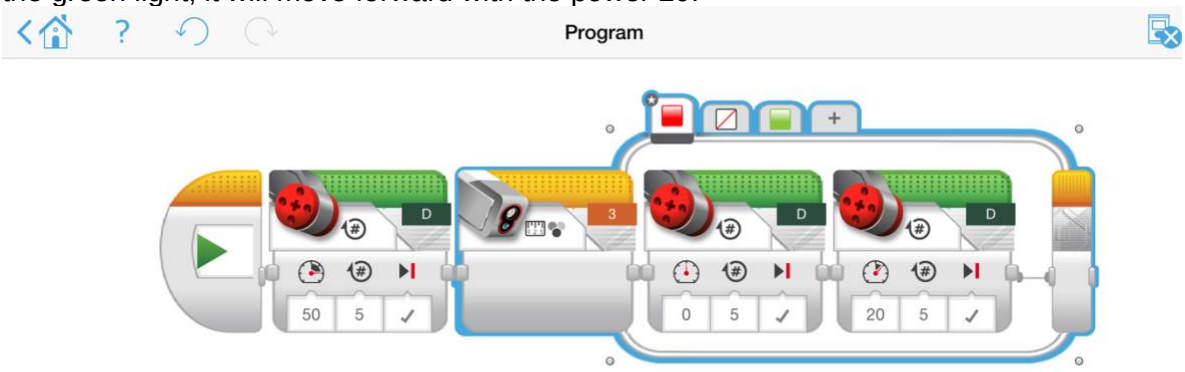
Instruction: *"So let's write this sentence in computer language."(share the screen with students while coding)*

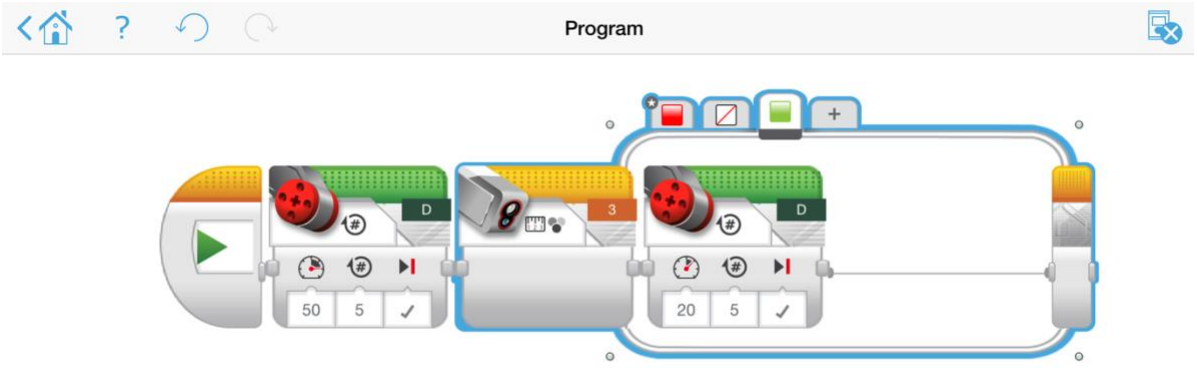




More examples:

1. The robot is moving forward with the power of 50 for 5 seconds, if it sees the red light, it will stop or 5 seconds and restart to move forward with the power 20. If it sees the green light, it will move forward with the power 20.





Instruction: *"So now please design your own movement for your robot and predict what will happen then. And after your prediction, connect your robot with your computer to check your result."*

Expected responses:

