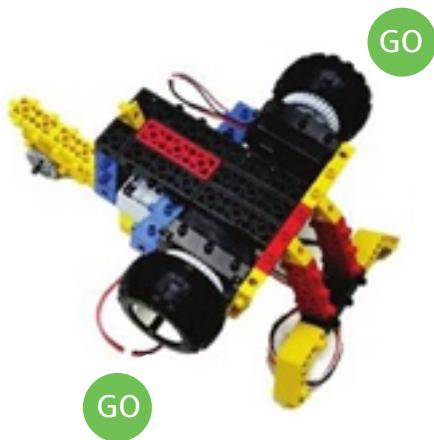


Extension of DC Motor

How to Move Lizard Robot (Extension of the DC motor)

Flip the lizard robot to see its bottom.

For the robot to move forward, we have to activate both motors at the same time.



If you code following the picture above, the computer will activate Motor4 and Motor7 at the same time and move the robot forward.

If you code following the picture below, we can combine the 'Stop Motor 4' block and 'Stop Motor 7' blocks to stop them at the same time.





Extension of DC Motor

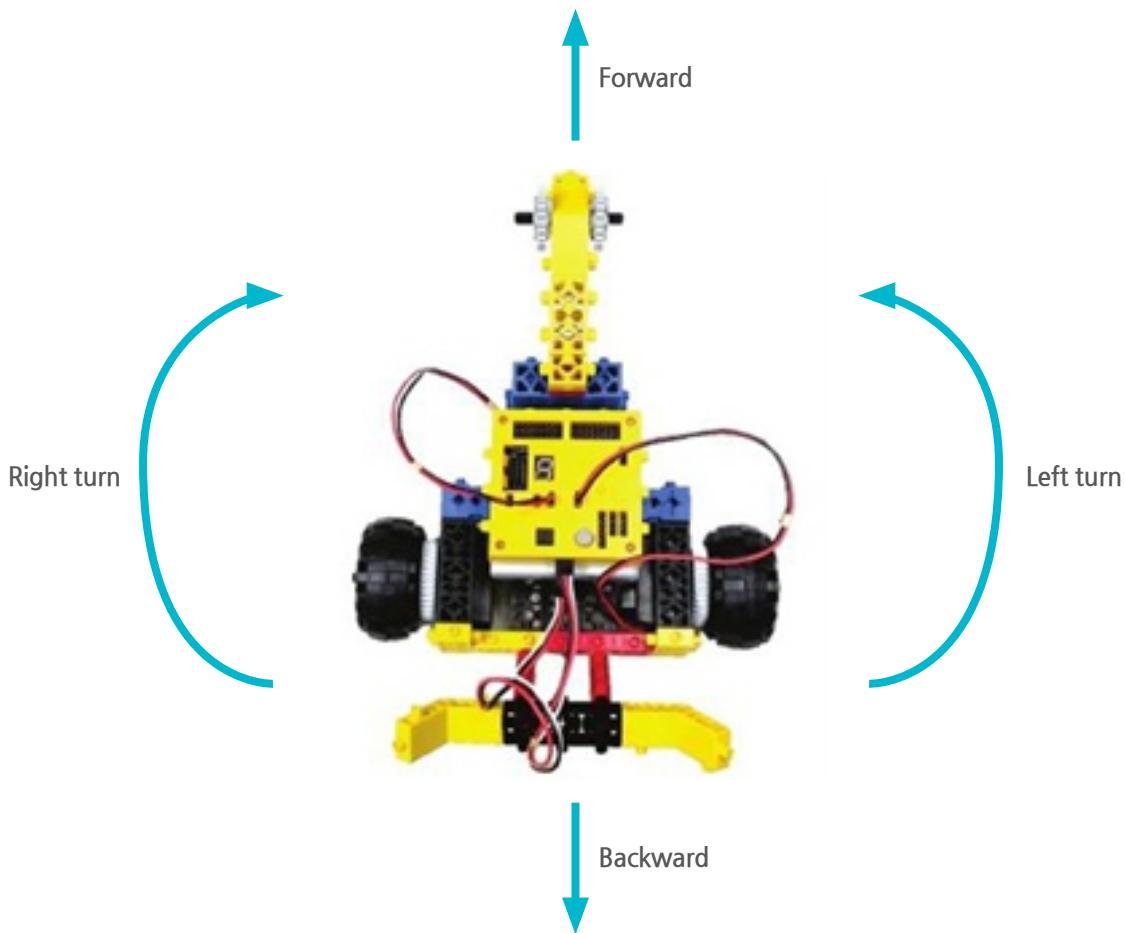
How to Change the Robot's Direction

You have learned that if you set two motors to rotate clockwise, it will move forward.

What if they rotate counter-clockwise? Would it be able to move left or right? Let's do some testing!

Let the lizard's wheels stay on the back and start.

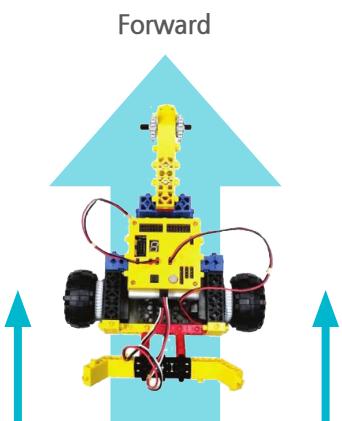
We will try four different combinations of motor movements to move the robot. Write down if the motor is going clockwise or counter-clockwise depending on its movement direction. Place the robot on the ground and see.



Extension of DC Motor

How to Make the Lizard Robot Move Forward

If you want it to go forward...



Motor4 (left motor) direction

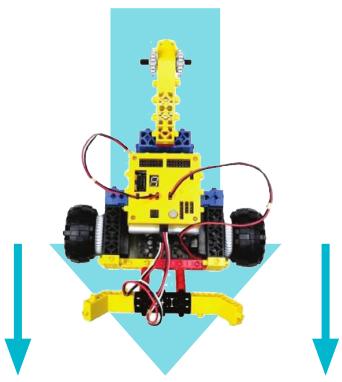
Clockwise

Motor7 (right motor) direction

Counter-clockwise

How to Make the Lizard Robot Move Backward

If you want it to go backward...



Motor4 (left motor) direction

Motor7 (right motor) direction



Extension of DC Motor

How to Stop the Lizard Robot

If you want it to stop...



Motor 4 (left motor) direction

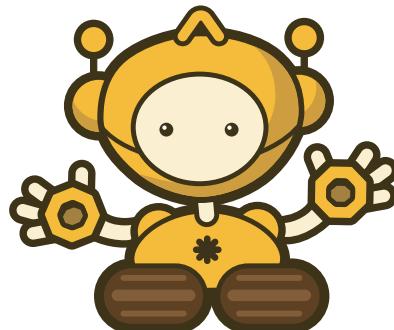
Off

Motor7 (right motor) direction

Off



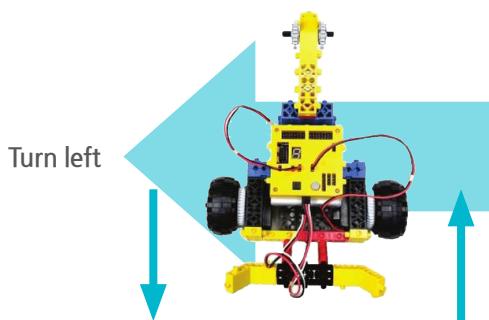
Tip: It will be easier to make the robot move if you make a code that stops Motor4 and Motor7 when the spacebar is pressed.



Extension of DC Motor

How to Make the Lizard Robot Turn Left

If you want it to turn left...

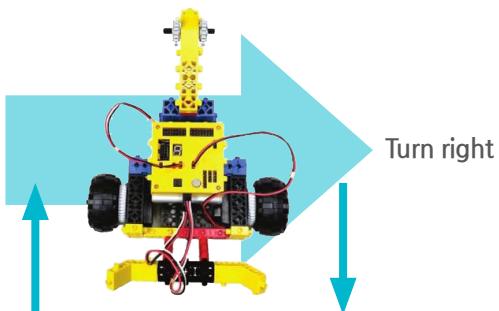


Motor 4 (left motor) direction

Motor 7 (right motor) direction

How to Make the Lizard Robot Turn Right

If you want it to turn right...



Motor 4 (left motor) direction

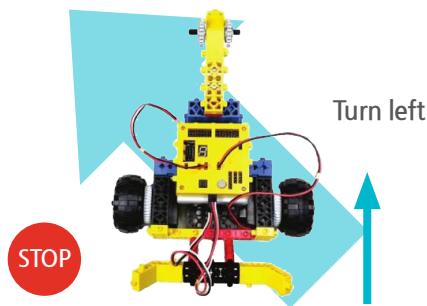
Motor 7 (right motor) direction



Extension of DC Motor

How to Make the Lizard Robot Slowly Turn Left

By activating one motor, the lizard robot will be able to slowly turn left. If you want it to slowly turn left...



Motor 4 (left motor) direction

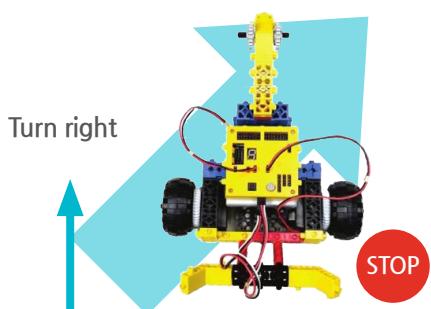
Off

Motor 7 (right motor) direction

Clockwise

How to Make the Lizard Robot Slowly Turn Right

If you want it to slowly turn right...



Motor 4 (left motor) direction

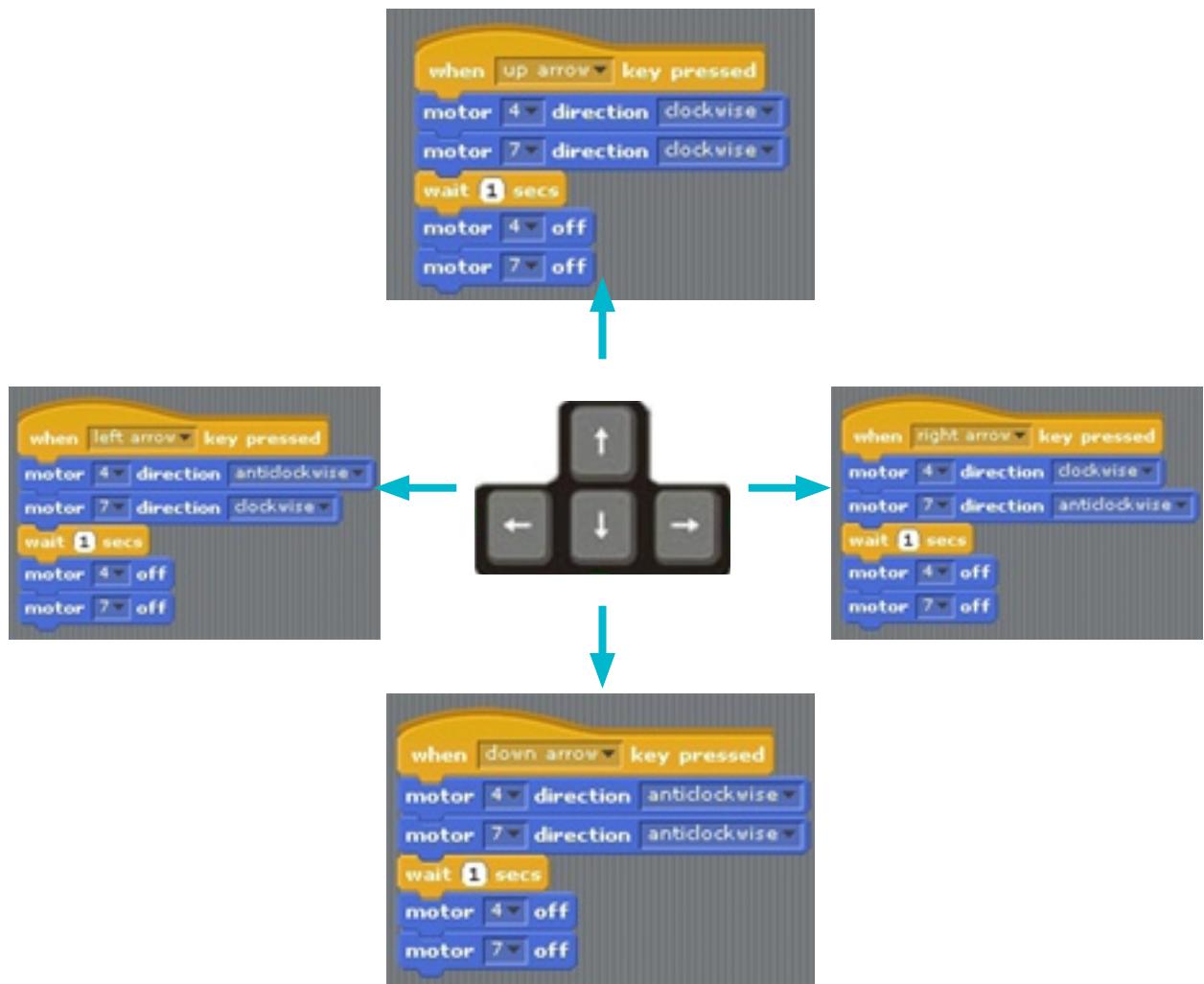
Motor 7 (right motor) direction

Extension of DC Motor

How to Use the Keyboard to Move the Lizard Robot

You can combine the 'Start' block to activate the code you made.

