Coding Monster

Exciting & Creative
Journey with a Hamster!

Exciting & Creative Journey with a Hamster!

Coding Monster

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Introduction

During the recent years, SW education has been emphasized worldwide according the change of the society. Many countries have already included SW education into their regular school curriculum, and we are following this trend as well. Keeping the pace with this trend, a few teachers have been running study groups to learn SW education since 2015, and from early this year, an organization called Association of Teachers for Computing (ATC) has been formed to perform various researches and training activities in local areas. This is how this book came to the world.

There are many other SW education books in the market. However, many teachers in the field still seek for an easier, kinder, and more detailed teaching material, and this book is responding to their wishes.

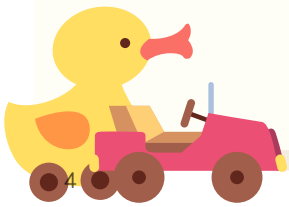
This is why this book pursues a format of a workbook, so that the teachers and students can apply this book right in the field. Also, in order to complete the coding education while naturally utilizing robots, during an authentic activity, this book is formed according to the modules, which includes a topic of a project.

I do recognize that this book might not be sufficient as this had been arranged and written in a short period time and based on little resources, however I hope this book plays a big role for teachers and students who just started to learn SW education. Moving forward, if any of the readers points out some lacking points of this book, I will willingly accept the ideas and keep them in mind for the better results.

Lastly, this book is a work of all the teachers in Association of Teachers for Computing (ATC), who did not hesitate to bring out ideas and join in writing job even during their busy daily lives with teaching. I was chosen to write down this introduction just because I was an older teacher among them. I deeply appreciate for all the teachers who have helped writing this book. Also, I thank Association of Teachers for Computing (ATC) who helped us publish this book and Prof. Kwang-Hyun Park of Kwangwoon University, who had pleasantly allowed us to refer to such many materials.

A Representative Author

Ho Jin Yu, Association of Teachers for Computing (ATC)



About This Book

This book is an educational material for coding that utilizes a hamster robot, which was developed in Korea, and uses the Scratch – educational programming language (EPL). The hamster robot contains various sensors and actuators in its cute and tiny body, and could get connected to the Scratch through Bluetooth. Thus, using this hamster robot, it is possible to provide a coding education that includes a specific operation activity, out of the computer screen. Students can move the robot using the code that they have built themselves, and will be able to learn the basic principle on how SW works in a real robot or other automation machines.

Profile of the Representative Author

- A Teacher of Sambo Elementary School
- A Leading Faculty of SW Education
- A Member of the Support Group of IT
- A Head of Training Department of SW Education, School Based Learning Communities, Appointed by Ministry Of Education
- A Member of Elementary SW Education Research Group of Chungcheongbuk-do
- An Author of Scholarship Materials for Support Group of IT (Chungcheongbuk-do) in 2015
- A Samsung Electronics Junior Software Academy Instructor in 2015
- An AT-Camp Instructor of Danjae Education Training Institute of Chungcheongbuk-do

Welcome to HAMZZI WORLD

Now, shall we adopt Hamzzi to raise him?
Let's show our attention to Hamzzi so that he could get along with us, and let's provide a nice environment just as the way Hamzzi likes.

Adopting Hamzzi

Welcome to HAMZZI WORLD

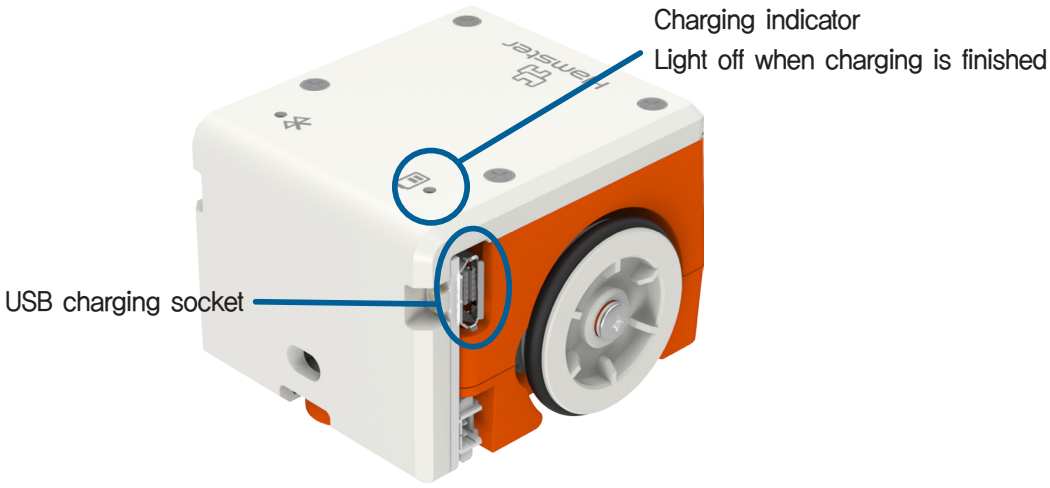
Unit 1. Feeding Hamzzi

Why don't you feed your newly adopted Hamzzi? Hamzzi cannot move if he is hungry.

Hamzzi's (hamster robot) food is electricity. Hamzzi can charge itself with electricity provided by a charger for a smart phone. Connect a micro USB plug to Hamzzi's charging socket. You can also charge by a USB cable. Connect a micro USB plug to Hamzzi's charging socket and connect the opposite plug to the USB port (socket) of a computer.

A charging indicator will light red during charging process, and when the charging is done, the light will be off. Fully charged, you can use Hamzzi for about 1 hour. (Charging 30mins, sustained operation 1 hour in average, waiting 12 hours max) It is better to charge after turning off Hamzzi.

If Hamzzi's battery is run out, the charging indicator would blink with red light, or Bluetooth connection indicator would occasionally and slowly blink with dark blue light. You must charge Hamzzi in these cases.



When the battery is run out, for Hamzzi produced in the beginning, Bluetooth connection indicator would occasionally and slowly blink with dark blue light, while for Hamzzi produced after November 20th, 2015, charging indicator would blink with red light.

Welcome to HAMZZI WORLD

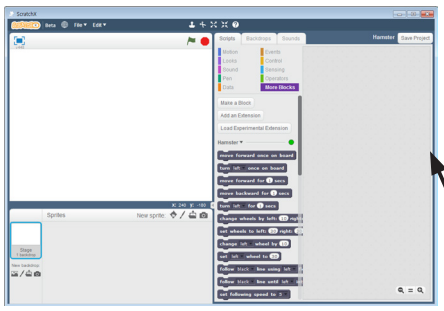
Unit 2. Installing Software

While Hamzzi is feeding himself, why don't you install software to have a conversation with Hamzzi?

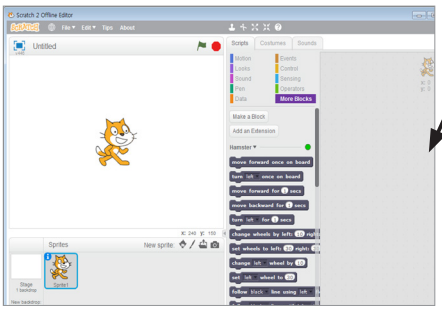
You need special software to control Hamzzi (hamster robot). The software needs to be installed before connecting Hamzzi and turning on its power. There are several softwares to connect Hamzzi as below:

Coding a Block Program

ScratchX online

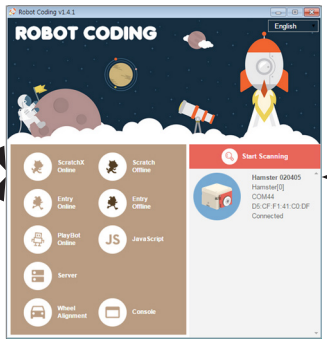


Scratch offline

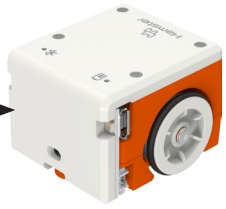


Controlling a Hamster Robot

Robot Coding software



Hamster Robot

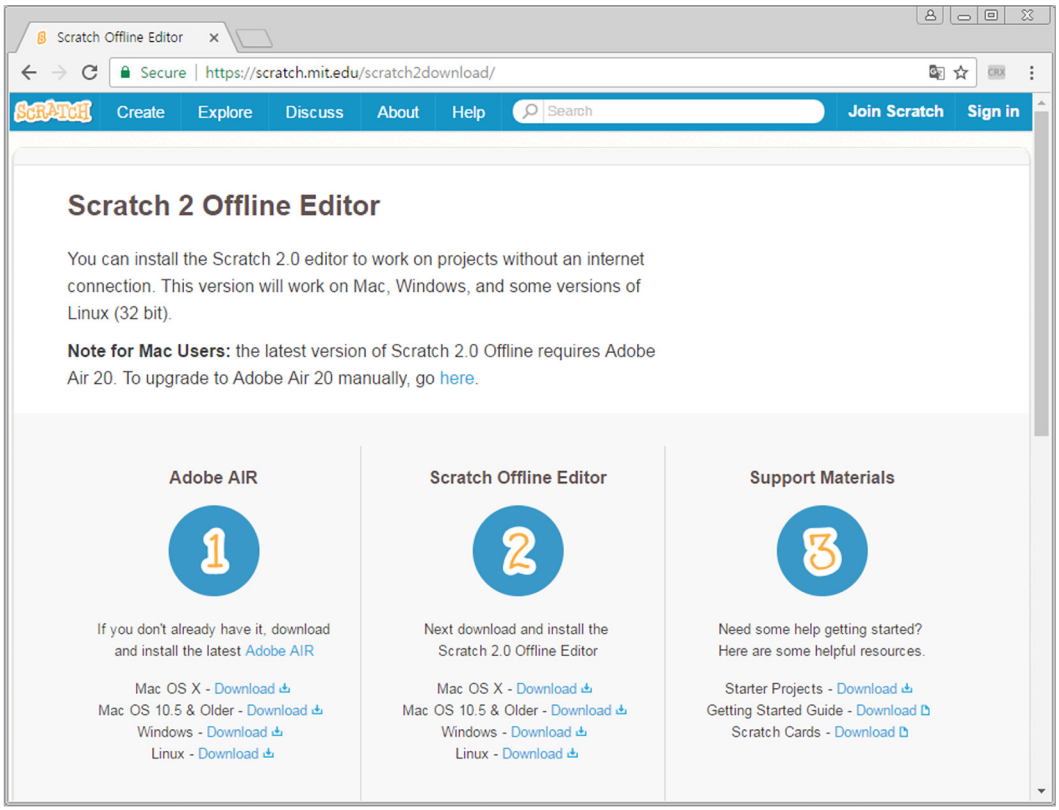


Now, shall we connect Hamzzi to the computer using Robot Coding software and Scratch offline?