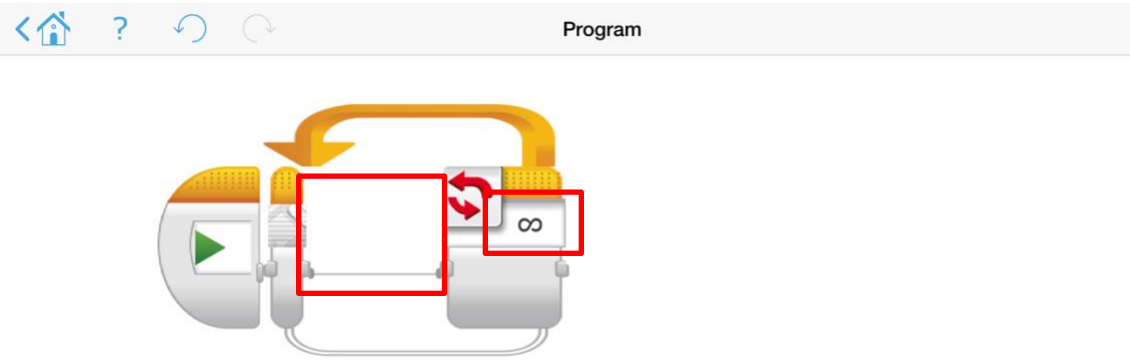
	red light	green light
Movement 1	Stop	Move forward slowly
Movement 2	Stop for 5 second and move forward	Stop for 2 seconds and move forward again.

Movement3	Stop for 10 seconds and move forward	Turn right

Teacher's Attachment: G

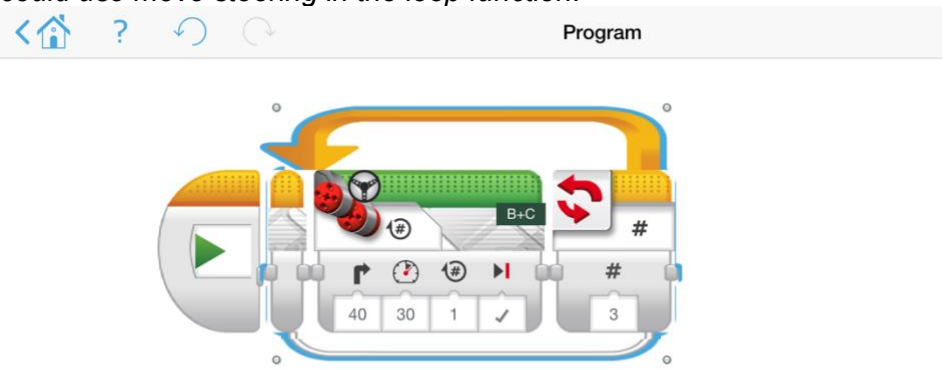
Used in activity:	3.3: Introduce Loop function in program and show it with examples
Along with Student's Attachment(s):	none

Instruction: *"As you just practiced, the driver will drive through traffic lights many times. So should we write the if-condition as much time as the number of traffic lights?*
If we don't want to repeat the same code all the time, we could use a loop function. Now let's have a look at this new function."



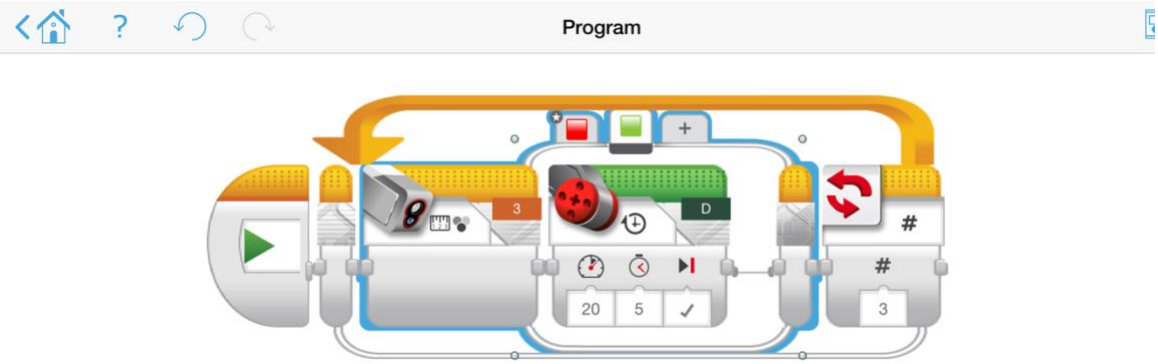
Instruction *"You could drag in what you want to repeat into the red box area, and the small red box on the right side means the condition which indicates when the loop will finish. We could choose different conditions to stop the loop, for example, count, times, color sensors, and so on."*