Put the 'Start' block on the top. After that, set each code to different arrow keys. By doing this, you will be able to control the robot's direction with the arrow keys!



Logic boost

Random numbers and loop

LESSON

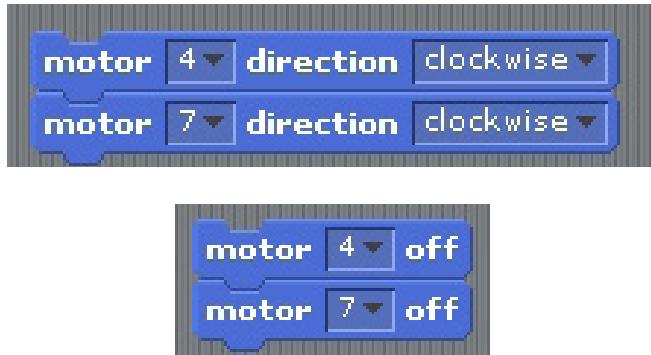
3



Random numbers and Coding

Random Movements of the Lizard Robot

Does the lizard robot move well? We just used keyboard arrow keys to control the robot. This time, we will code the robot to move for a random amount of time. Let's review first.

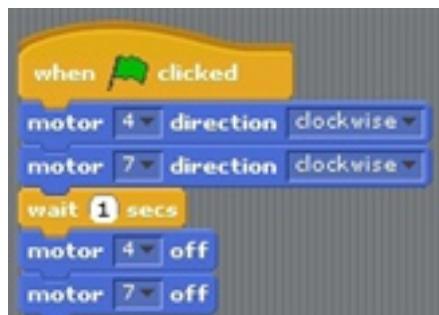


Click the 'Motor's rotating direction' block to move the robot forward and click the 'Stop Motor' block to turn off the robot.

How much did they move?

The time you took between activating the motor and stopping the motor was random. Now, we will learn how to code a motor to activate for a random amount of time.

Refer to the picture below to set an exact time for the motor to activate.



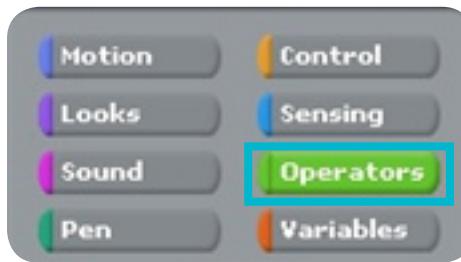
The robot will move forward for 1 second and stop if you activate the program. Let's set it to move forward for a random amount of time.



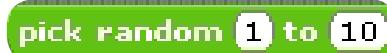
Random numbers and Coding

How to Use Random Numbers

To move the robot for a random amount of time, there is a new block we will be using to produce a random number. Click the 'Operators' button in the palette.



If you click 'Operators' you will see 'Random number between 1 and 10.'



Drag the block to the script and click it. If you click it, a number will appear at the right side of the block.



When you keep clicking the button, you will see the number change because this block produces a random number between 1 and 10.

Since waiting for 10 seconds is a bit long, let's change 10 to 5. Click '10' and press 5 to change it.



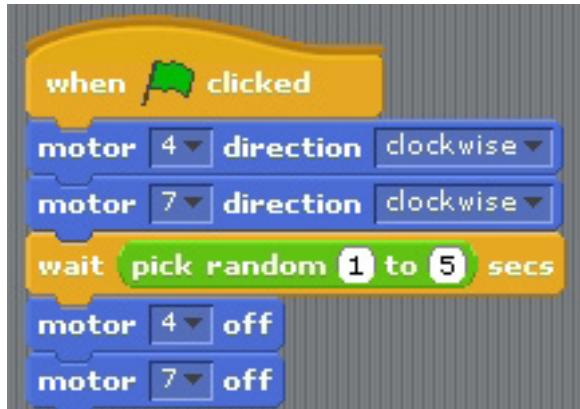
Random Numbers and Coding

How to Code the Lizard Robot

Just like we learned before, we can use the keyboard to edit the numbers on the blocks.



Drag the green random number block into the 'Wait' block to make the script below.



If you activate the script, the lizard robot will move for a random amount of time between 1 and 5 seconds. This is how you use the random number to activate a robot for a random amount of time. Now, we will learn about 'Loop,' which can repeat a robot's movement.



Intro to 'Loop'

What is 'Loop'?

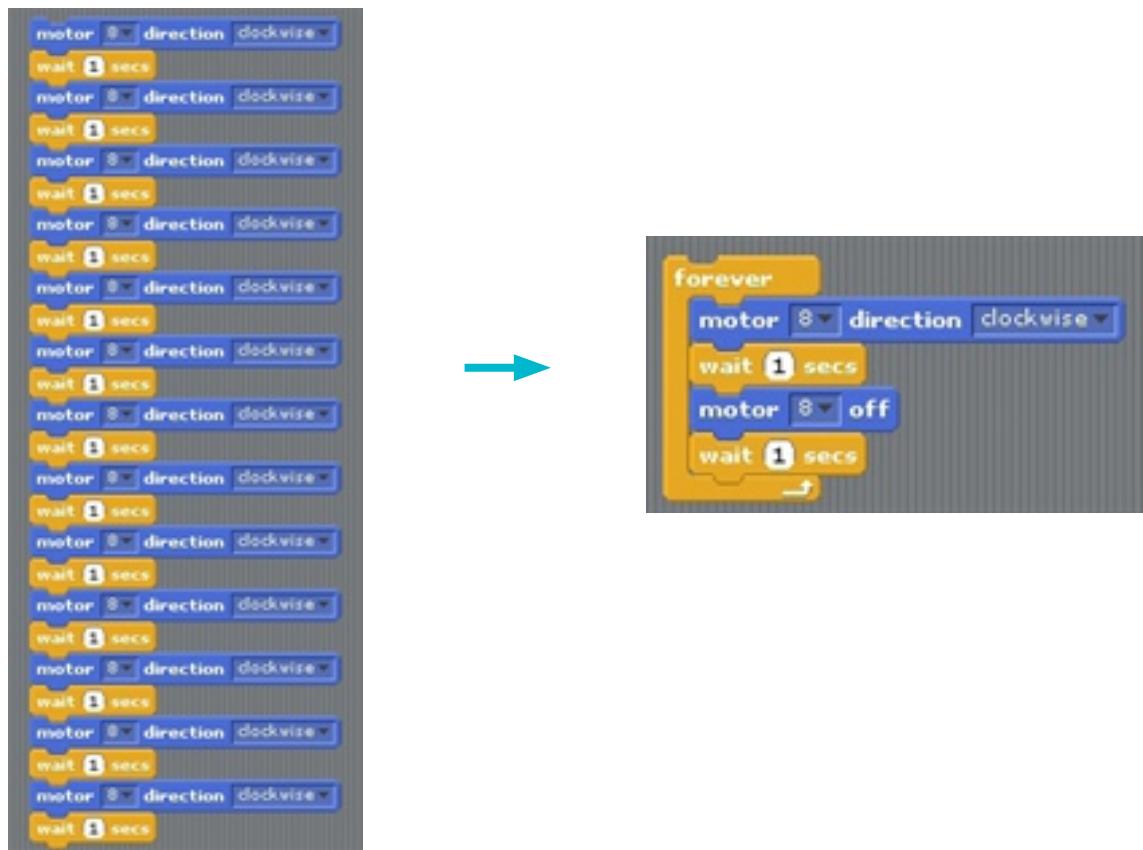
'Loop' can repeat a robot's movement and lets us constantly check many different settings.

It is useful when you make a code that includes more than one movement. In this lesson, we will learn two loops.

The simplest loop is when a computer repeating the same order again and again.

Also, loop can make your code simple and help you easily make repeating code.

For example, when you want to make a repeating code that turns a motor on and off, you will probably need an infinite combination of the same blocks. Thanks to the loop, we can order the computer to repeat one action.



Intro to 'Loop'

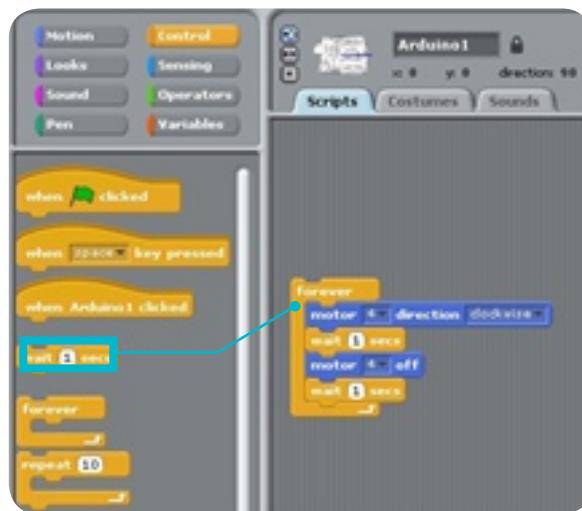
Infinite repetition

To understand how loops work, we will use the lizard robot. We will use the loop to infinitely rotate the motor instead of using an infinite number of blocks. Refer to the picture below.



If you activate this, the left wheel of the lizard robot will turn on for 1 second and turn off.

Now, we will use the 'infinitely repeat' block to keep turning on and off the left wheel. You can find this block under the 'Control' tab in the palette. Drag it to the script and make it surround the other blocks.



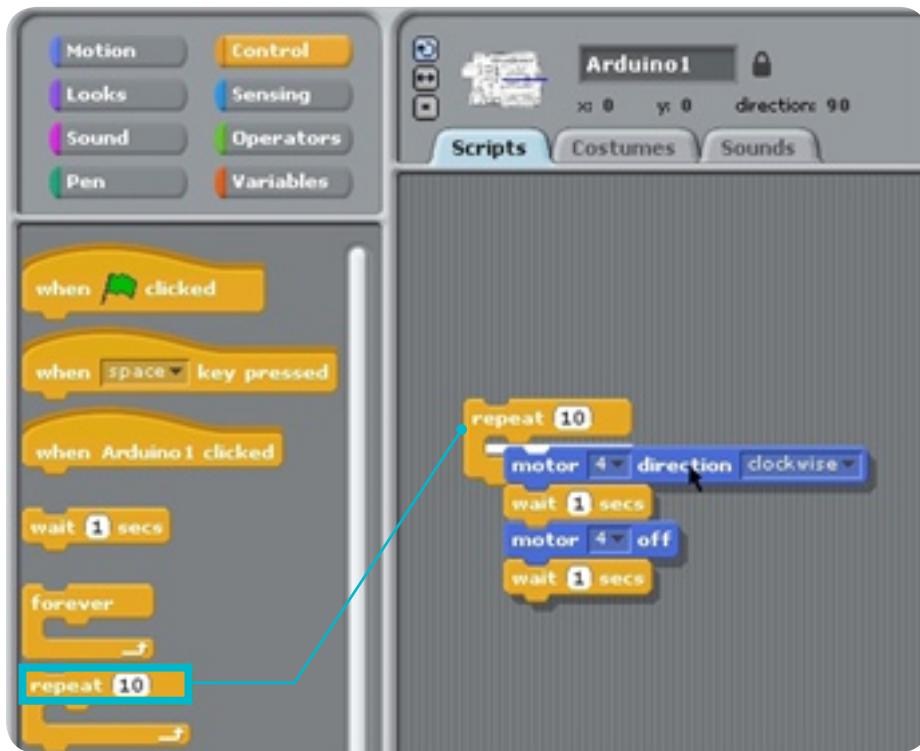
If you activate this program, you will see the motor repeat turn on and off continuous. This is on infinite repetition.