① Enter below address in a Web browser's address bar.

https://scratch.mit.edu/scratch2download

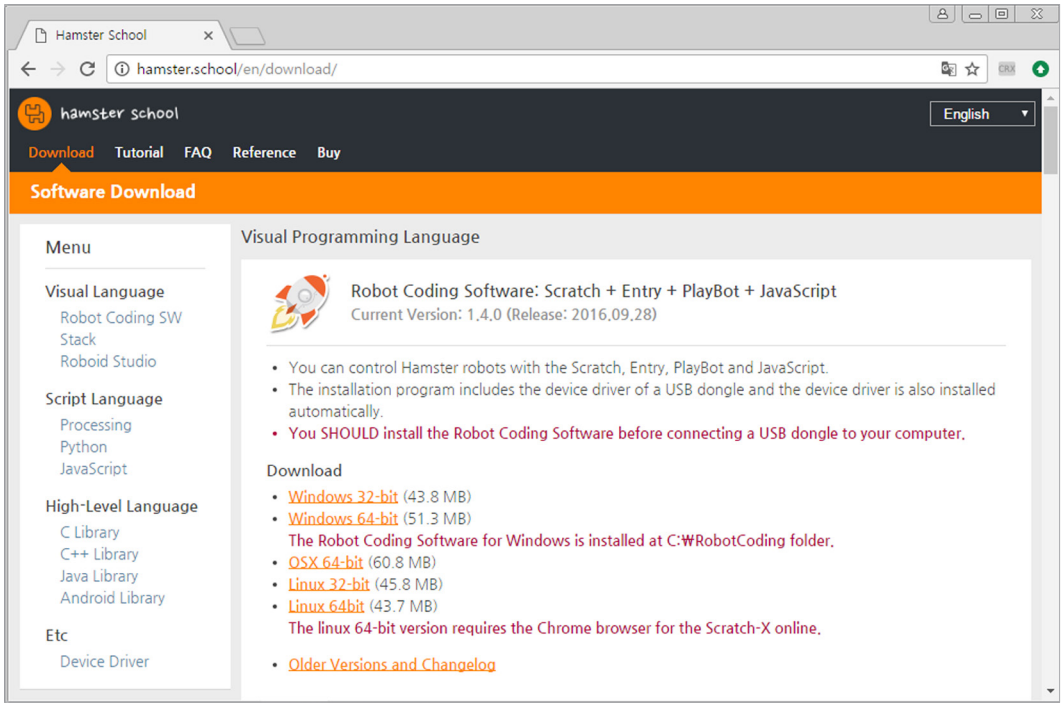
② Download and install the Adobe AIR and Scratch offline editor.



③ Enter below address in a Web browser's address bar.

http://hamster.school

④ Download and install the Robot Coding software.

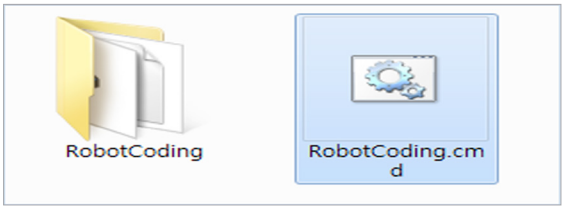


The installer of the Robot Coding software includes the device driver of a USB dongle and the device driver is also installed automatically.

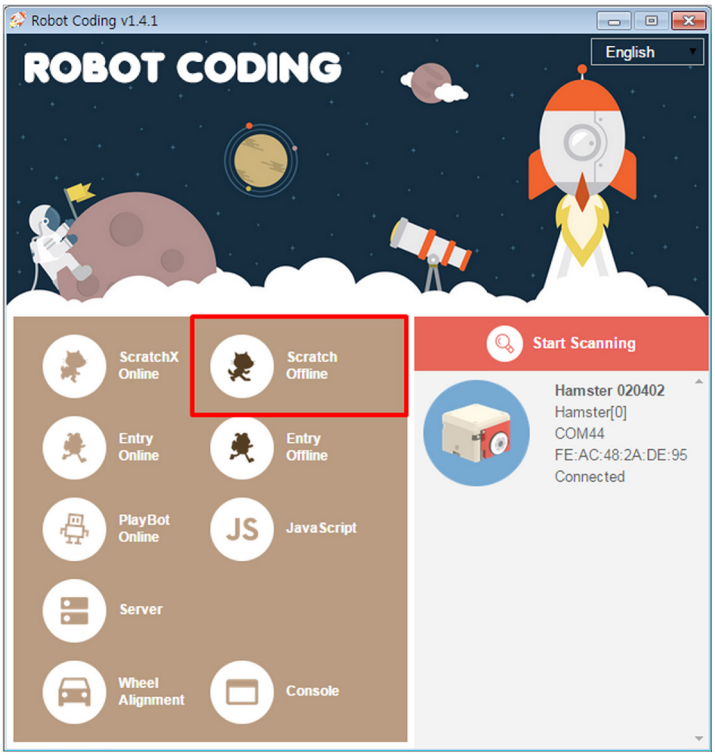
The Robot Coding Software for Windows is installed at C:/RobotCoding folder.

For OSX or Linux, refer to the hamster school webpage. (http://hamster.school)

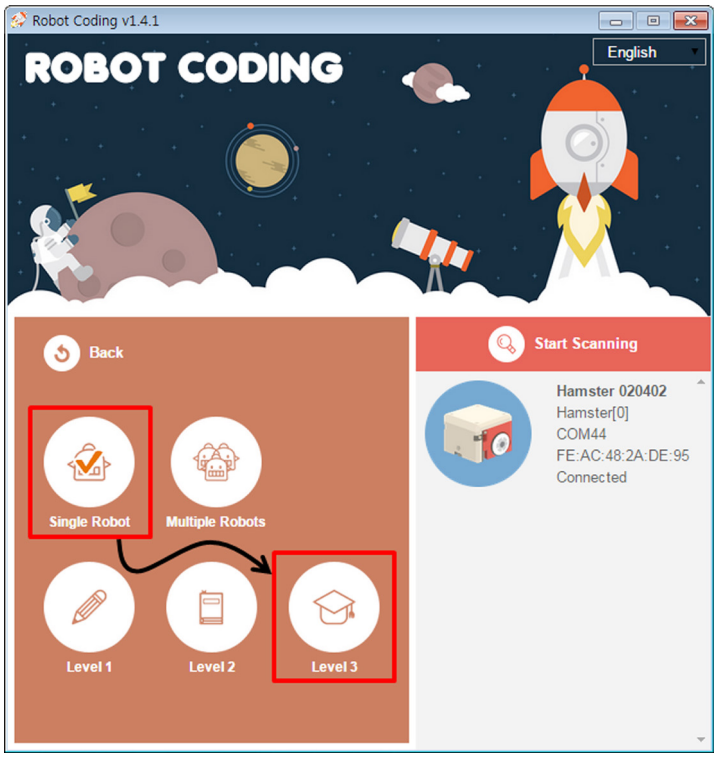
⑤ Double click on a RobotCoding.cmd file in the C:/RobotCoding folder.



⑥ Click on the “Scratch Offline”.



⑦ Click on the “Single Robot” and then “Level 3”.



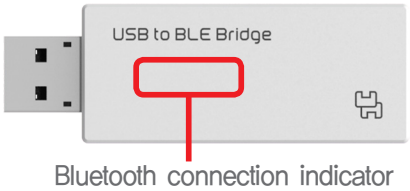
Welcome to HAMZZI WORLD

Unit 3. Connecting Hamzzi with PC

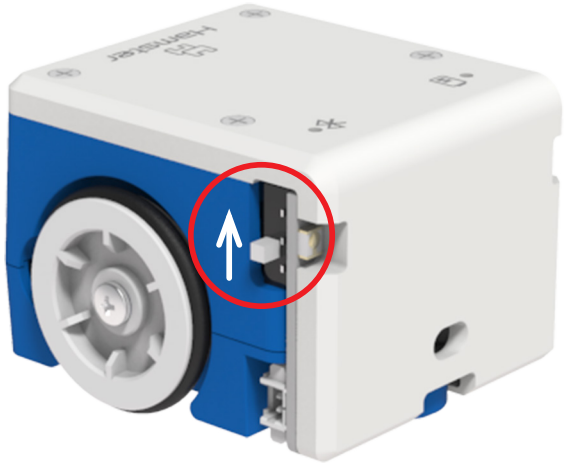
In order to connect Hamzzi with PC, a device called dongle must act as glue in between. Find how to connect dongle from below:

••• When first use: Connect a robot and USB dongle by pairing.