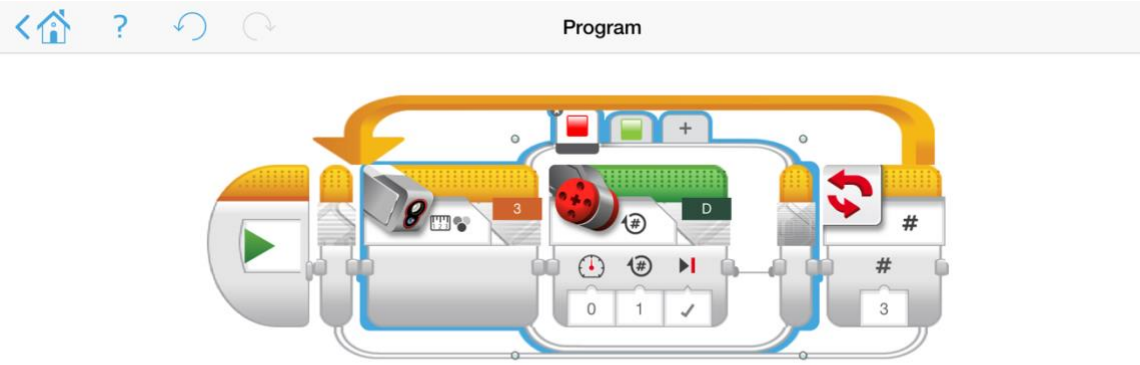
Instruction: *"For example, If we want to turn the car to the left for 90 degrees for 3 times, we could use move steering in the loop function."*



Instruction: *"Could you combine the Switch and the Loop together to instruct the car to go through the traffic light 3 times?"*

Answer:



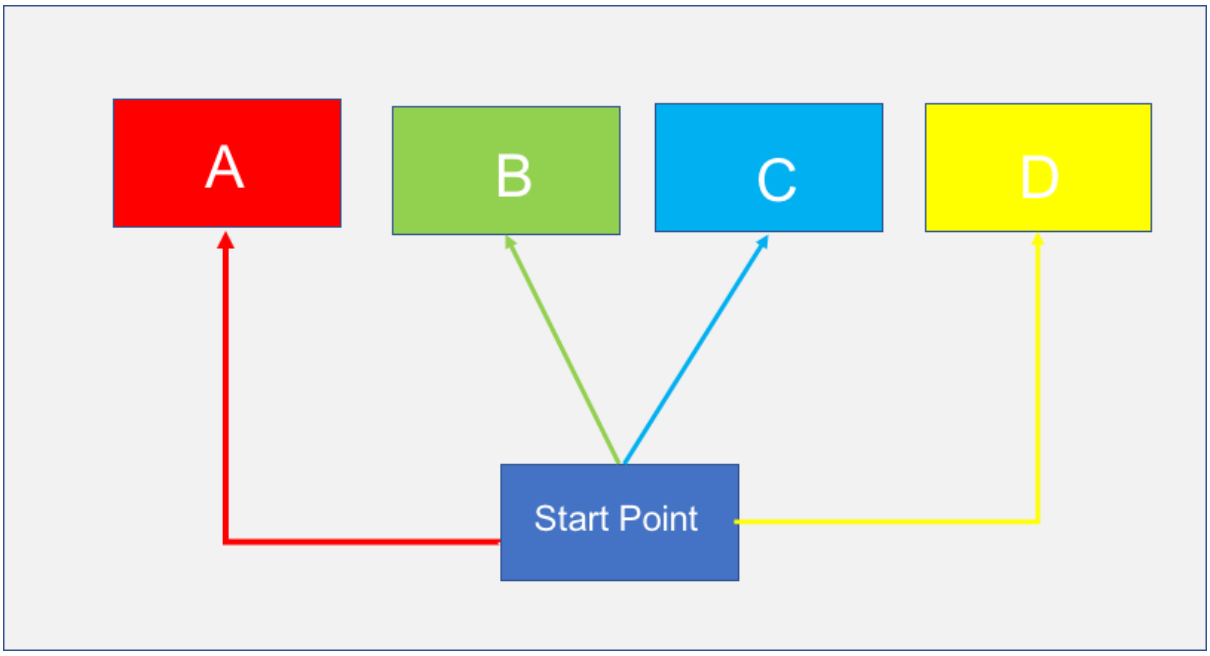


Function of this program is, when the car sees red, it will stop; when it sees green, it will move forward. And this function could be applied unlimited times.

Teacher's Attachment: H

Used in activity:	4.2 Comprehensive Activity 1
Along with Student's Attachment(s):	1

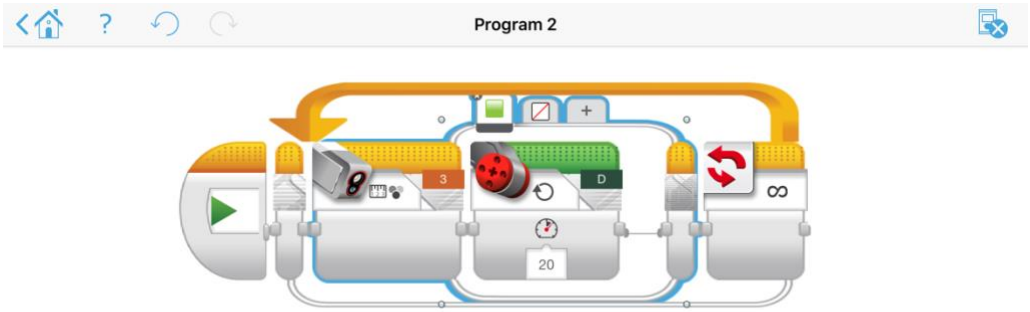
Instruction: *"Thanks for all of you to make my robot work again! In some special work filed, the robot needs to walk the path as human designed. How could we make it work? Let's have a look at this factory map! There are four storehouses which contain different kinds of products. The robot should follow the color line on the ground to deliver the product to a particular storehouse. Let's work on it together!"*

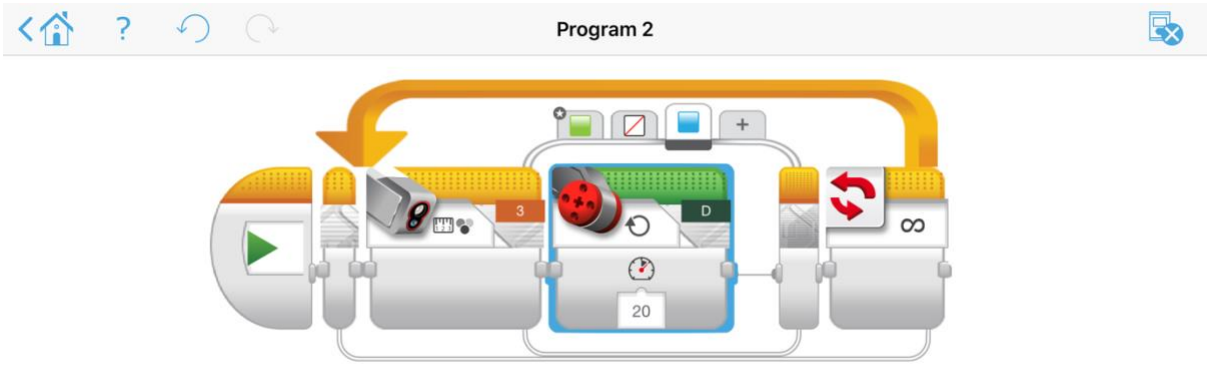


Advice: the teacher could start the car with the specific direction to make the task easier. If the teacher wants to have more challenging task, he/she could ask the students to adjust the starting direction.