Intro to 'Loop'

'Repeat' Block

Now, we will learn about a loop that will repeat a certain number of times. If you want the motor to rotate 10 times, you just need to drag 'Repeat 10 times' block to the script. Take the 'Infinite repetition' block and change it to the 'Repeat 10 times' block



You should've seen the motor turning on and off 10 times!

These are two types of loop we will be using in this lesson.

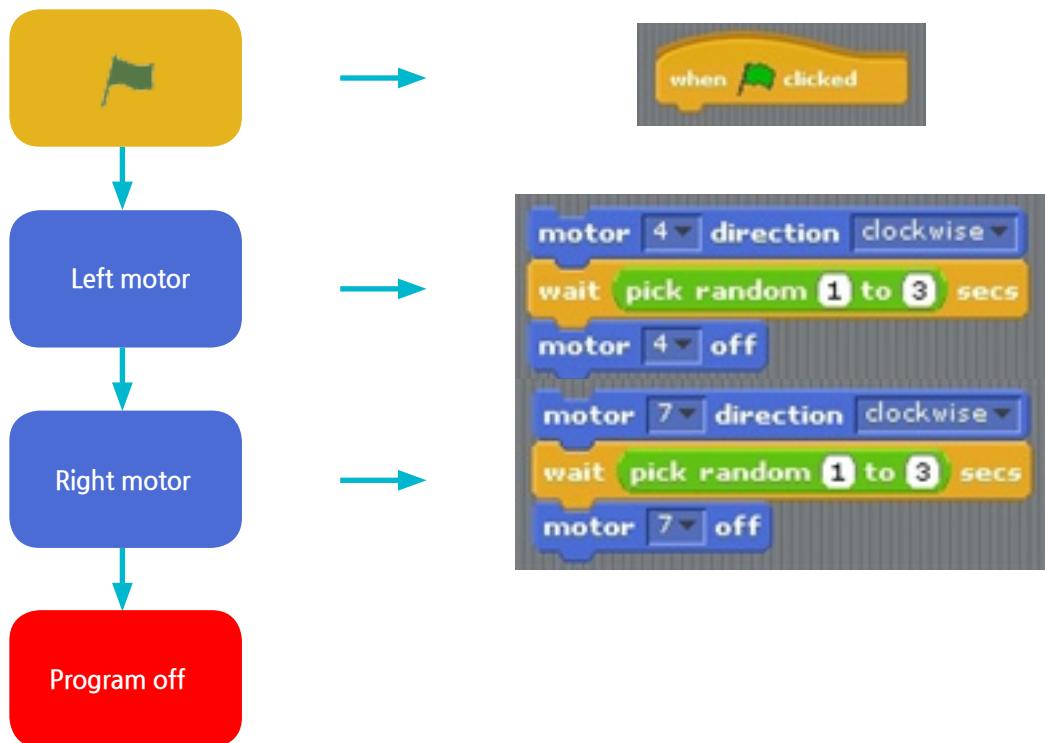
Loop and Random Numbers

Wiggly Lizard Robot

Now, you understand what loops are. Let's make a simple game program.

This game is called 'Wiggly Lizard Robot!' We will code for the left motor and the right motor to move for a random amount of time to make the lizard robot move forward. Instead of moving once and stopping, we will use a loop to keep the robot moving for a certain amount of time.

Refer to the picture below





Loop and Random Numbers

How to Code a Wiggly Lizard Robot

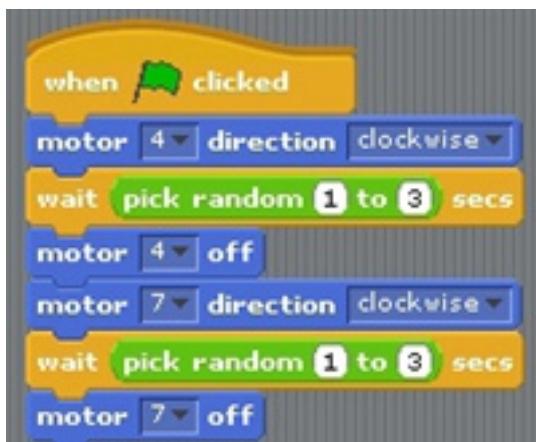


This code will make the left motor turn on and off for a random amount of time



This code will make the right motor turn on and off for a random amount of time. This is using what we learned about random numbers before.

Connect the codes and look below.



If you activate this code, the left motor will turn on and off for 1-3 seconds and then the right motor will turn on and off for 1-3 seconds.

Loop and Random Numbers

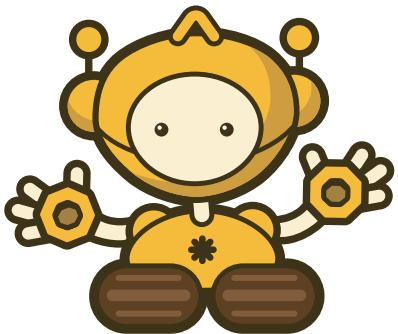
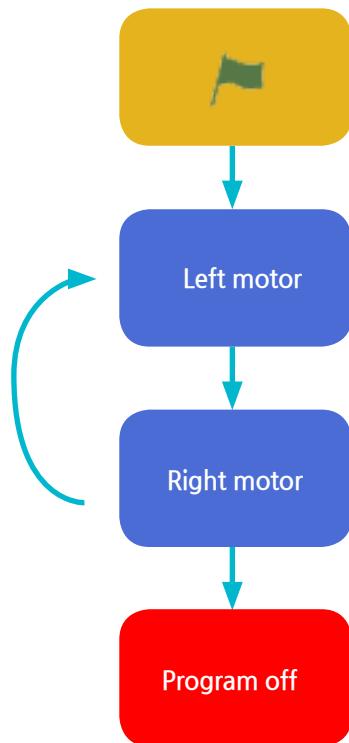
How to Code a Wiggly Lizard Robot

If you activate the script we have been making, the lizard robot will stop after moving once, so it cannot move forward!

Therefore, we need something that will repeat the program. It's loop!

Look at the picture on your right. You have to add a block, so the left and right motors are keep activated.

But, the right picture is not right. This will not give some time for the lizard robot to stop after the movement of the right motor. So we will need to give some time for it to stop in between!



Way to go, lizard robot!

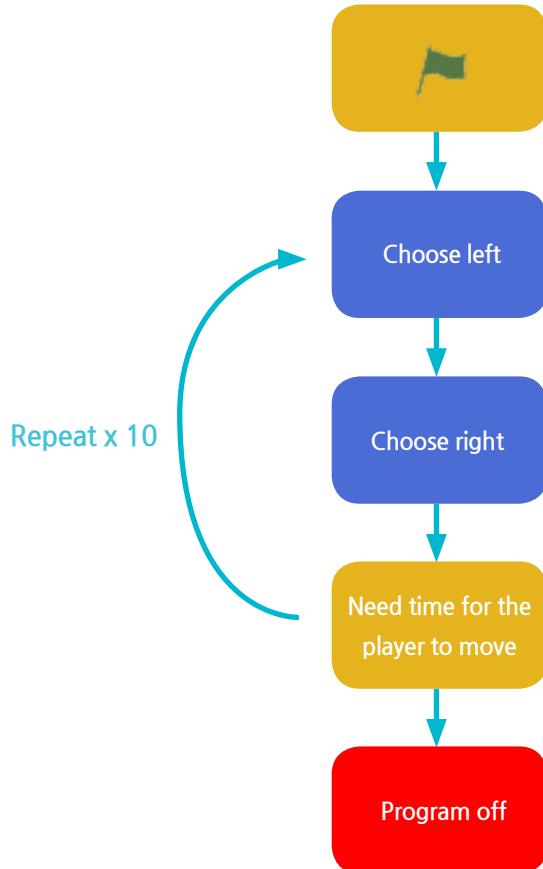
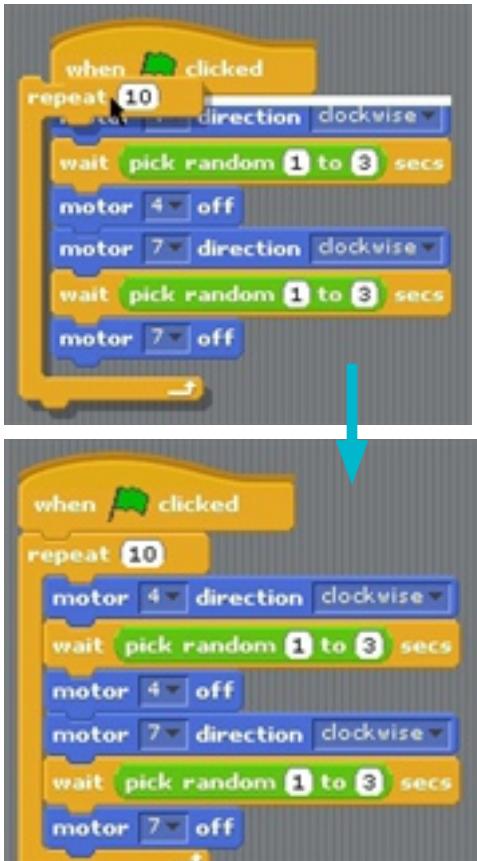


Loop and Random Numbers

How to Code a Wiggly Lizard Robot

For the lizard robot to activate well, it needs some time to wait before moving left motor after the right motor. This sequence is different from the one before. We will set the lizard robot's motor to activate, wait 1 second, and activate again.

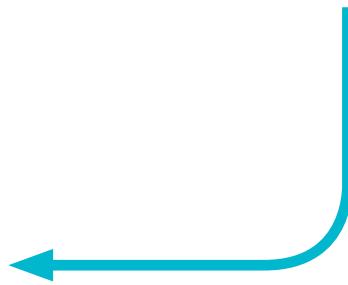
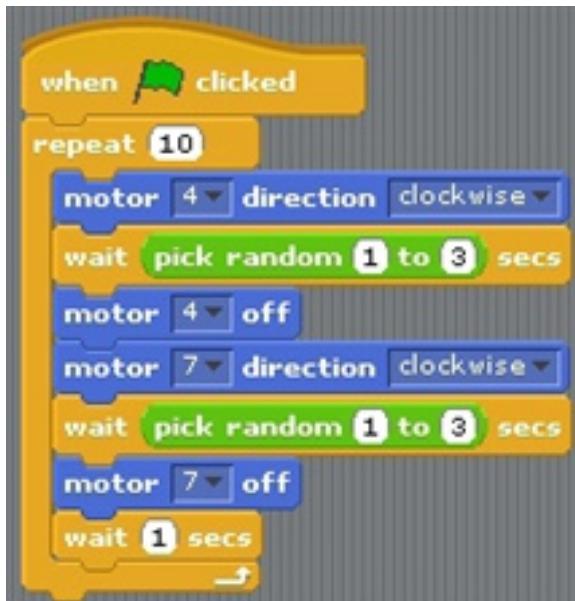
First, drag 'Reapeat 10 times' block to your code.



Loop and Random Numbers

How to Code a Wiggly Lizard Robot

We will make the lizard robot wait for each motor to move. To do this, add the 'Wait 1 second' block like the picture below.