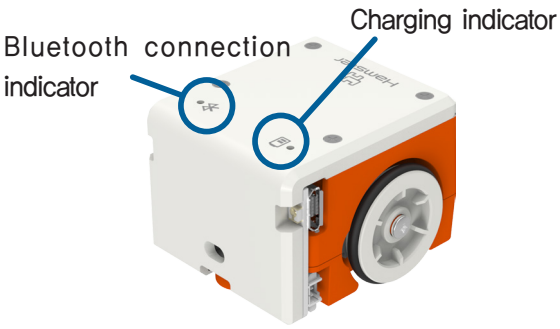
① Connect USB dongle into USB port of a PC. If the Bluetooth connection indicator slowly blinks in blue, it is normal.



② Turn on the power of Hamzzi by flipping up the switch.



③ Bring Hamzzi near USB dongle (within 15cm of the distance between Hamzzi and USB dongle). Then there will be a beep sound from Hamzzi, and if Hamzzi and USB dongle's Bluetooth connection indicator is continuously on with blue, or is blinking quickly, it is normal.



This procedure is called pairing. When pairing is done, one Hamzzi and one USB dongle will be paired. Pairing could be done only once, when connecting Hamzzi and USB dongle for the first time.

When Hamzzi is newly bought, Hamzzi and USB dongle are not paired. Hamzzi and USB dongle should be paired to each other before the first use.

Pairing between Hamzzi and USB dongle is done between the two hardware devices, so it is not related to any software. The reason for putting USB dongle into PC's USB port is to provide electricity to USB dongle.

For reuse: Connect robot and USB dongle.

If pairing is done, there's no need to repair them, but just put USB dongle into PC's USB port, and turn on Hamzzi.

① Put USB dongle into PC's USB port. If USB dongle's Bluetooth connection indicator is blinking slowly with blue, it is normal.

② Turn on the power of Hamzzi by flipping up the switch. If there is a beep sound from Hamzzi, and if Hamzzi and USB dongle's Bluetooth connection indicator is continuously on with blue, or is blinking quickly, it is normal.

USB dongle memorizes only one, most recently paired Hamzzi. If USB dongle is connected to one Hamzzi, it is not possible to pair it with another Hamzzi. In this case, you need to disconnect the connected Hamzzi by turning it off, and then need to re-pair the new Hamzzi.

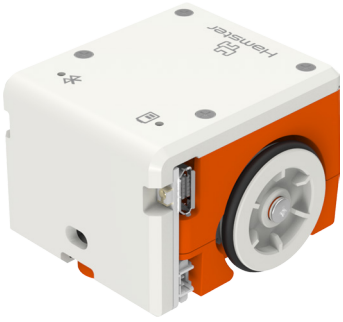
Welcome to HAMZZI WORLD

Unit 4. Getting to Know of Hamzzi

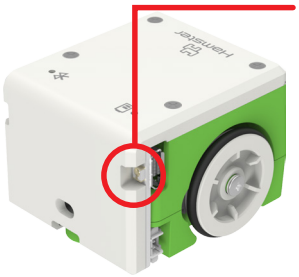
Have a look at Hamzzi!

Dimensions and Weight

Dimensions	Width 35mm x Depth 40mm x Height 30mm
Weight	30g (Own weight except decoration)



Sensors

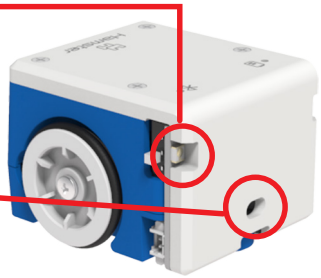


Proximity Sensor: Detects obstacles

infrared, range: 1–30cm, accuracy: 1mm,
can operate under sun light,
measures 100 times per second,
transmits 50 times per second

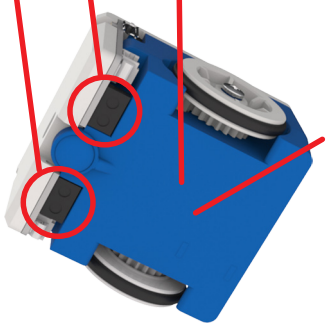
Light Sensor

range: 0–65,535Lux,
measures 10 times per second



Floor Sensor: Line tracing

infrared, reflective photo interrupter,
measures 100 times per second,
transmits 50 times per second



3-Axis Acceleration Sensor

ranges: 2g, 4g, 8g, 16g,
accuracy: 16bits,
band width: 7.81–1000Hz

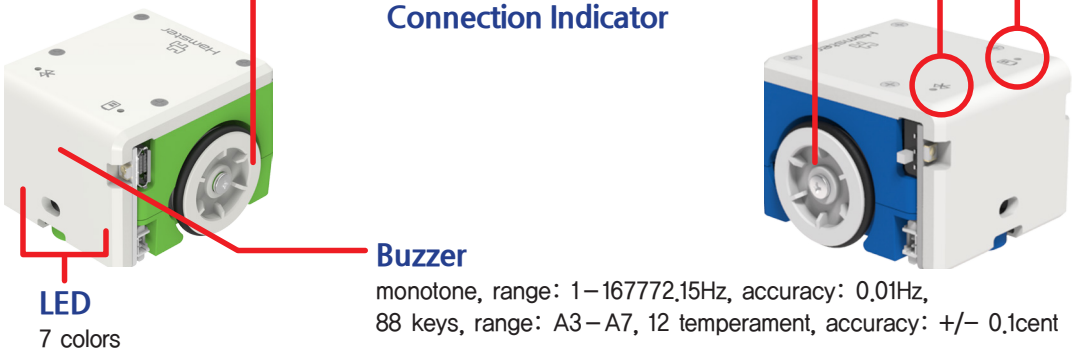
Internal Temperature Sensor

range: –40 to 87.5 degrees C,
accuracy: 0.5 degrees C

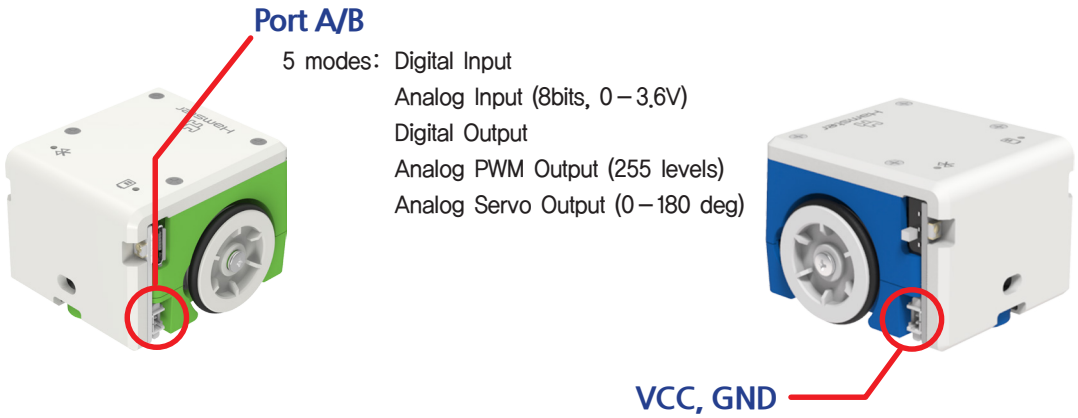
Battery Voltage Sensor

accuracy: 0.01V

Actuators



External Input/Output Extension



Others

Communication: Bluetooth 4.0 BLE (Connection range within 15m)

Battery: Charging 30mins, sustained operation 1 hour in average, waiting 12 hours max

Charging Socket: Micro USB (a charging cable for a smart phone)

PC Connection: Serial communication through USB dongle

Smart Phone Connection: Bluetooth 4.0 BLE

Welcome to HAMZZI WORLD

Hamzzi is getting used to staying at your place!
Please let Hamzzi know how he can drink water, and let him look around your place.
Have a deeper conversation with Hamzzi to understand each other, and get to know each other better.

Have a conversation with Hamzzi

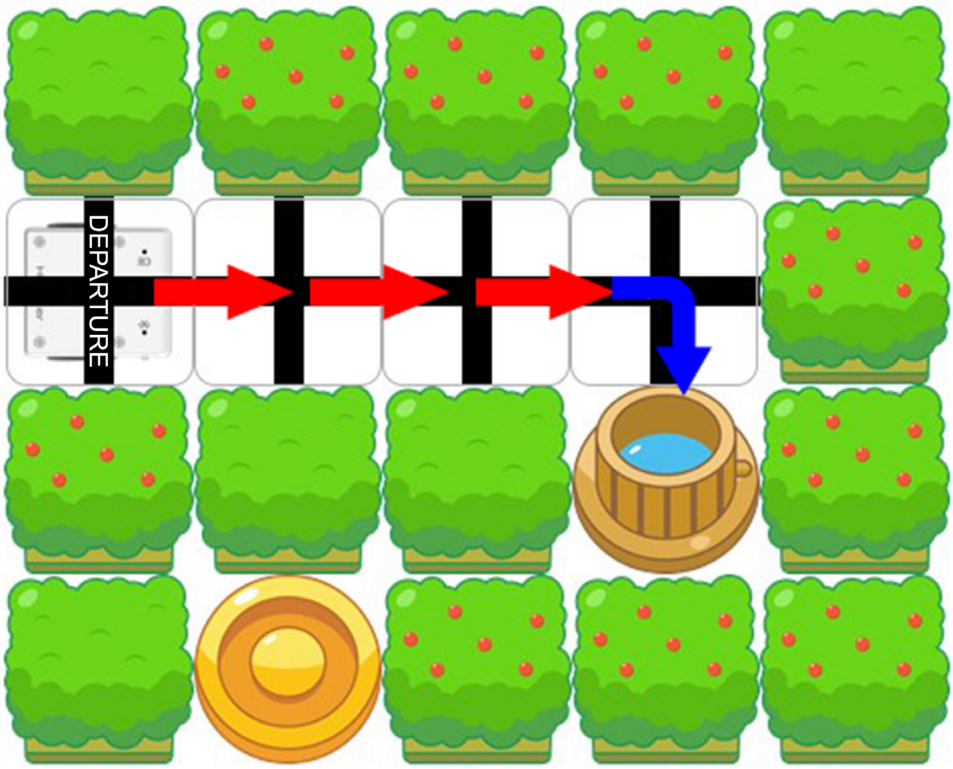
Unit 1.