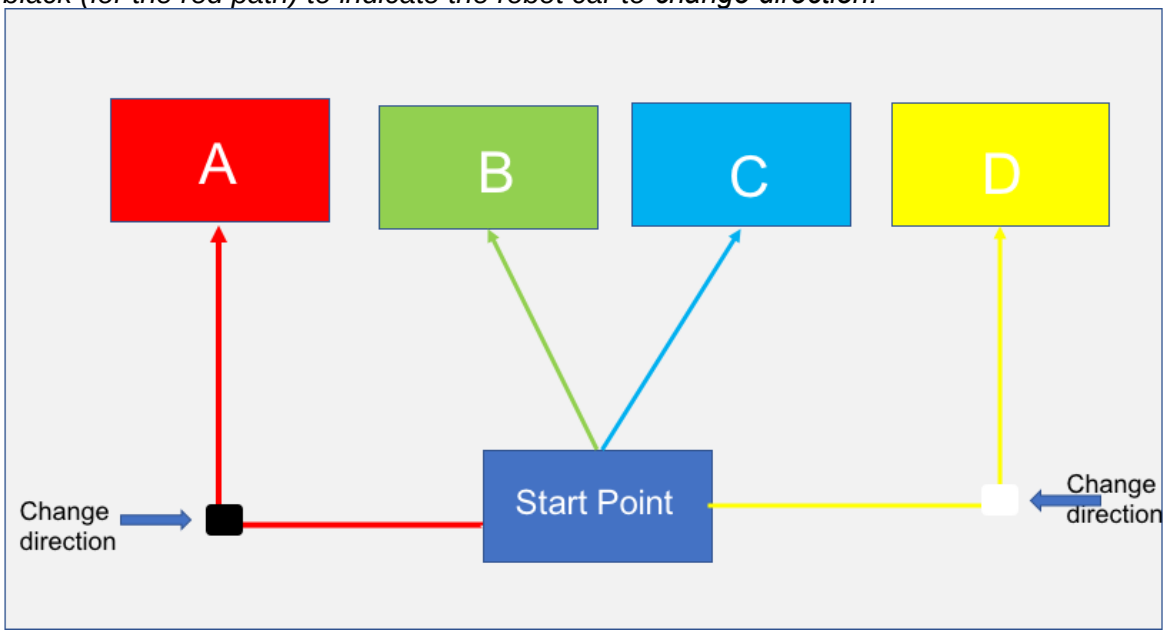
Instruction: *"The green line and the blue line is a straight line without changing direction. So this is easy to make."*

Answer:

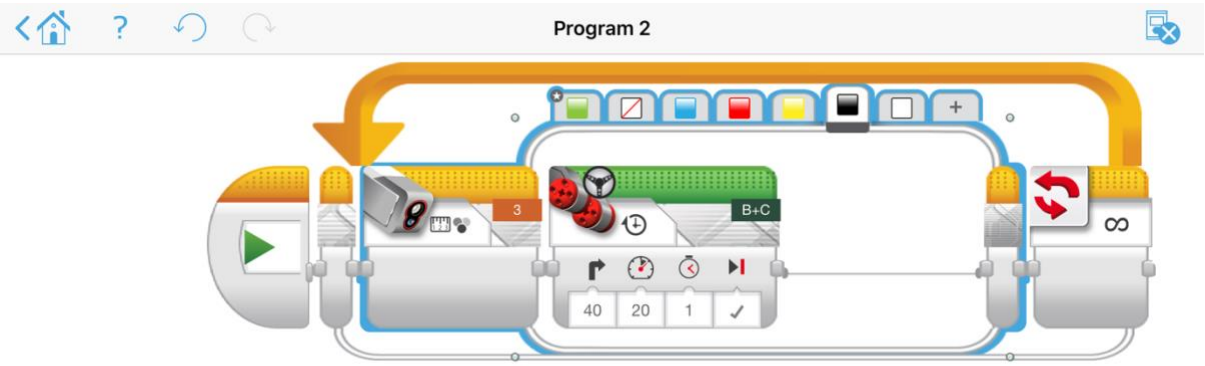


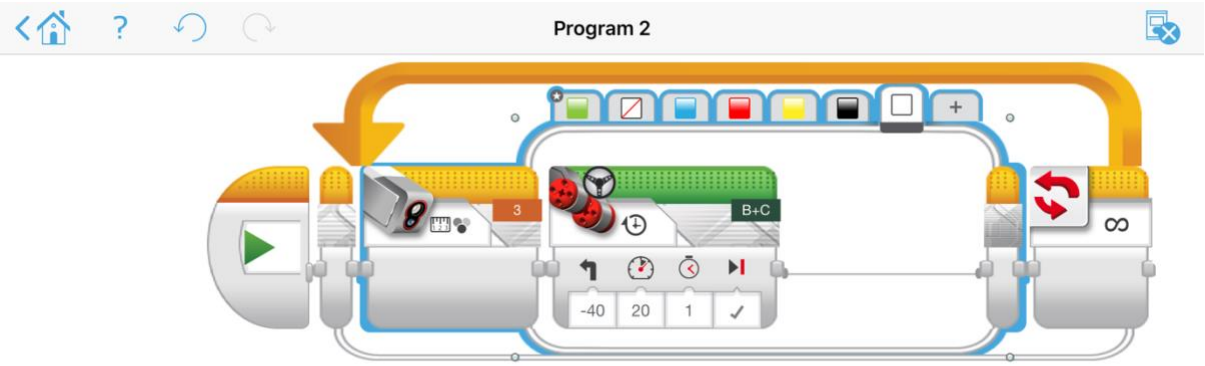


Instruction: *"The red line path and the yellow line path contain a turn so we should add another color to indicate the car to change the direction. We could use white (for the yellow path) and black (for the red path) to indicate the robot car to change direction."*



Answers:

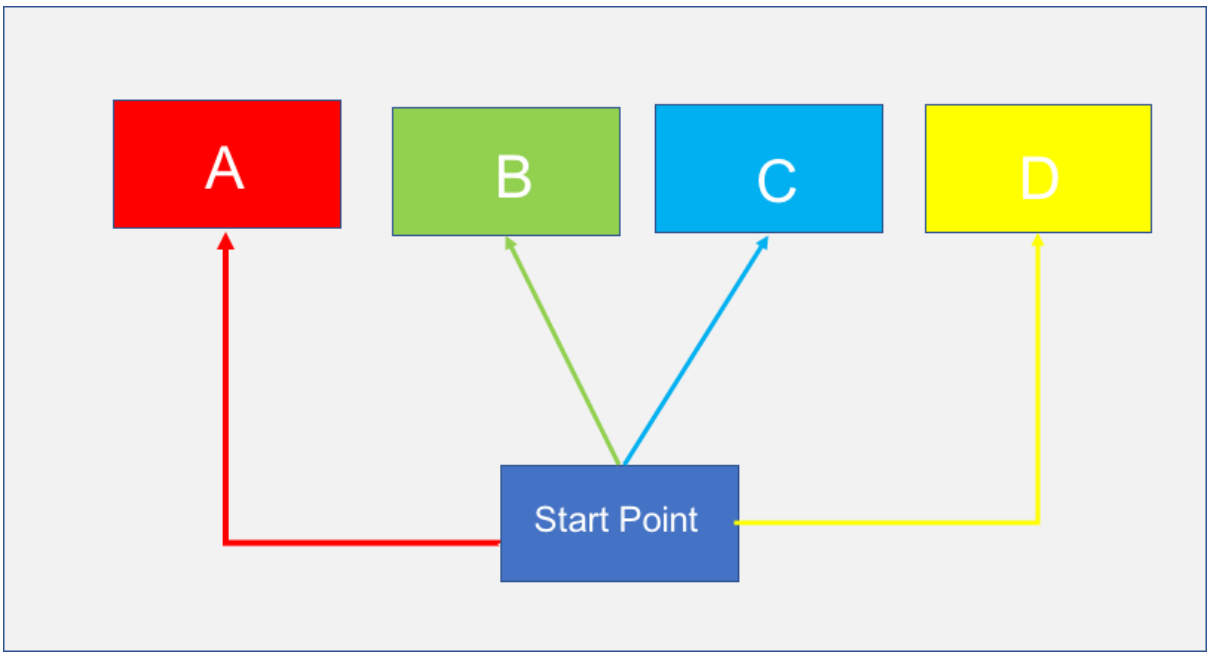




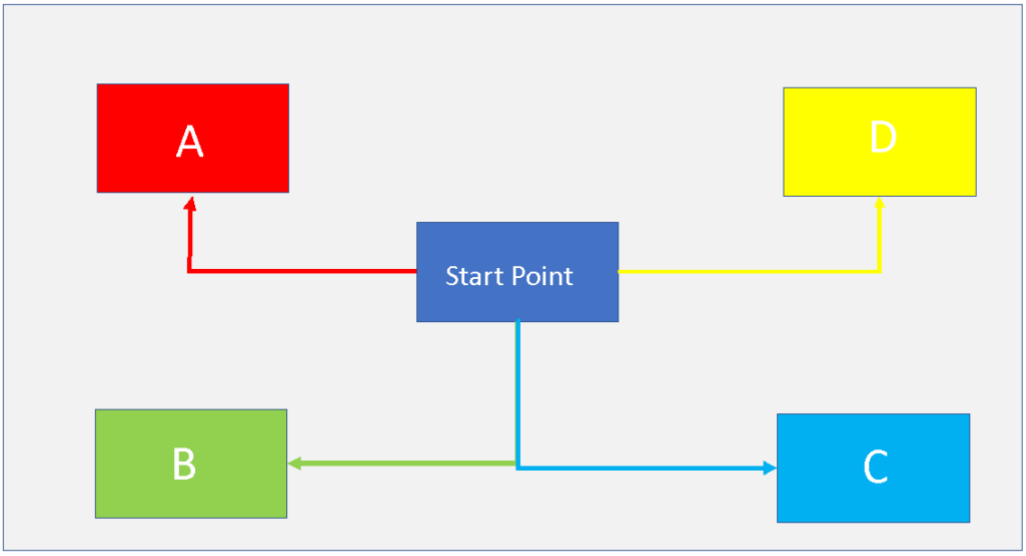
Instruction*: "Please try it with your robot! Let's make them work!."*

Student's Attachments

Attachment 1: Comprehensive Activity 1



Attachment 2: Comprehensive activity 2



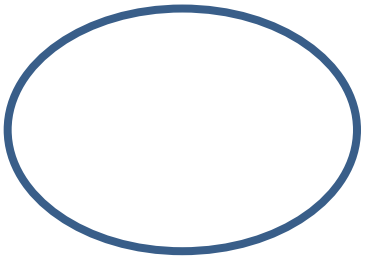
Hint 1: You could use color sensor to change the direction.
Hint 2: You could also measure the length of the road and program in the motor.
Hint 3: Remember to use Move Steering to adjust the angle.

Evaluation

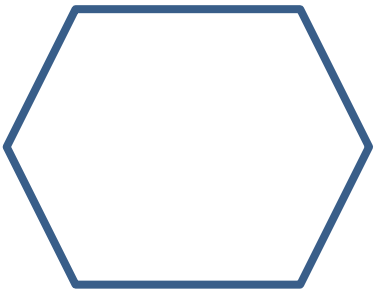
Task: Design a special path for your robot? What kind of pattern you want to draw? Be creative to think about your own path.Let's see how great you could control your robot!

Possible paths:

Path 1: Circle



Path2: hexagon



Path 3: Letters

A