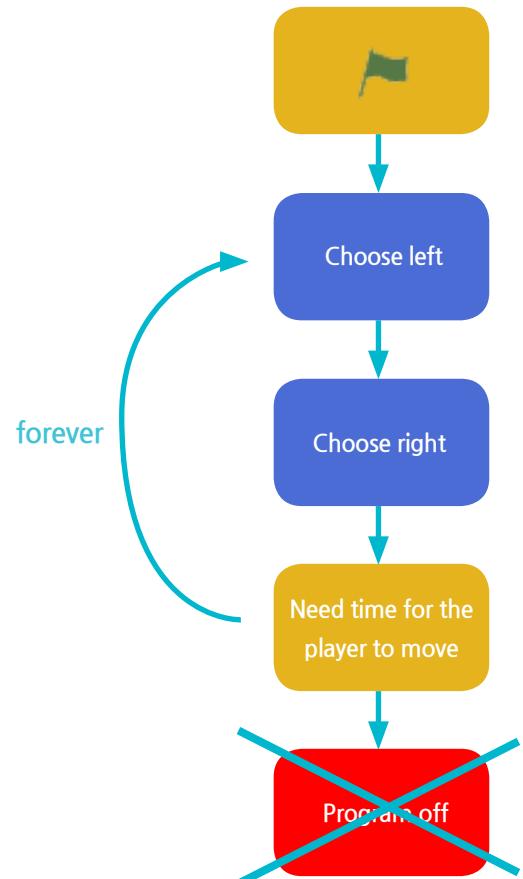
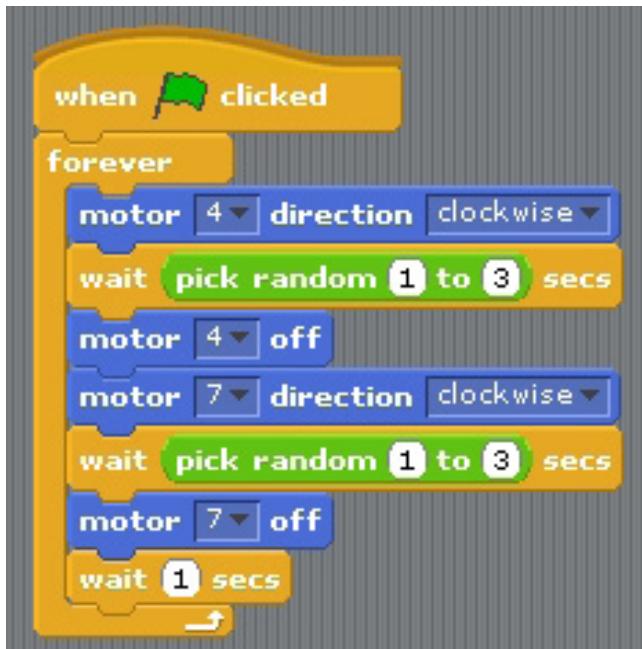




Practice

Play 'Wiggly Lizard Robot'

If you want to repeat more than 10 times, try using the 'Infinitely repeat' block. It will look like below!



For now, the sequence looks like this!

See how there is no 'Program off' anymore! The computer will infinitely repeat this script, so it never ends. If you want it to end, you will have to turn it off.

Now, race with each other's lizard robots! The one that goes the farthest is the winner!

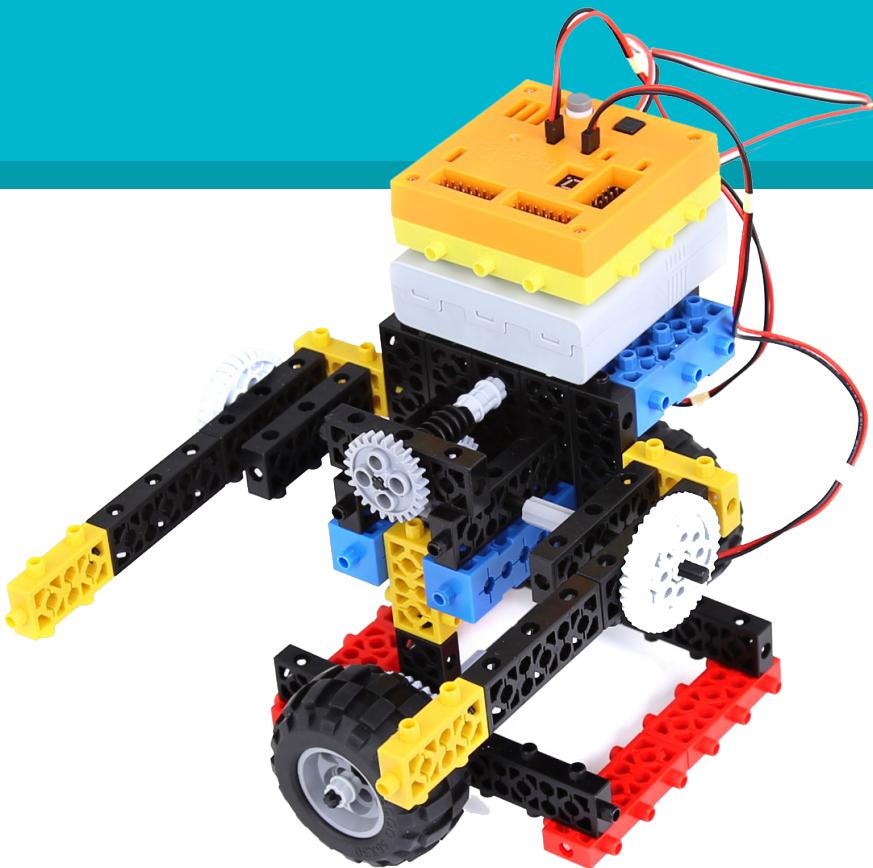
S C R A T C H C O D I N G K I T

Logic boost

Gunman robot

LESSON

4





How to Make a Robot

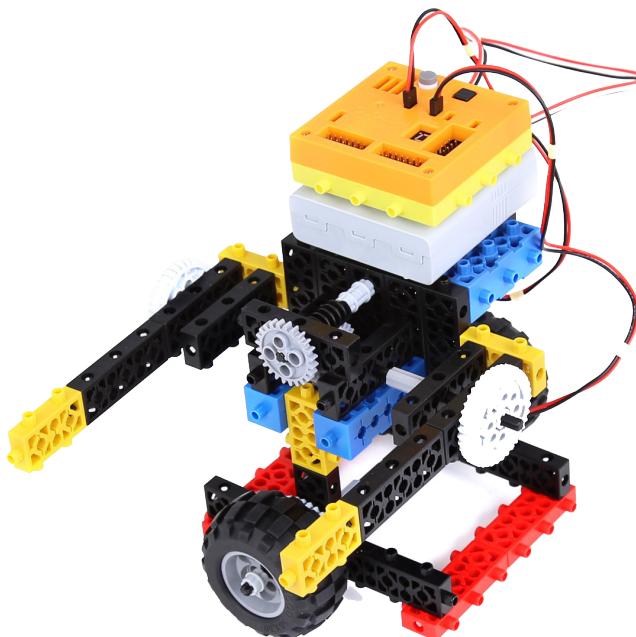
Gunman Robot

Let's make a moving gunman robot. Using Scratch, it can move forward/backward and shoot rubber bands. Just like you learned before, we are going to use the arrow keys on the keyboard to activate the motors.

There are two motors used in Gunman robot. One helps it to go forward/backward and the other one shoots rubber bands. We are going to use the left and the right arrow keys to move the robot. The space bar will shoot the rubber bands.

If you remember how to control motors using arrow keys, you will be able to code the program easily this time. It won't be hard to change from the arrow keys to the spacebar.

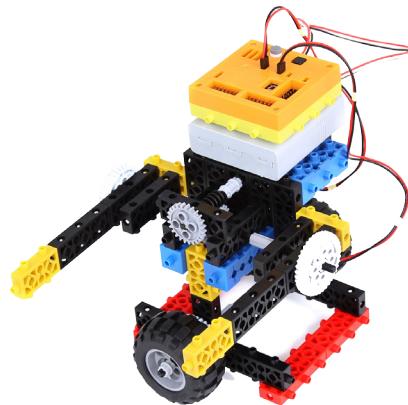
Let's go!



How to Make a Robot

How to Make a Moving Gunman Robot

We will be learning what each motor does for the gunman robot. As you know, one DC motor will help the robot to go forward/backward, and the other DC motor will be shooting rubber bands. Let's make the model first.



Materials needed for Gunman

x 2	x 2	x 2	x 3	x 7	x 9	x 2	x 2	x 2
x 5	x 1	x 2	x 4	x 1	x 6	x 3	x 1	x 2
x 1	x 1	x 1	x 1	x 2	x 2	x 2	x 2	

How to Make a Robot

How to Make the Gunman Robot

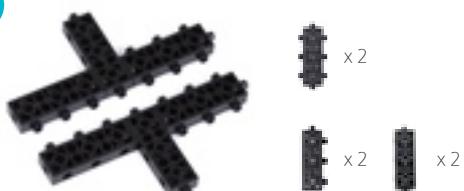
1



x 2

x 2

2

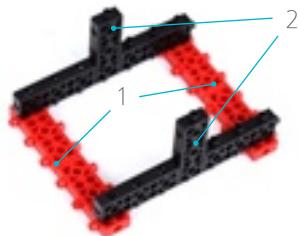


x 2

x 2

x 2

3



1

2

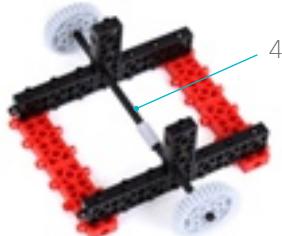
4

x 1
A64x 1
A96

x 2

x 1

5



4

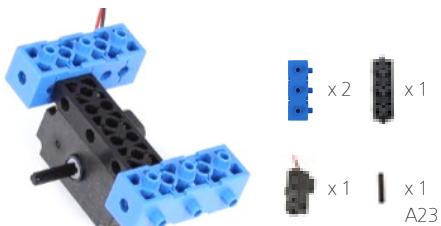
6



x 2

x 2

7



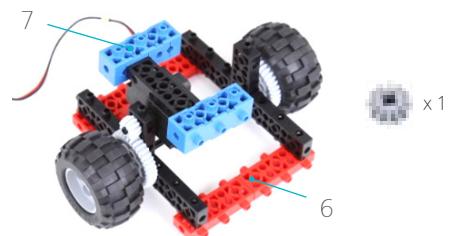
x 2

x 1

x 1

A23

8



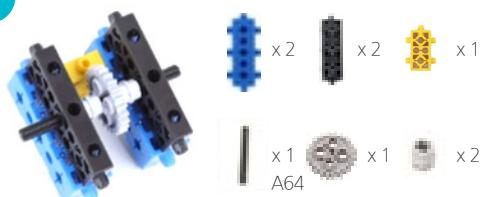
6

x 1

How to Make a Robot

How to Make a Gunman Robot

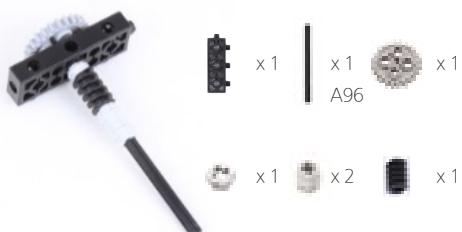
9



10



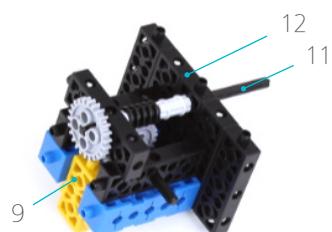
11



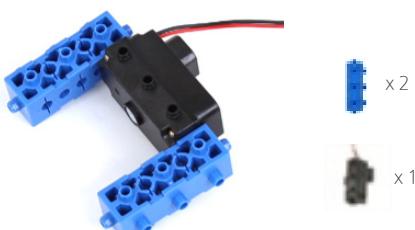
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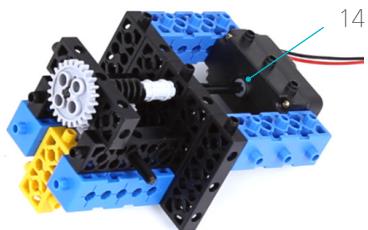
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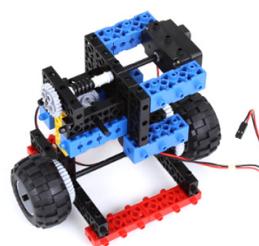
14