Hamzzi going to drink water

Hamzzi going to look for a well

Hamzzi, fully charged, now wants to go to drink water. If he passes through the path in the woods, there is a well. Think about how Hamzzi should move to get to the well.

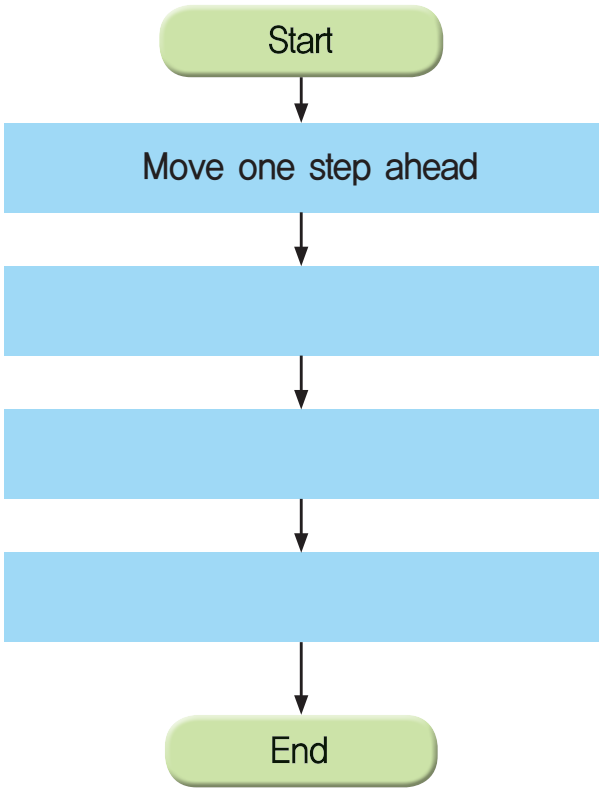
(Appendix – Hamster Board 1)



Game boards of appendix can be downloaded by clicking "Classroom Materials" in http://hamster.school/en/tutorial

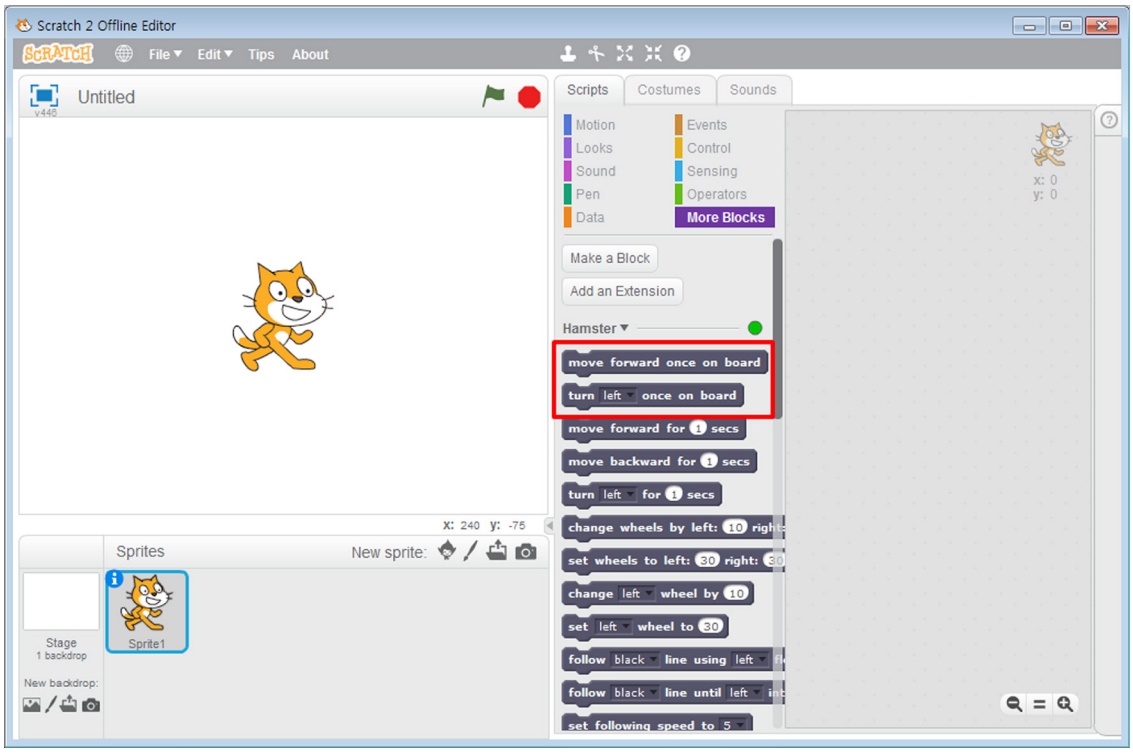
Let's organize our thoughts!

In order to simplify our thoughts, let's think about the order of the movements using "move one step ahead", and "turn 90 degrees left (or right)". How can you move Hamzzi to get to the destination? Once Hamzzi is arrived at the destination, Hamzzi should be facing the well, so that he can drink water. Organize your ideas and write down your commands in order, in the empty spaces below.



Now let's think about if the order we have come up with was correct. Pair up with a partner, and one of you should read the commands in order that he/she has written down. The other person should hold Hamzzi with his/her hand, and follow the command one by one on the board. Do not slide Hamzzi on the board as it might hurt Hamzzi, so please lift Hamzzi up to move each space of the board. If all the commands were given, but Hamzzi have not arrived at the destination, something's wrong. Look carefully to see what is wrong, reorganize your ideas, and perform the commands once again in the same manner.

Implement your thoughts and check them.



Let's build a program to actually move Hamzzi.

For the action of "turn 90 degrees left", you can use `turn left once on board` block, and in the same manner, for the action of "turn 90 degrees right", you can use `turn right once on board` block.

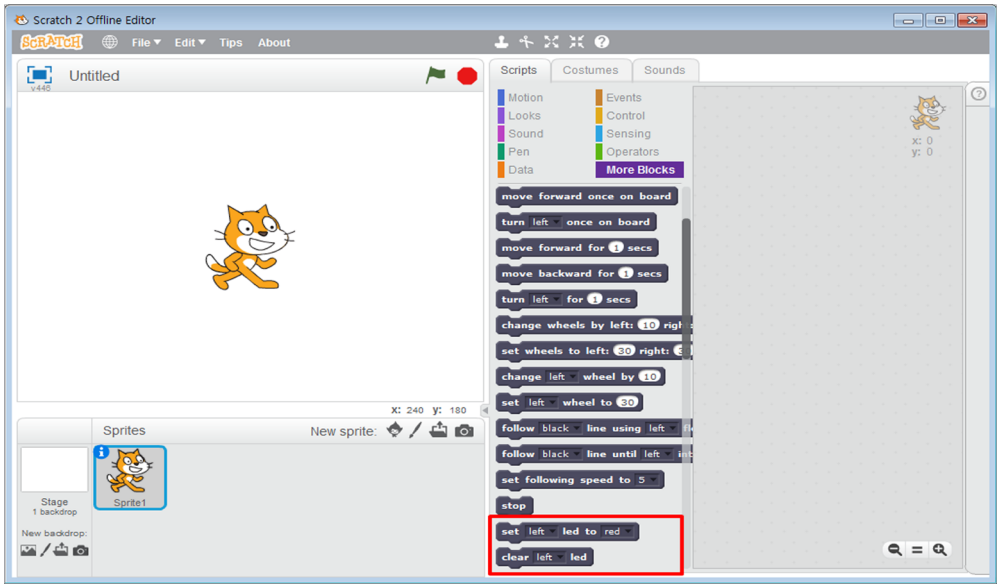
How about "move one step ahead"? If you want to move one space, you can use `move forward once on board` block.

Using the blocks made in this way, build a program according the order of your organized ideas. Put Hamzzi on the board facing the right way, and run the built program to see its movement.

(Use Appendix – Hamster Board 1)

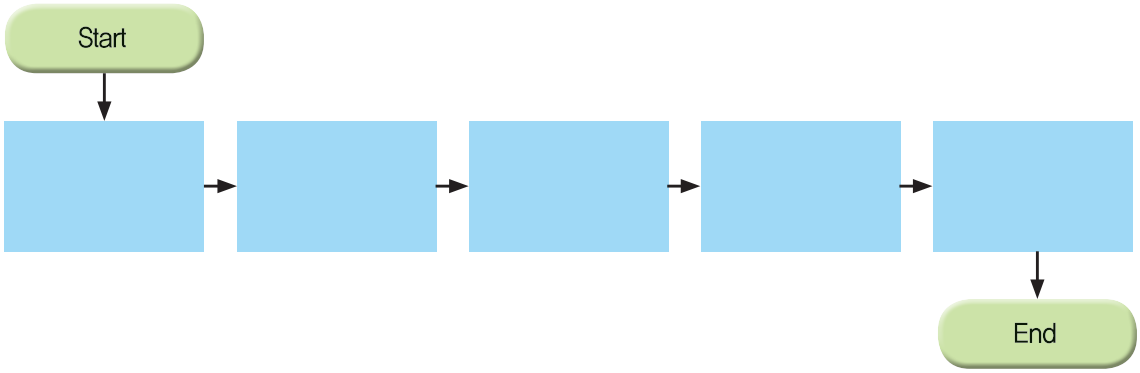
Hamzzi Being Happy Finding a Well

Express Hamzzi's emotions using LEDs in front of him



What do you have to do to light LEDs on Hamzzi's both cheeks with blue to express his nice feelings as he arrived at the well? The block you need to use to light Hamzzi's cheeks is set left led to red. If you click "left" part, you can choose one option among left, right, and both, choose "both". Also, if you click "red" part, you can choose various colors. Choose "blue".

Organize your thoughts and write down your commands in order, in the empty spaces below.



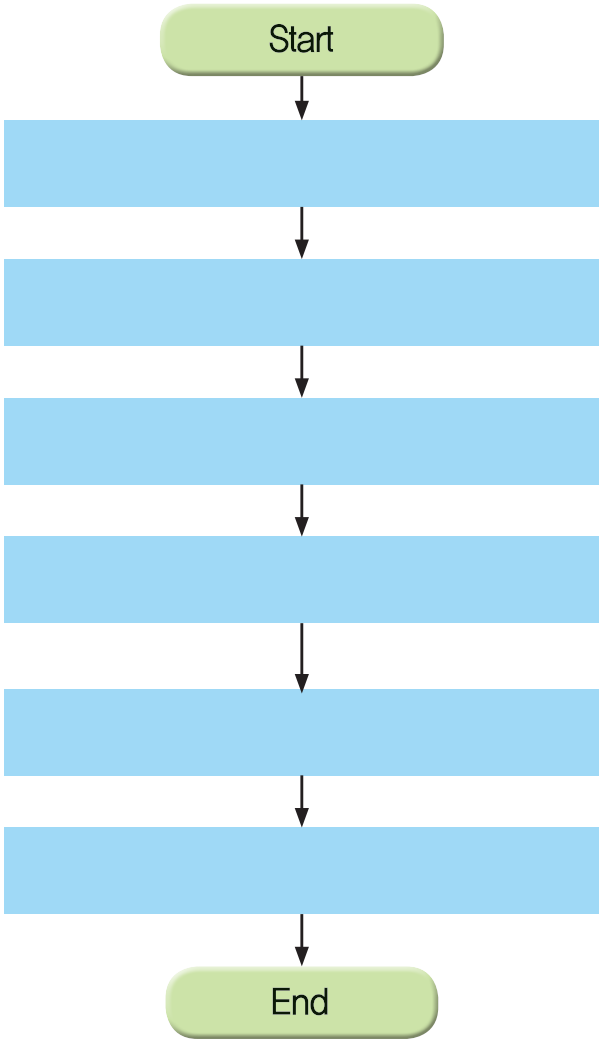
If your thoughts are all organized, build a program and run it.

Express feelings using LEDs and piezo speaker.

If he finds a well, he can make a loud sound to let his friends know this. Edit your program so that Hamzzi would make a sound once he is arrived at the destination. The block that Hamzzi needs to make a sound is 

block.

Just like you did previously, first organize your thoughts before building a program. Organize your thoughts and write down your commands in order, in the empty spaces below:



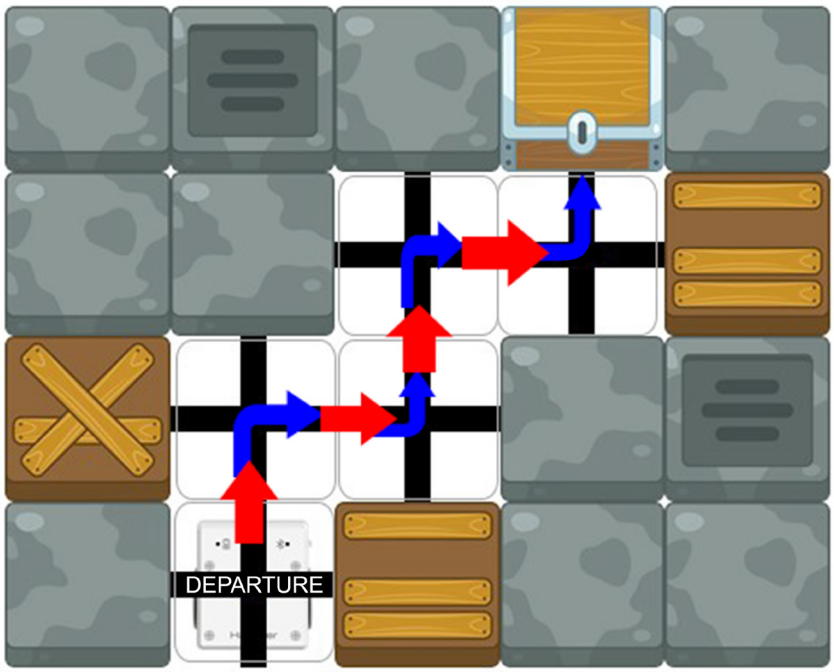
If your thoughts are all organized, build a program and run it.

Unit 2.

Hamzzi Exploring a House

Hamzzi searching out his way through a complicate road

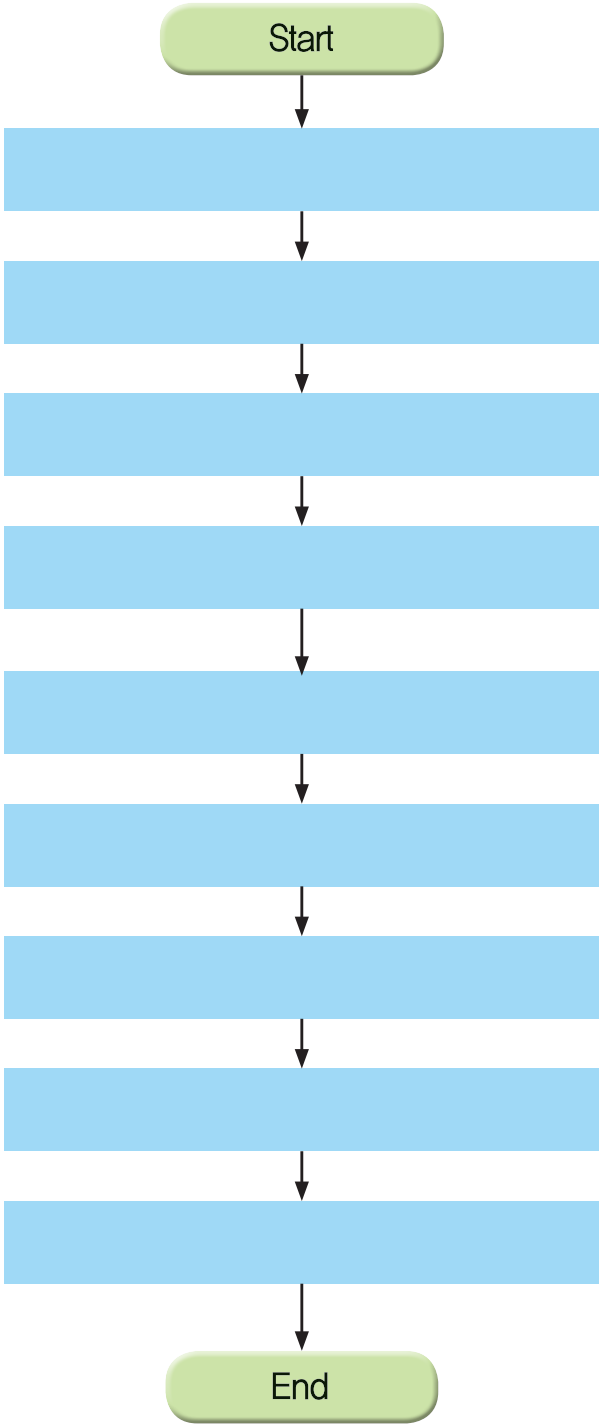
Well fed, had water, now Hamzzi is full of curiosity. While going around a house, Hamzzi met a complicated road. How can he find his way? (Appendix – Hamster Board 2)



••• Let's organize our thoughts.

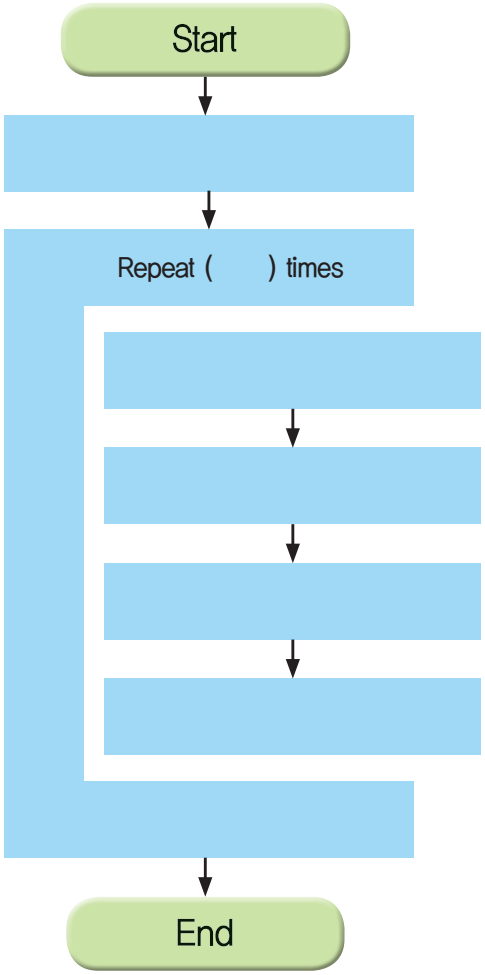
In order to simplify our thoughts, let's think about the order of the movements using "move one step ahead", and "turn 90 degrees left (or right)". How can you move Hamzzi to get to the destination? Organize your ideas and write down your commands in order, in the empty spaces of the next page.