15



16





How to Make a Robot

How to Make the Gunman Robot

17



18



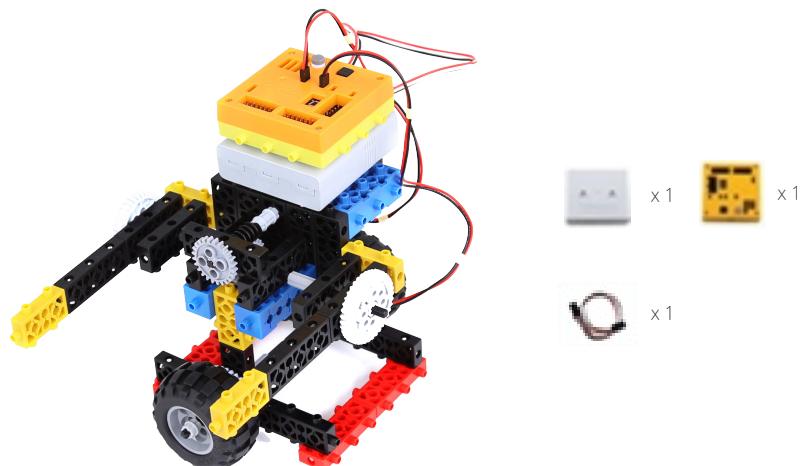
19



20



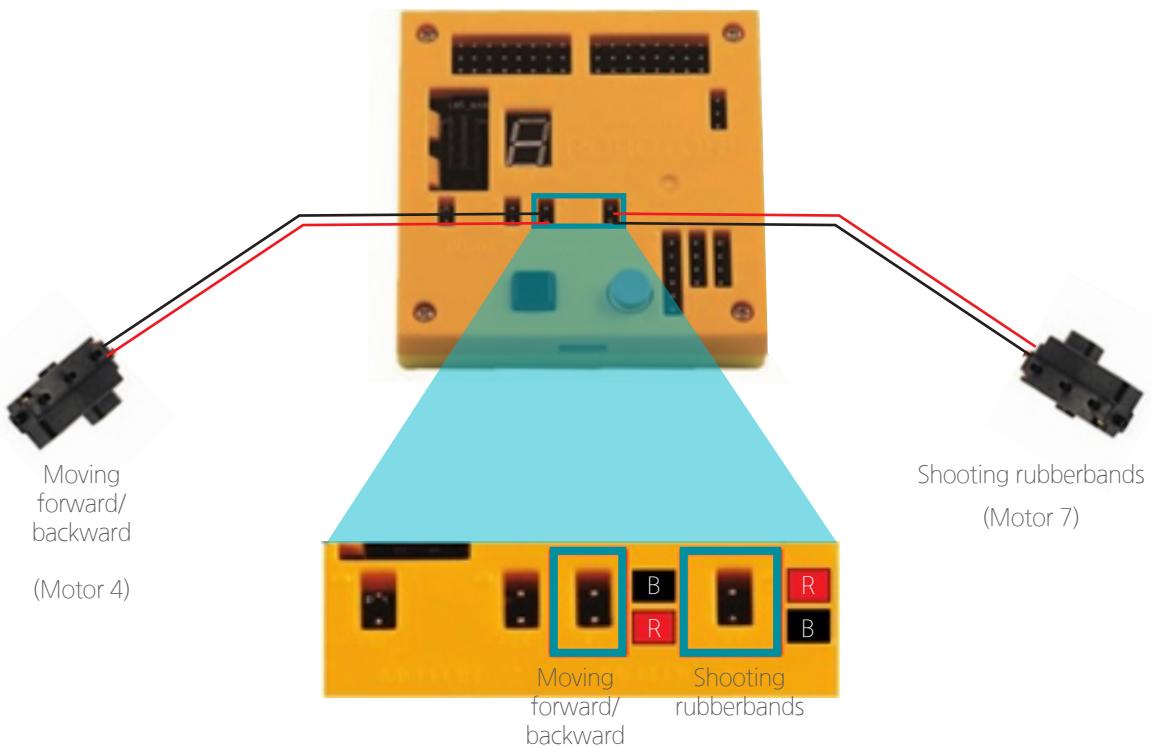
21



Connecting to the Main Cell

How should we connect the robot and the main cell?

Look at the picture below! When connecting the motor that will help the robot to move forward/backward, plug in the black cable on the top pin and the red one to the bottom pin. When connecting the motor that will be shooting rubber bands, plug in the red one on the top, and the black one to the bottom.



*Be careful when plugging in the cables

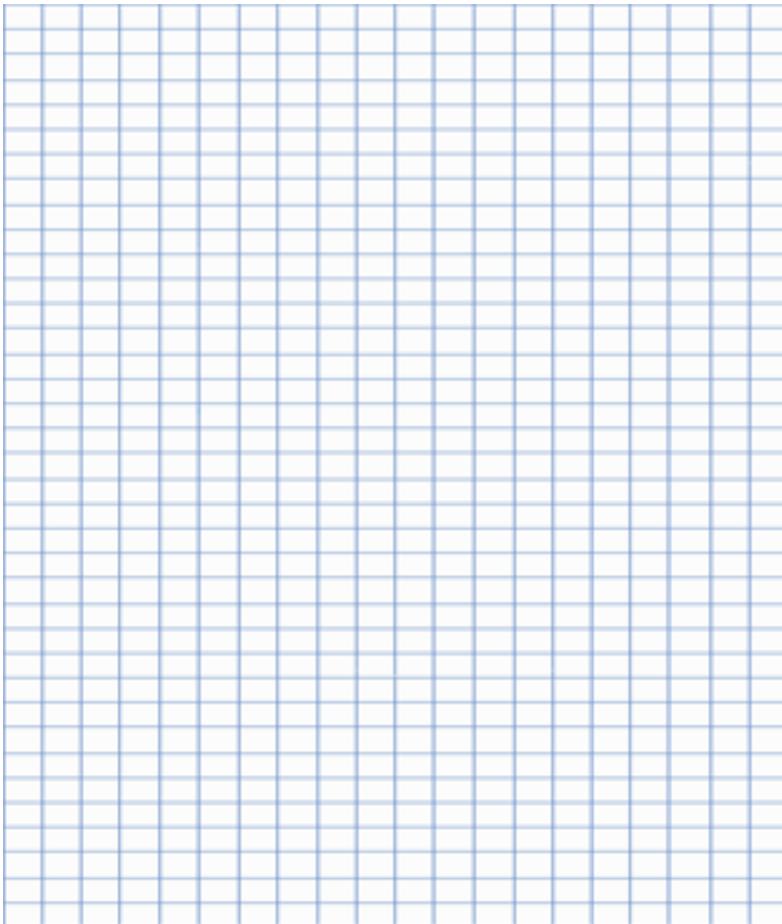


Exercise

Coding the Gunman Robot

Try coding by yourself. When you press the left arrow key, the robot has to go left and when you press the right arrow key, the robot has to go right. When you press the space bar, it has to shoot rubber bands using the motor. Motor 4 moves the robot, and Motor 7 shoots rubberbands.

Let's try it!



Explanation

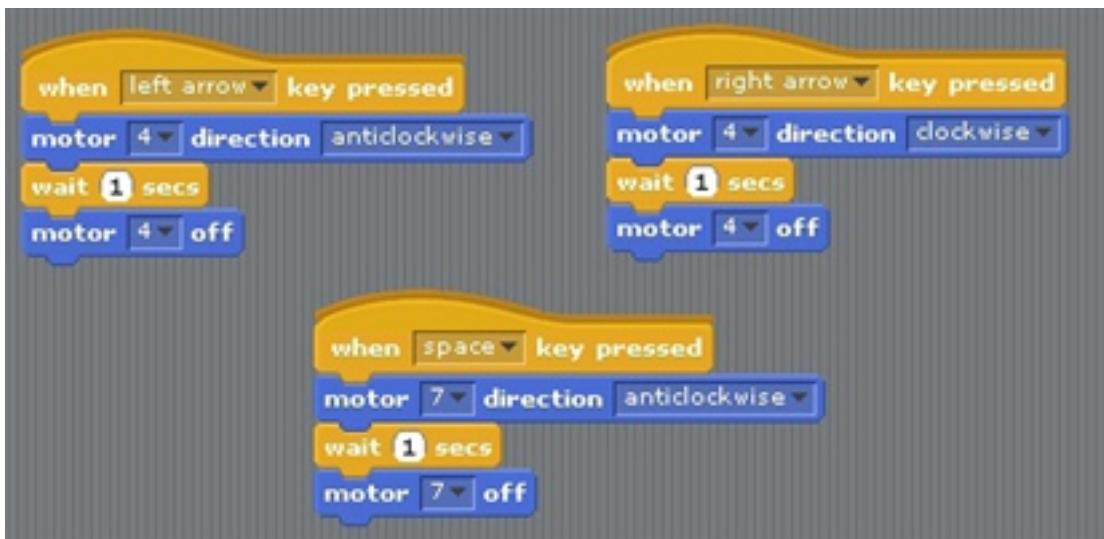
Controlling the Gunman Robot

Were you able to code it? Did it work correctly?

If it did, then great job!

But, if it didn't go well, refer to the script below.

If you press the left key, Motor4 rotates counter clockwise for 1 second. If you press the right arrow key, Motor4 rotates clockwise for 1 second. By doing this, you can move the robot right then left. When you press the spacebar, Motor 7 rotates counter clockwise for 1 second to shoot rubberbands. Then, the script will look like this!





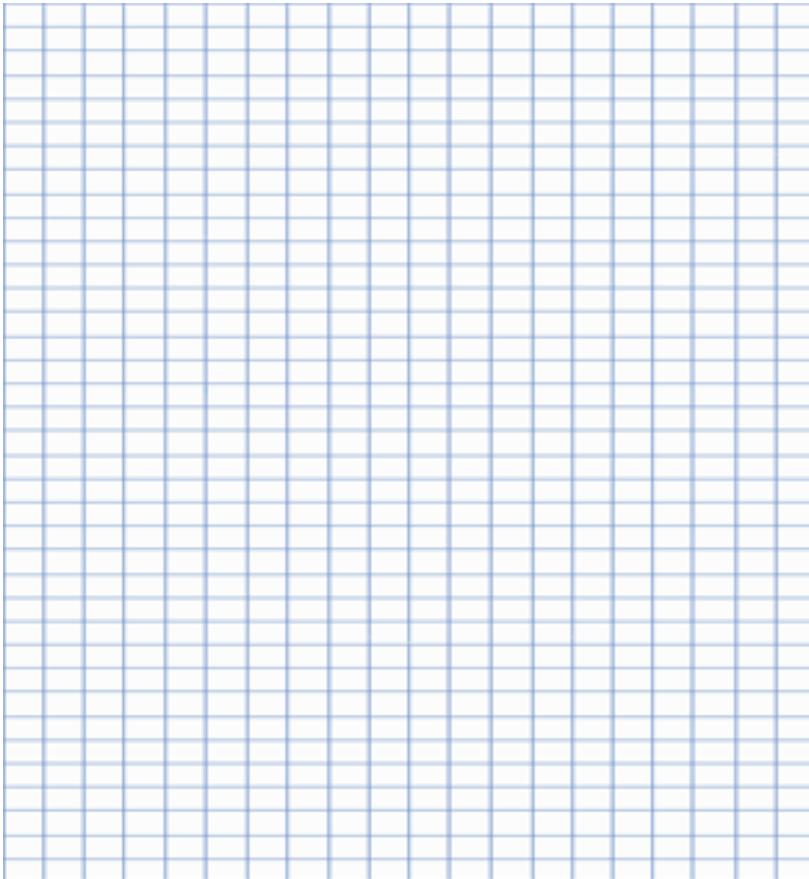
Exercise

How to code the gunman robot

Does the robot work well? Now, we are going to use 'Loop' and random numbers to slightly change the movement of Gunman. Before, spacebar caused the robot to shoot rubber bands.

Add a script so that when the flag icon is clicked, Motor 7 shoots the rubber band and waits 1-2 seconds. Then, make it repeat 5 times and stop the motor. Make sure the robot has five rubber bands since it will be shooting five times.

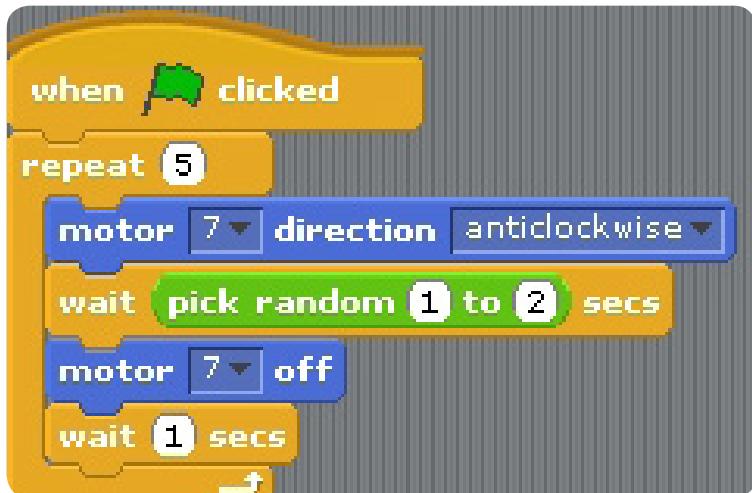
Try it!



Explanation

Controlling the Gunman Robot

Were you able to make the script? If it doesn't work well, refer to the script below. First, it has to start when the flag icon is clicked. Then, Motor 7 has to rotate counter clock wise five times. Also, Motor 7 has to wait 1-2 sec after its action. Then, Motor 7 will stop.



Now, code so that it moves in any way you want. You can try shooting down a heavy cell or light cell with rubber bands!

Try using different coding blocks for different movements!



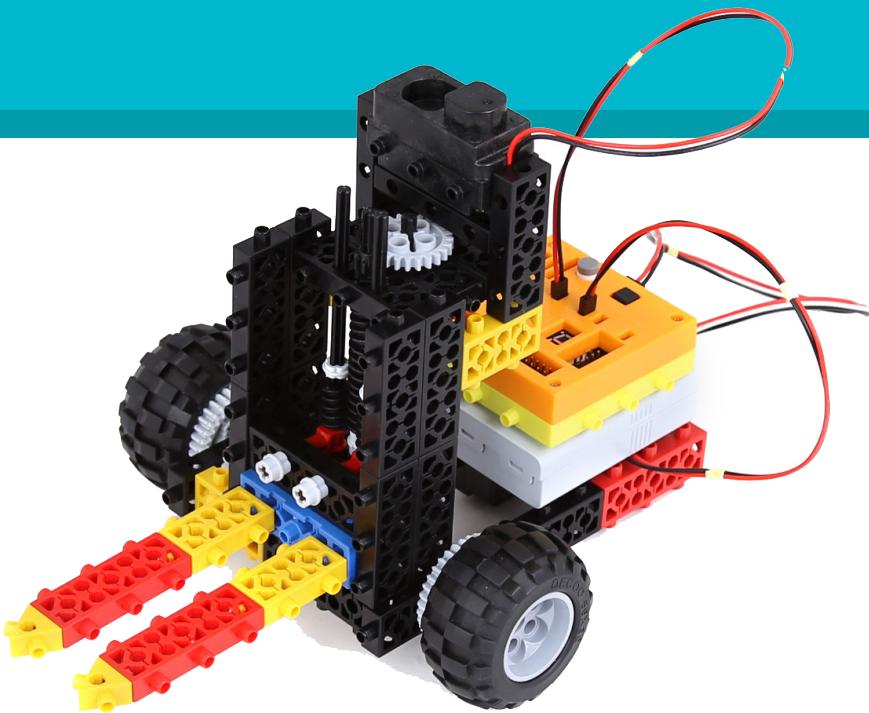
S C R A T C H C O D I N G K I T

Logic boost

Transport Robot

LESSON

5



How to Make a Robot

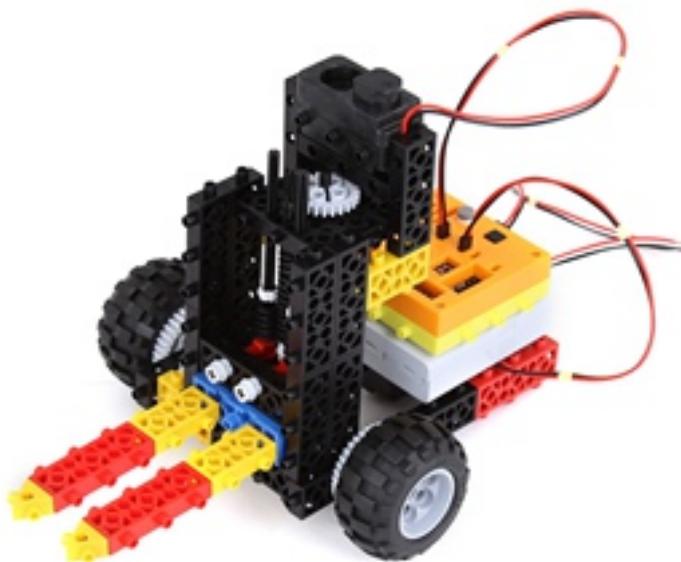
Transport Robot

Let's make a transport robot that can move stuff around. Using scratch, it can move forward/backward and carry stuff.

Two motors are used for the transport robot. It's similar with the gunman robot. One motor will be helping the robot to move forward/backward, and the other motor will help the robot to carry an object.

By coding the transport robot, you will be thinking about the sequence of its actions and code. We will be coding it in order, so that it moves in a way you want.

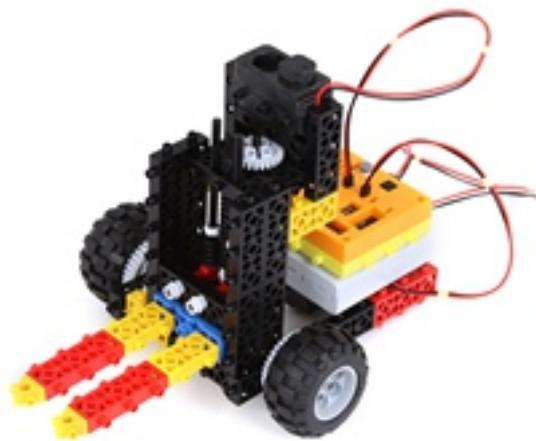
Let's go!



How to Make a Robot

Transport Robot

Let's make a transport robot!



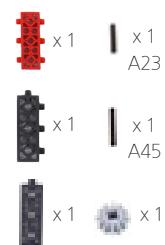
Materials Needed

x 1	x 1	x 3	x 10	x 5	x 3	x 2	x 2	x 6
x 2	x 2	x 1	x 2	x 4	x 5	x 4	x 3	x 1
x 3	x 2	x 3	x 4	x 2	x 2	x 2	x 1	

How to Make a Robot

How to Make a Transport Robot

1



2



3

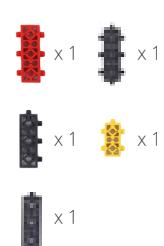
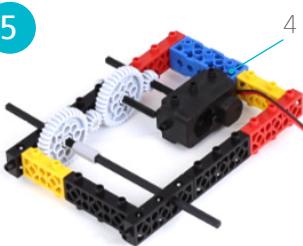


back

4



5



6



7



8



7

6

How to Make a Robot

How to Make a Transport Robot

9



x 1



10



back

11



x 2



12



x 1

13



x 1

A45



14



bottom

15



x 1

A64

x 1

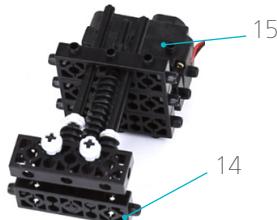
A64

x 1

A64

x 1

16



15

14

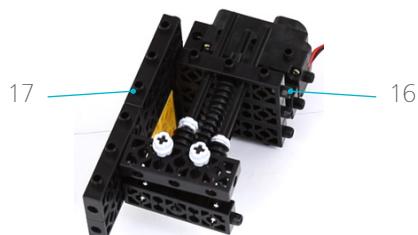
How to Make a Robot

How to Make a Transport Robot

17



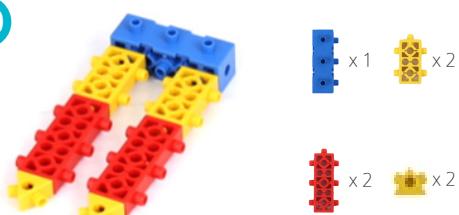
18



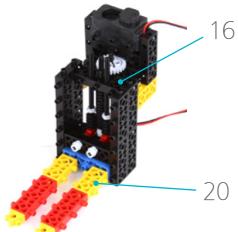
19



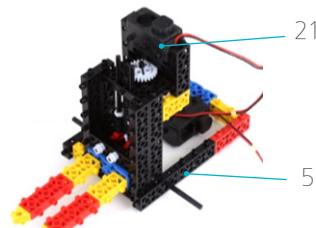
20



21



22



23



24



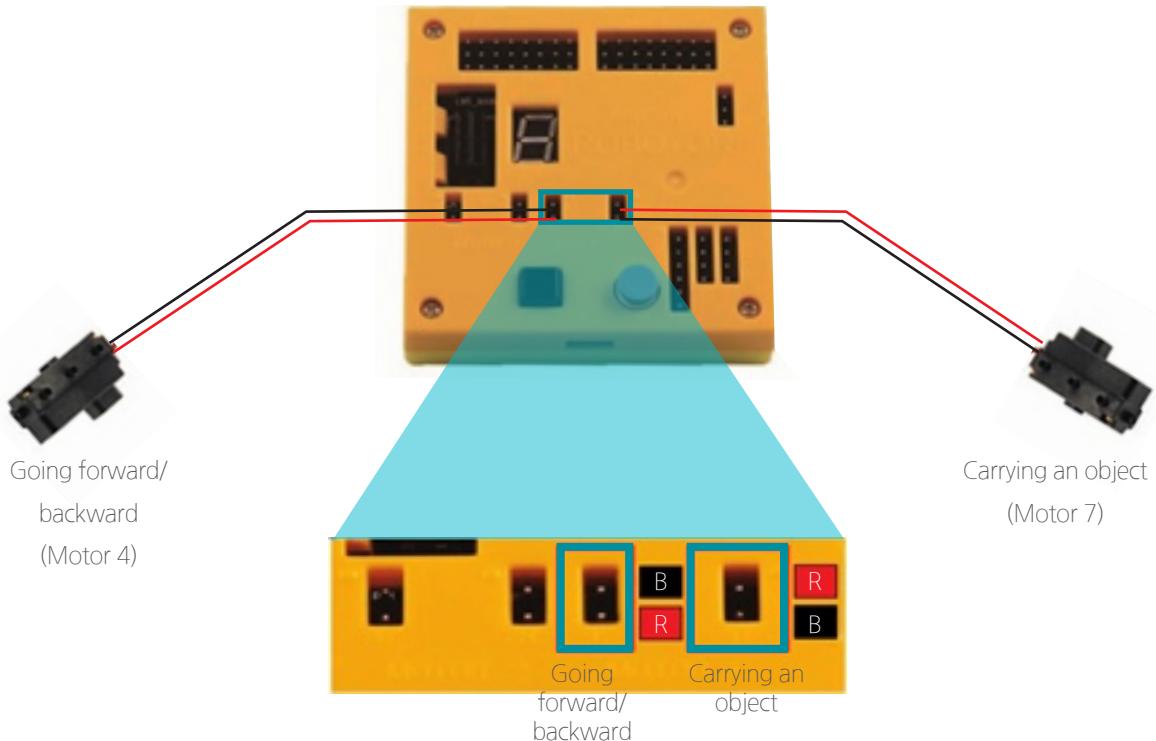


Connecting to the Main Cell

Connecting the Transport Robot

How should we connect the main cell and the robot?

Study the picture below! When plugging in the motor that will be moving the robot forward/backward, plug in the black cable on the top pin and the red one to the bottom pin. When connecting the motor that carries an object, connect the red cable to the top pin and the black cable to the bottom pin.