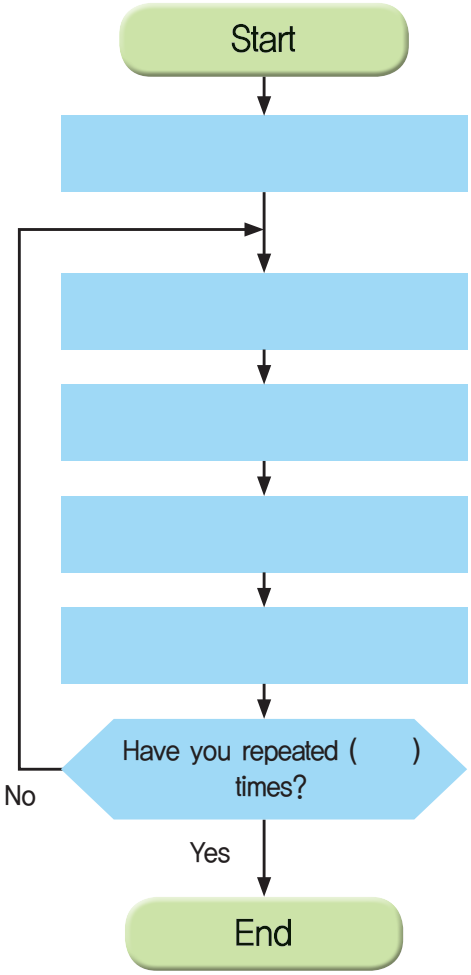
There is one condition though. Light both LEDs in the front of Hamzzi, to find a way. Then, when Hamzzi gets to the destination, turn left once so that he could face a treasure box.



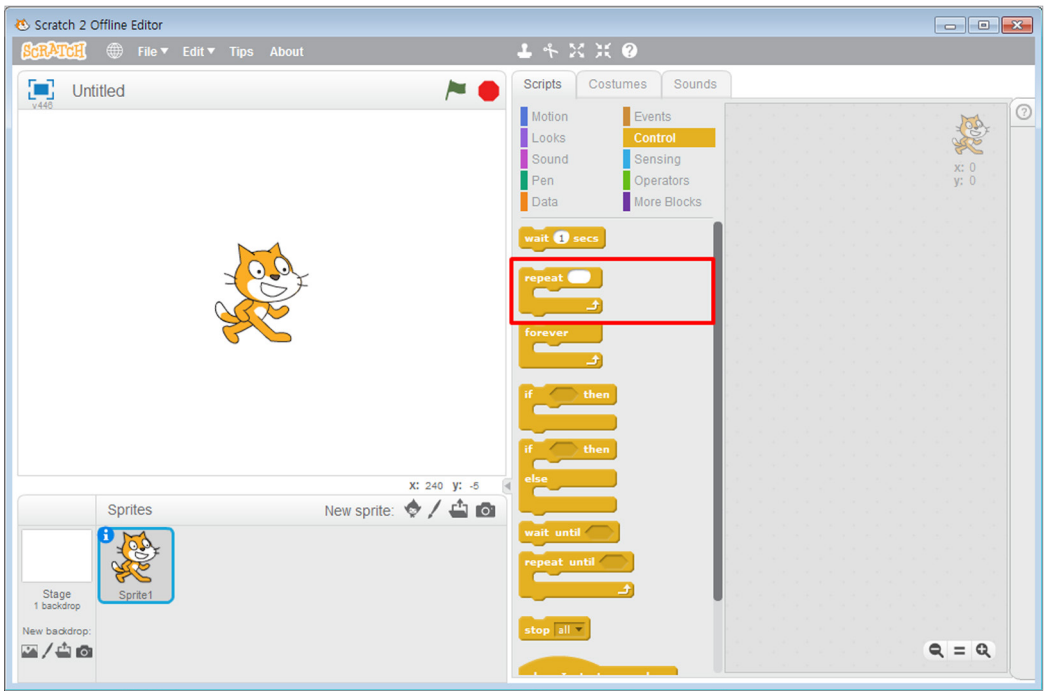
Now let's think about if the order we have come up with was correct. Pair up with a partner, and one of you should read the commands in order that he/she has written down. The other person should hold Hamzzi with his/her hand, and follow the command one by one on the board. Try to perform all the given commands, and if Hamzzi successfully found his way to the destination, look at the flowchart above, and mark the repeated commands.

Omit the repeated commands, and rewrite your flowchart.





Implement your thoughts and check them.



Let's build a program to actually move Hamzzi. In order to repeat the same commands as many times as you want, you could use 

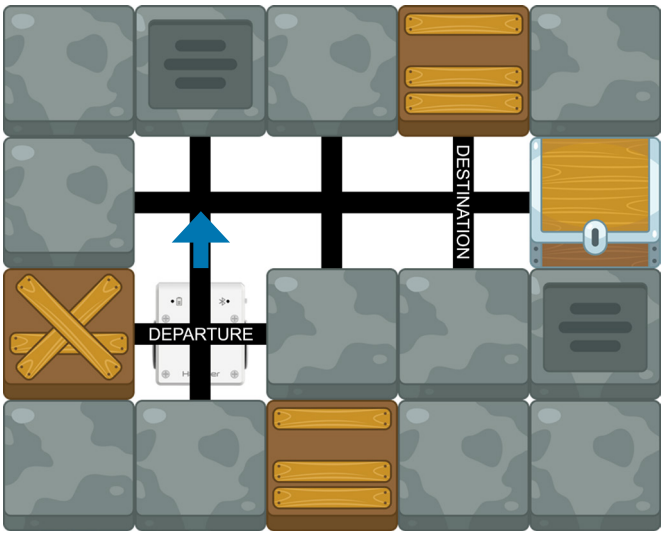
block, and you can write down the number of repetition in the yellow space.

Unit 3.

Training Hamzzi 1

Shall we do it by ourselves?

Let's make a new maze! Cut out the pictures in the appendix, and paste them on an empty board. Mark the direction our hamster robot should be facing with a blue arrow as shown in the picture below. Let's see how cool our own cave mazes could become! (Appendix – Hamster Board 3, 4, 5)



Exchange your cave maze with your friend's, and try to solve your friend's maze problem.
When you explore the maze, please keep the rules below in mind:

① Light both lights with white color before moving.
② When turning left, only left light should be lit, while when turning right, only right light should be lit.
③ Once arrived at the destination, the hamster robot should be facing a treasure box, with a beep.
④ If you form your paths to use many repetitions, you will have a better problem as you can refer to what you have learned previously.

Game boards of appendix can be downloaded by clicking "Classroom Materials" in http://hamster.school/en/tutorial

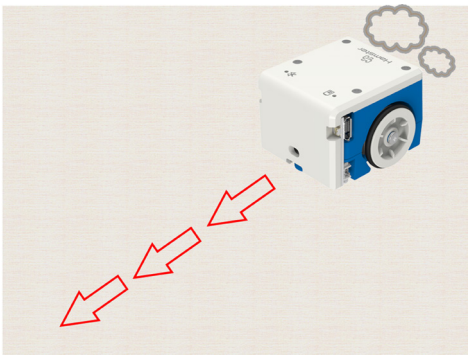
Unit 4.

Training Hamzzi 2

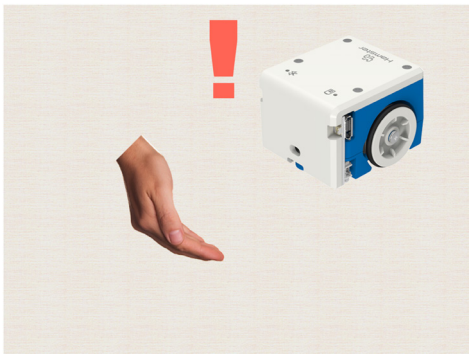
Clumsy Hamzzi

Clumsy Hamzzi, moving around everywhere in the house! Why don't you train Hamzzi to have a more comfortable life with Hamzzi?

••• As it is given in the pictures below, train Hamzzi to stop, when he meets its owner's hand, while moving ahead.

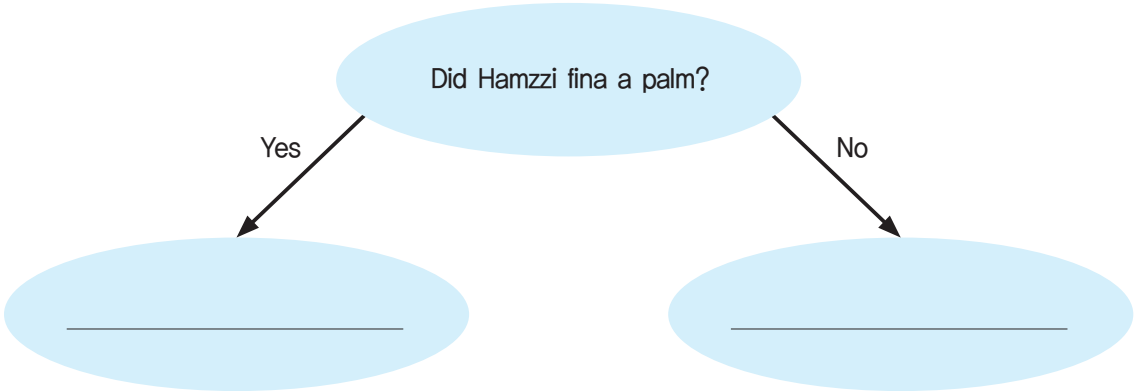


Hamzzi moving forward



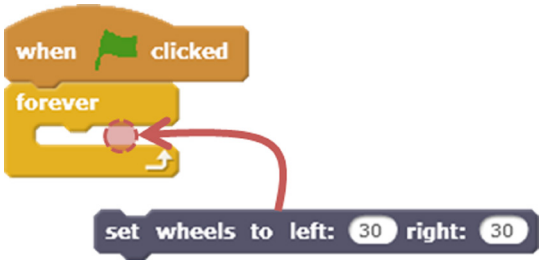
Hamzzi stopping when meeting a hand

••• Think about which action Hamzzi would take in each case, and write them down.

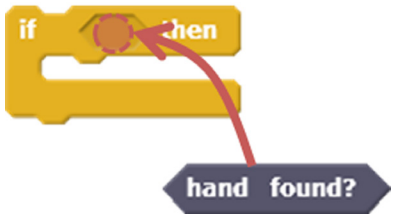


••• Give Hamzzi a command using Scratch.

① Using "set wheels to left: 30 right: 30" block, make a command to keep Hamzzi going forward.

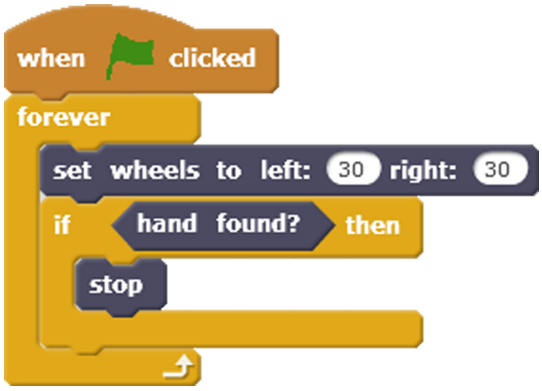


② Insert a block which will tell Hamzzi if he met a palm.



③ Use "stop" block to stop Hamzzi when he meets a palm.

④ Check the completed command blocks, and run your program.



••• Which characteristics can you find from 

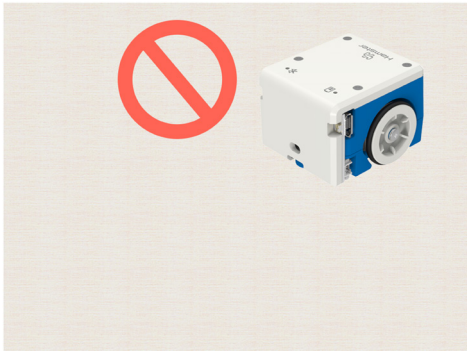
block?

The blocks inside of the block will only run when the condition of hexagon shape is (True / False).

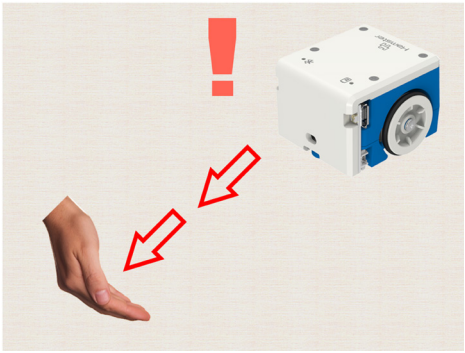
Hamzzi following his owner's palm when it appears in front of him

Why don't we do the opposite this time? Hamzzi, very bored, falls asleep, and when the owner's palm appears right in front of him, he suddenly awakes and follows the palm.

• • • Just like the pictures given below, make Hamzzi, staying still, move forward if his owner's palm appears in front of him.

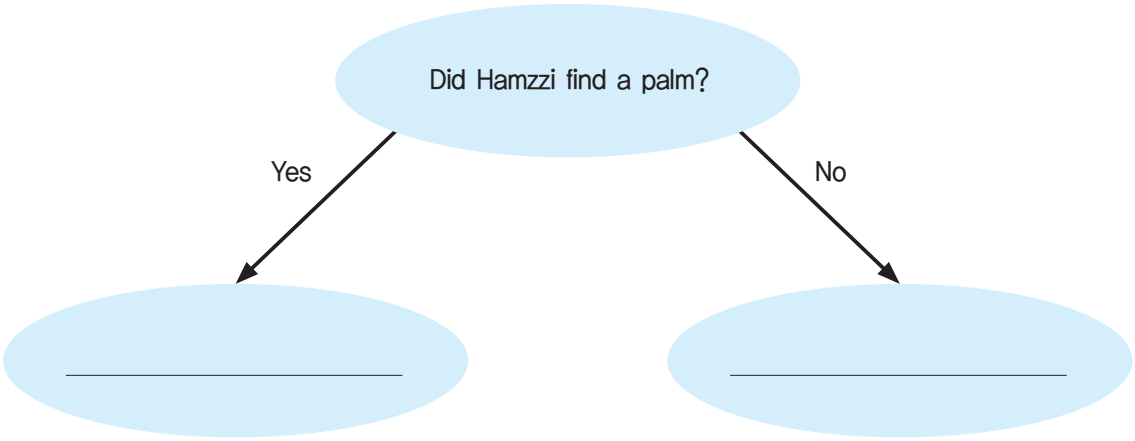


Hamzzi staying still



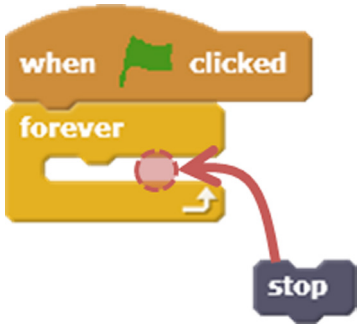
Hamzzi moving forward when a palm appears in front of him

• • • Think about which action Hamzzi would to take in each case, and write them down.

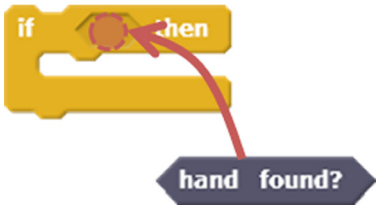


Give Hamzzi a command using Scratch.

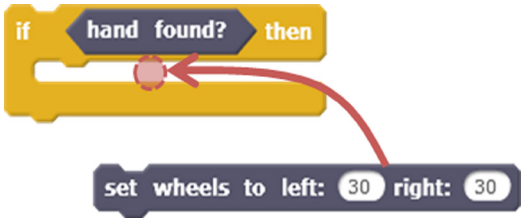
① Have Hamzzi stay still using 'stop' block.



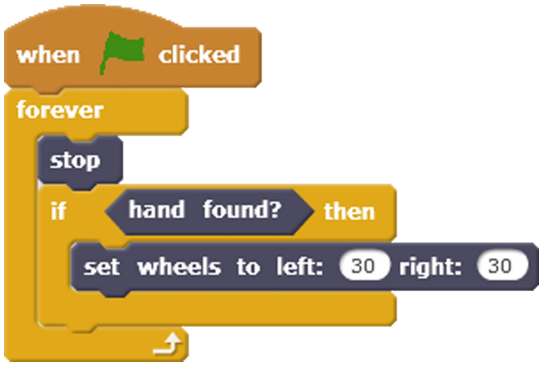
② Insert a block which will tell Hamzzi if he met a palm.



③ Have Hamzzi move forward when he meets a palm.



④ Check the completed command blocks, and run your program.



Freely express Hamzzi's feelings when he meets the owner's palm using LEDs or beep.

Unit 5.

Building a Jukebox

Activity Objective	Will be able to build a jukebox using a hamster robot.	
Target Students	Elementary Students Grade 5–6th	〈Applying NDIS Model〉 It is a project-based instruction model to solve problems through design and development, in order to boost computational thinking, based on problem recognition in a real life. This model consists of the procedures of Need, Design, Implementation, and Share.
Suggested Time	3 Classes	
Module Level	Basic	

Activities of Blended Subjects

Science (S)

Getting to know of the reflection amount of infrared light according to distance, using a proximity sensor.

Music (A)

Play and create music.

Practical Course (SW)

Design and implement an algorithm to solve a problematic situation.