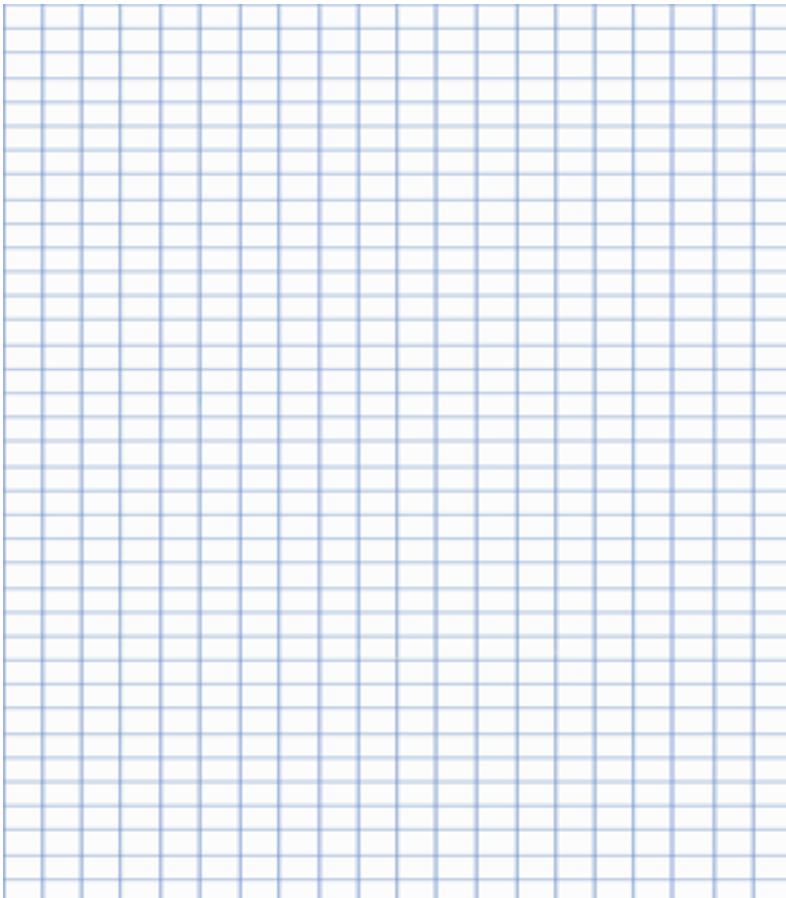
*Careful when plugging in the cables

Exercise

Coding the Transport Robot

Try coding this next part by yourself. When you press the flag icon, the robot has to go forward for 3 seconds, and lift up its part that carries an object for 1 second. Then, go back down for 1 second, and move backward for 3 seconds. Make it repeat infinitely.

Carefully make a sequence that can do the actions in order. Let's try it!





Explanation

Activating Transport Robot

Were you able to make the script?

If it did not work well, check the script on the next page.

When you press the flag icon, the script has to start and go forward by rotating Motor4 clockwise for 3 seconds. Then, rotate Motor7 clockwise for 1 second to lift up an object and rotate it back counter clockwise for 1 second to completely carry it.

Then, rotate Motor 4 again counter clockwise for 3 seconds to move the robot backward.

Let's look at the script on the next page.



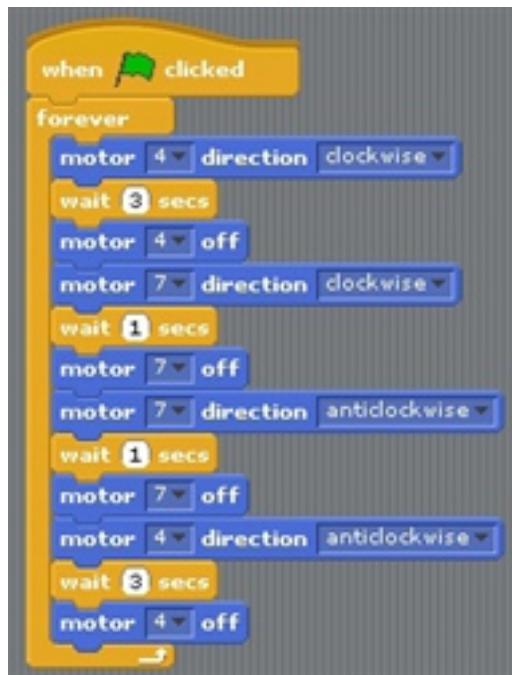
Explanation

Activating Transport Robot

Do you understand this script?

If you carefully think about the order of its movements, it's easy to code.

Organizing each action in the right order is also called sequencing.





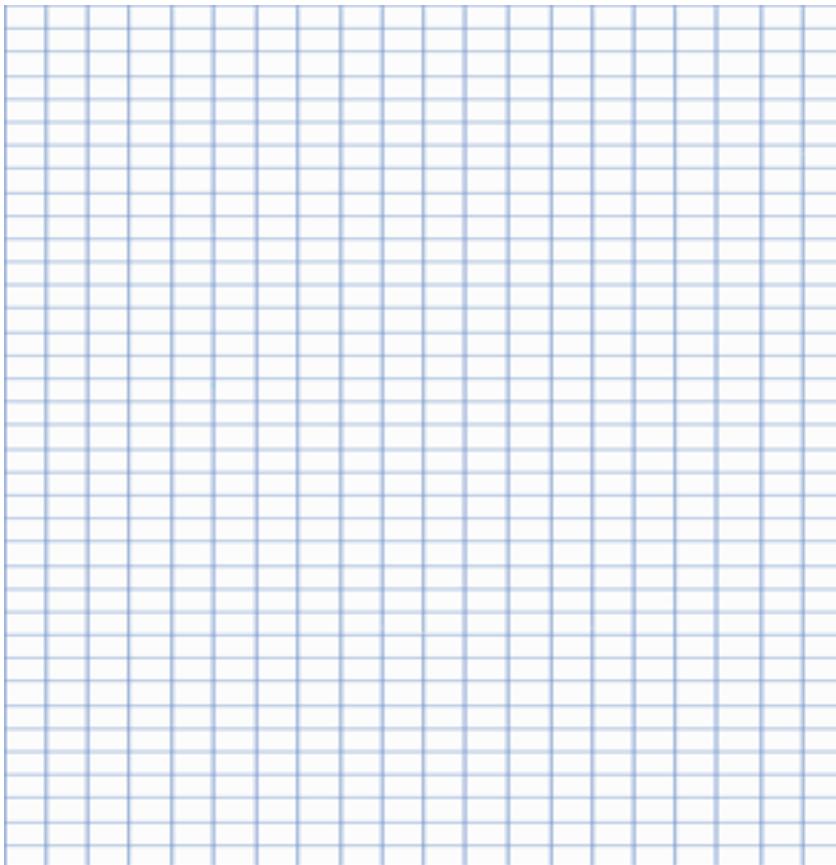
Exercise

Coding Transport Robot

Try coding the robot so it moves.

When you press the left arrow key, the robot moves forward and the right arrow key moves the robot backward. The up key lifts up the object and the down key puts it down. Each movement goes for 1 second.

Refer to the code of Gunman robot.



Explanation

Activating Transport robot

Did you finish coding?

Did it work well? If it did, then good job!

But if it didn't work correctly, check the script on the next page.

Left key rotates Motor 4 clockwise for 1 second, and the right key rotates Motor 4 counter clockwise for 1 second. You can move the robot forward/backward using only one motor.

Up key rotates motor7 clockwise for 1 second, and the down key rotates motor7 counter clockwise for 1 second.

This is how you control the part that lifts up an object.





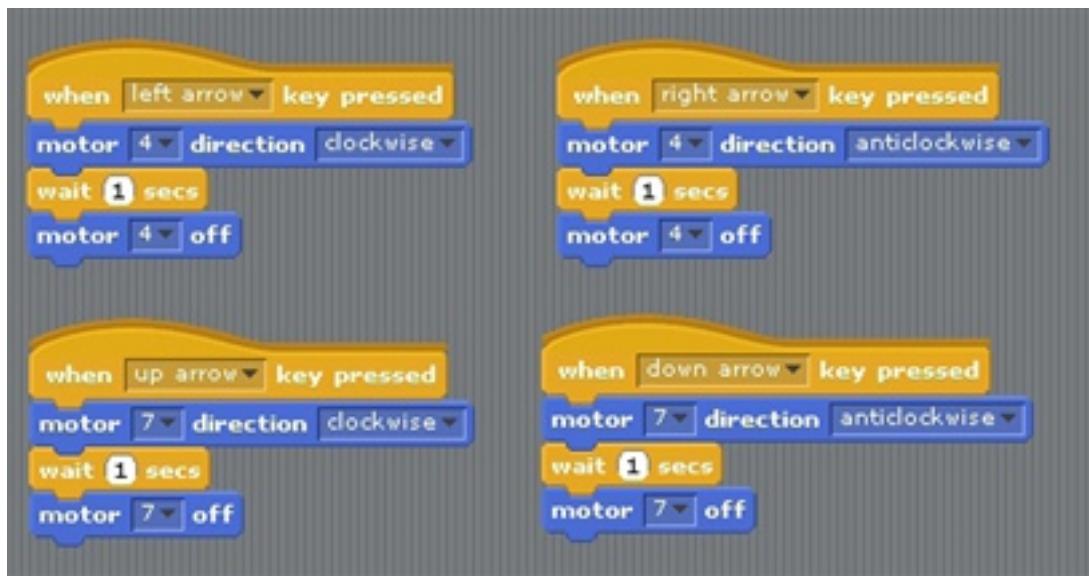
Explanation

Explanation

You can easily make this script, right?

Now, practice using the robot to move stuff around!

Feel free to change time or control keys!



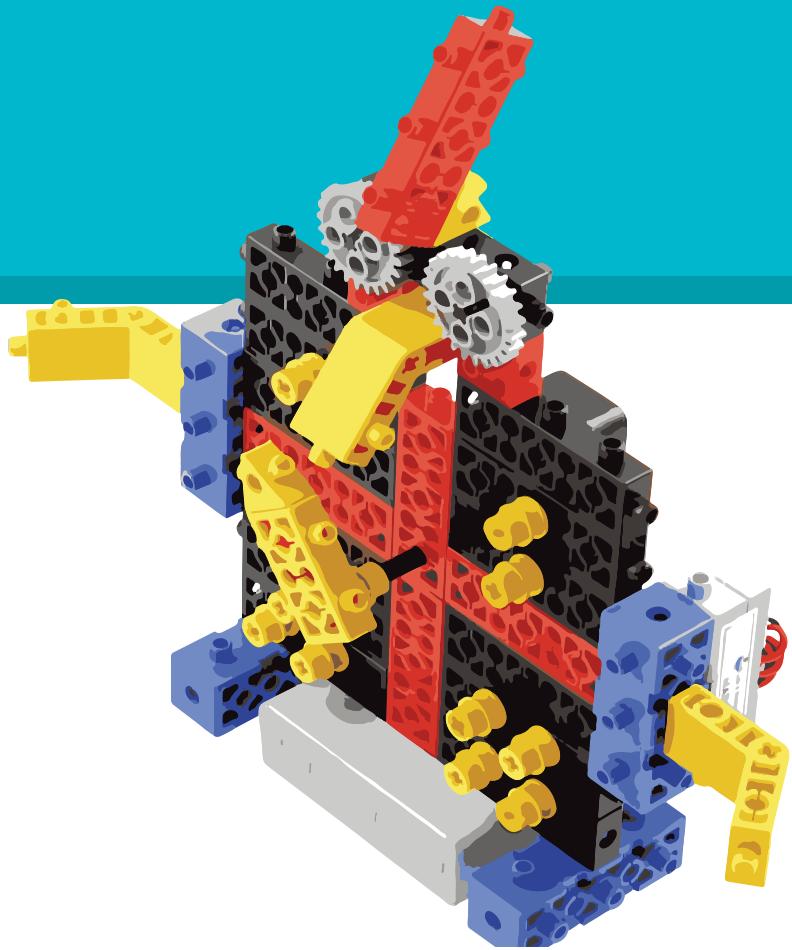
SCRATCH CODING KIT

Logic boost

Chicken Dart

LESSON

6





Exercise

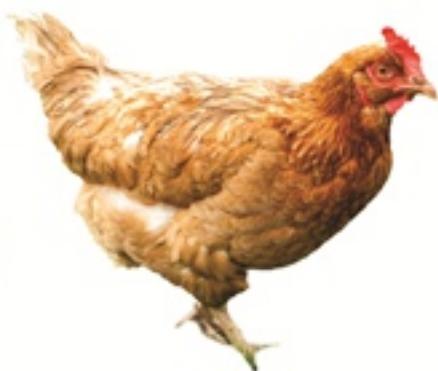
robotori Chicken Dart



Let's play a game with friends or family using the robotori chicken dart!

The robot will tell you what to do, and the winner is who gets to 'End' first. We are going to code so that the arrow of the robot stops turning after a random amount of time. It points to a number, and that's how many spaces a player will be moving on the board.

Should we start making the chicken dart?



Exercise

Making the Chicken Dart



Chicken Dart Materials

Diamond V6 x 4	Rubi 7 x 3	Rubi 4 x 11	Rubi 6 x 2	Rubi 0 x 2	Mini 2 x 3	Mini 1 x 2	Curve x 3
Triangle x 2	Sawtooth 24 x 2	Short connector x 2	Motorconnector x 11	A23 x 2	A45 x 1	Battery case x 1	DC motor x 1

CLASS 1

Exercise

1

1-1



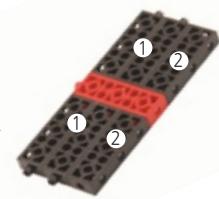
x 1



x 4



x 2



1-2



x 6



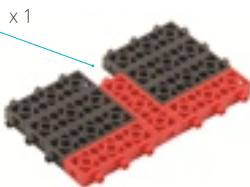
x 2



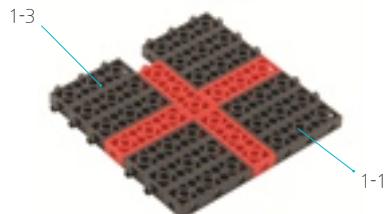
1-3



x 1



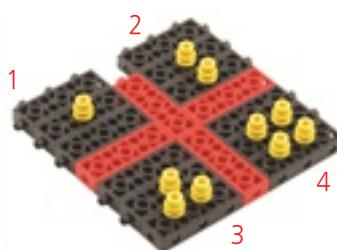
1-4



1-5



x 10



2

2-1



x 2



x 1



x 1



2-2



2-3



2-4



x 1



x 1



x 1



2-5

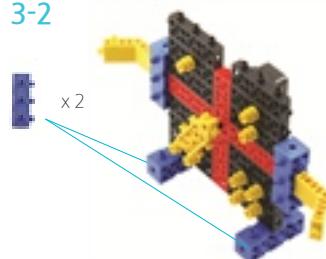


Exercise

3



3-2



3-3



3-4

Front



3-5

Back



4

Complete!

Plug in the motor to slot 4

Refer to the picture below

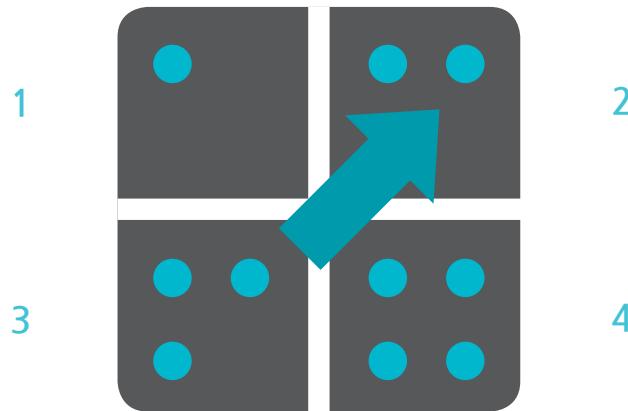




Exercise

Intro to the Chicken Dart

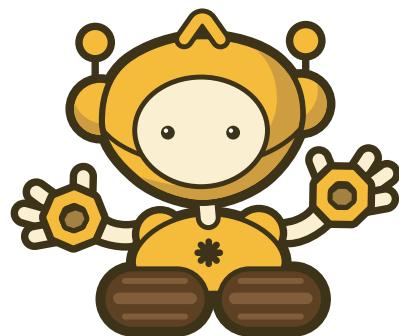
The chicken dart robot will tell you how many spaces to move on the game board. As you can see below, the chicken dart is divided in four parts:



Start the chicken dart when it's your turn. The arrow will point at a number after turning for a certain amount of time. The number of circles you see on it is the number of spaces you will be moving.

Now, try coding the chicken dart by yourself!

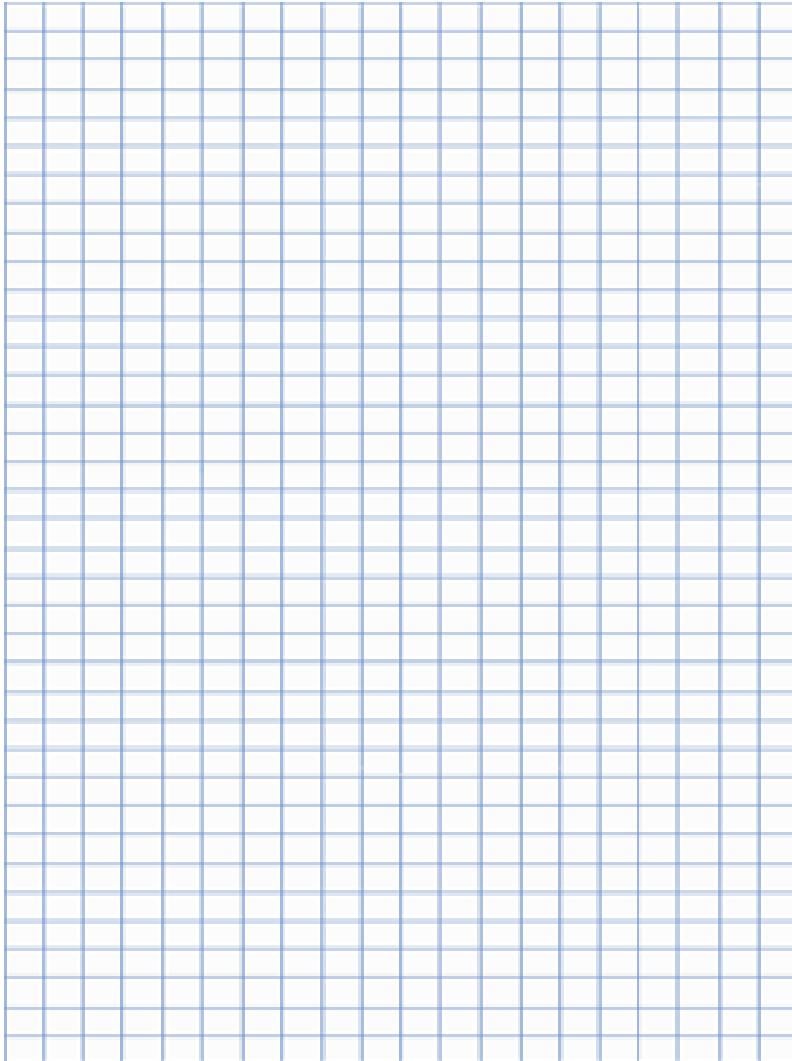
fighting



Exercise

Coding the Chicken Dart

Try coding the chicken dart by yourself. The DC motor has to rotate for a random amount of time and point a number. Use blocks that are related to the motor and random number blocks to complete a script!

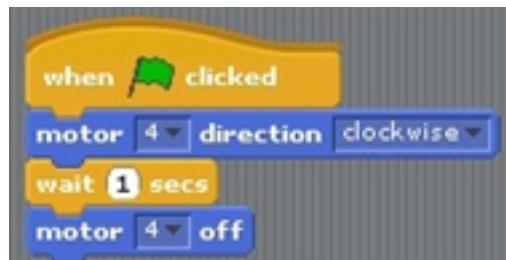




Exercise

Coding the Chicken Dart

First, make a basic script that will activate the motor. When the script starts, the DC motor has to activate for 1 second and stop.

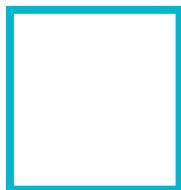


Now drag a green random number block into the script

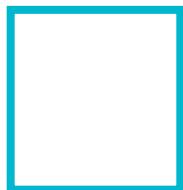


Your program will start a motor and stop for a random amount of time!

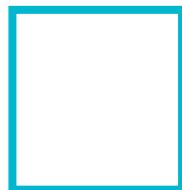
You just completed coding the chicken dart robot! Start the program 3 times and draw the part it pointed to.



1st try



2nd try



3rd try

Exercise

Rules of the Chicken Dart Game

Use the game board on the next page. Every player needs their own game piece. Use different colored cells of a robotori kit.

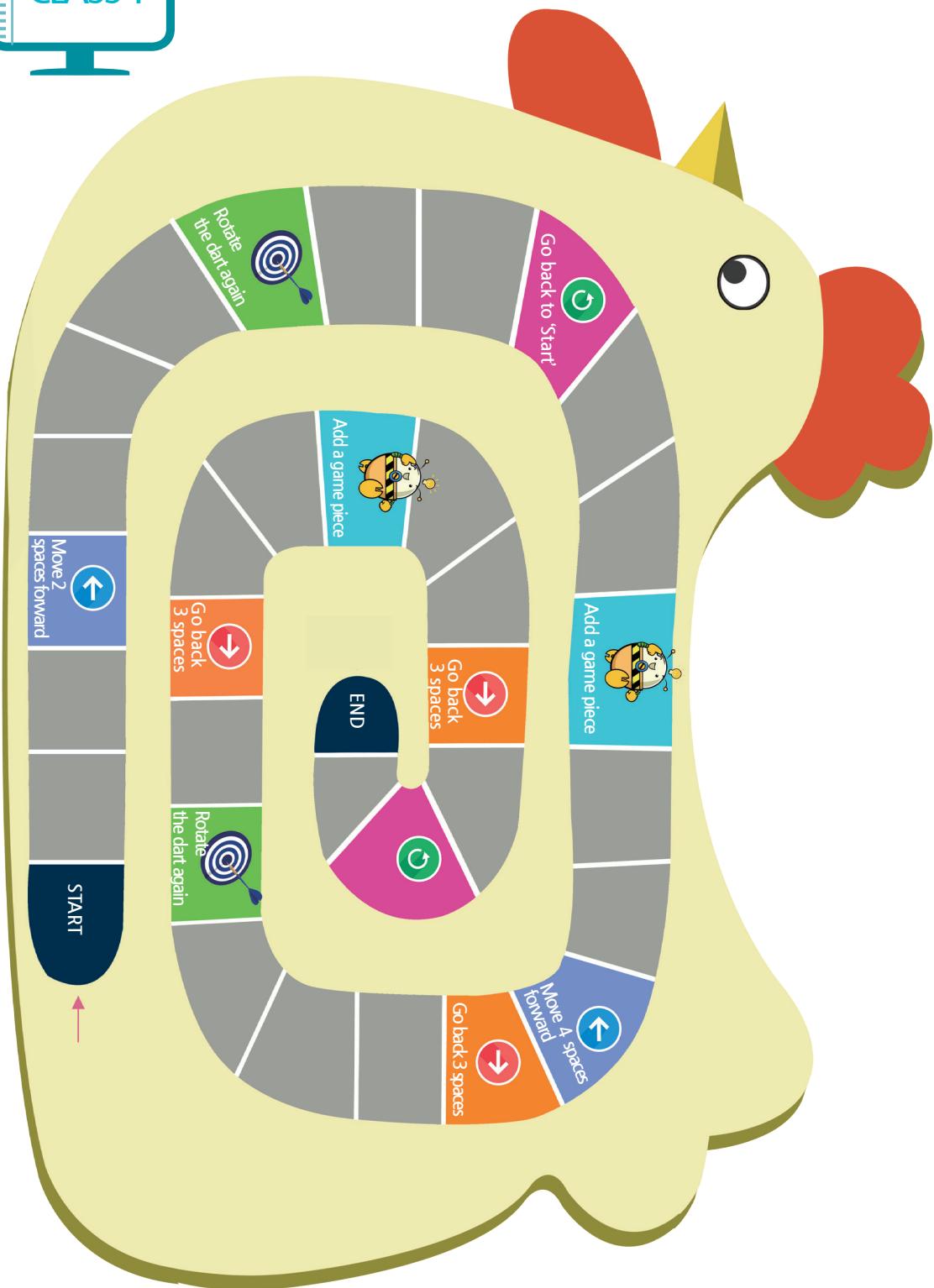
Robotori Chicken Dart Game Rules

1. Click the green flag icon to start the chicken dart program.
2. The number it points to is how many spaces the player can move.
3. If a player reaches the special space, he or she should read what it says and do what it says.
4. After every player gets a turn, the first person clicks the flag icon to start the program again.

The player who gets to 'End' first wins!

The board is on the next page. Have fun!

CLASS 1



FCC Information to User

This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one of the following measures:

- Reorient or relocate the receiving antenna.
- Increase the separation between the equipment and receiver.
- Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.
- Consult the dealer or an experienced radio/TV technician for help.

Caution

Modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.

FCC Compliance Information : This device complies with Part 15 of the FCC Rules. Operation is subject to the following two conditions: (1) This device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.

This equipment complies with FCC radiation exposure limits set forth for an uncontrolled environment.