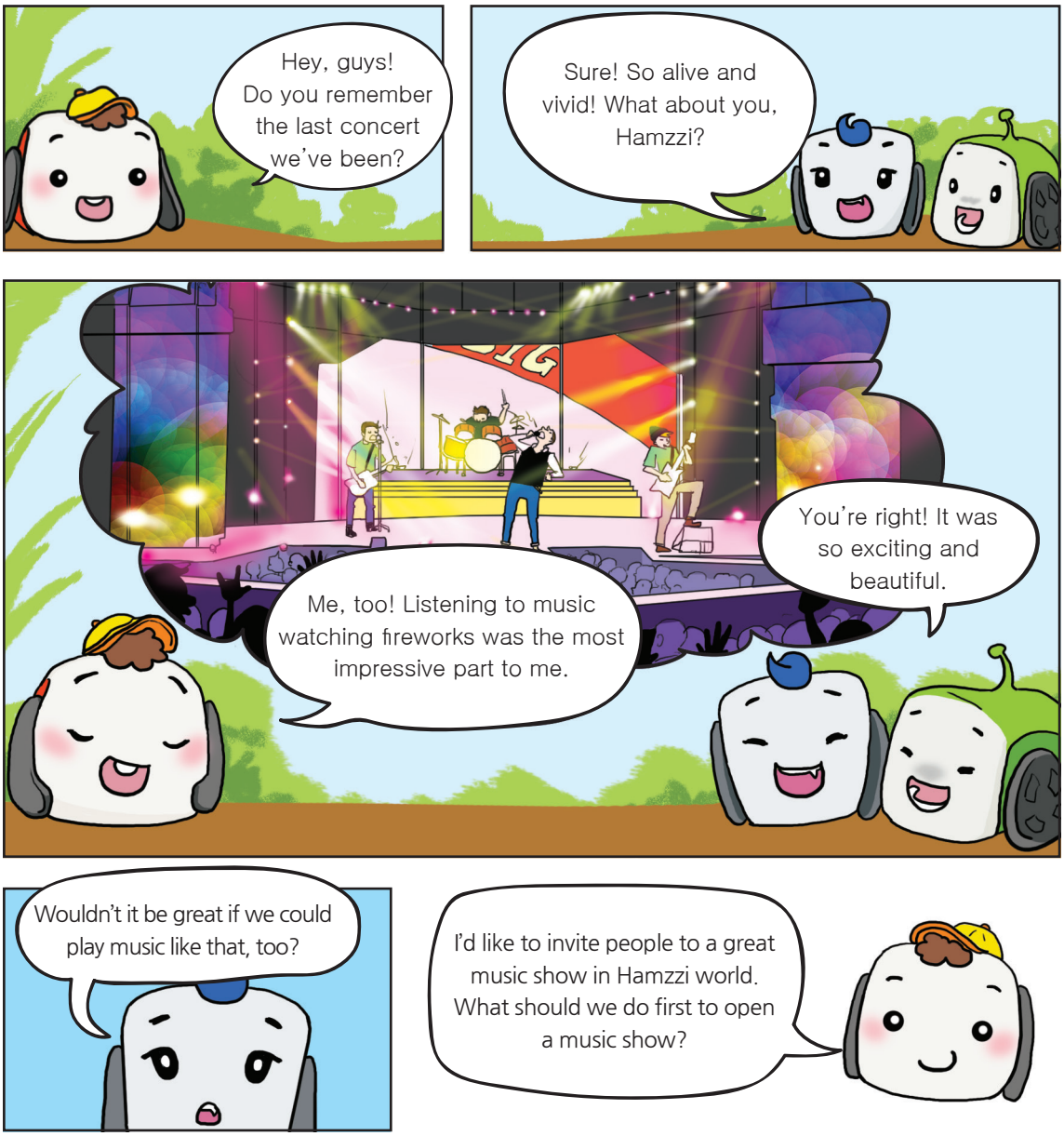
Technology (T)

Run a jukebox using a proximity sensor and a light sensor.

※ Before starting the activity, check on the things that you already know.

- I understand the sequence, selection, and iteration structure. (Algorithm) ☐
- I can run a hamster robot using Scratch. (Function) ☐

N-1 : What shall we do this time?



Hamzzi and his friends are talking about the concert they have been. They say that among all the things they've seen, the most impressive part was a music show played with glamorous fireworks! Hamzzi and his friends want to share the fabulous music show with their friends in Hamzzi world! Using a hamster robot, let's create a jukebox!

◆ **Let's find out how a jukebox moves and works using a cute hamster robot, and create one ourselves!** ◆

N-2 : Jukebox[1], who are you?

Look at the pictures below and think about the questions.

- What are the pictures about?

- What do the pictures have in common?

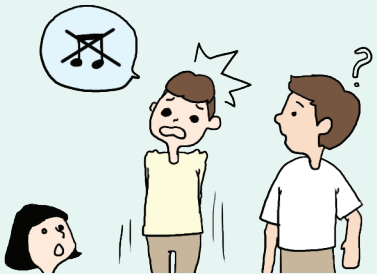
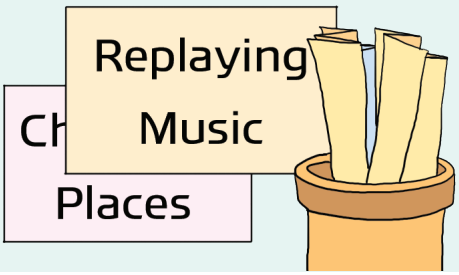
- What functions would you need in your hamster robot to work in a similar way as these machines?

1) Old jukebox was a machine that plays a song when someone inserts some coins in it and chooses a song that he/she wants to listen to, but jukebox of today refers to a performance of someone playing many songs that he/she owns to other people.

D-1 : Make a sound according to the instruction – Take Turns Singing

(An unplugged activity requires 8 members)

Game Rules

Activity Examples	Activity Explanations
	① 8 members sit side by side, each of them assigned with a note of C, D, E, F, G, A, B, C.
	② Play a simple song that is sung by notes.
	③ All members remember the song, stand up when their notes are called, and sit down again. One member points the other members with a pointing stick according to the notes. ④ All 8 members complete a song.
	⑤ If a member misses his/her note by missing a beat or not standing up, the game fails.
	⑥ When re-playing the game, members might want to use various hints such as “Changing Places” or “Replaying Music”.

D-2 : Finding out about sensors of hamster robot which can be used for a jukebox

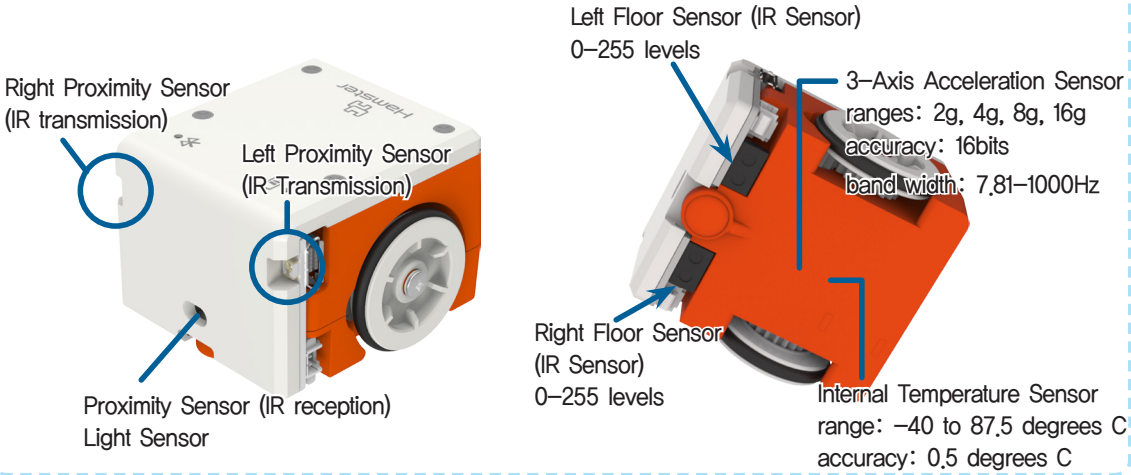
(S, T)

Reading Material

What is a sensor? It refers to an instrument which senses or measures certain physical amount such as heat, light, temperature, pressure, or sound, and notifies them through signals.

Just like a human recognizes his external environment through his eyes, nose, and ears, a machine or robot can recognize its external environment through its sensors. And a hamster robot can react in various ways according to the values of its sensors.

Then, let's find out which sensors are included in the hamster.

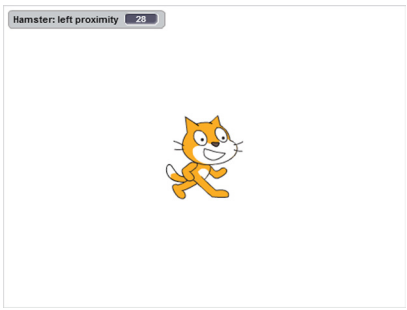


Sensor Blocks in Scratch

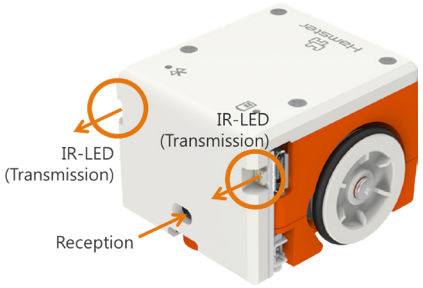
Reading Material

You can check the values of sensors.

A hamster robot measures its external environment like eyes, nose, and ears of humans. How can a hamster measure and handle the environment? If a human can feel if it is bright or dark naturally, a hamster robot can measure and express the amount of light by quantifying it. Try to check the values of sensors that a hamster robot measures.

	Check a checkbox in the left of a block of which you want to observe its value.
	On the stage, you can see the value of a sensor that keep changing!
	If you want to observe more than one sensor value at once, you can check all of them.

Let's find out the characteristics of proximity sensors (IR–LED).



Proximity sensors, located in the front of a hamster robot, consist of IR-LEDs, which emit infrared light, and a phototransistor that detects infrared light.

A phototransistor detects the reflection amount of the infrared light which was emitted by IR-LEDs, and if an obstacle is near, this reflection amount of the light would increase, so the measured value would increase, too, while if the obstacle is far, this reflection amount of the light would decrease, and thus the measured value would decrease, as well. Therefore, the value is in inverse proportion to the distance to the obstacle. If there are no obstacles, there would be no reflection of the infrared light, which will set the value to 0.

The proximity sensors of a hamster robot are installed one on the left, and one on the right, in the front of the robot, and the phototransistor is installed in the below center, so that it takes turns detecting the amount of light of left and right IR-LED. This can detect any obstacles in between 1cm to 30cm in front of it, and gets the values from 0 to 255.

Block in front of a hamster robot with your hand, and vary the distance between your hand and the robot to see how the values of left and right proximity sensors change. (Use a ruler and a piece of A4 paper)

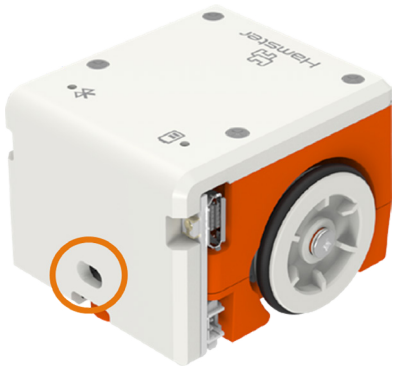
Distance to an obstacle (hand)	0cm	1cm	5cm	15cm	20cm
Values of left proximity sensor					
Values of right proximity sensor					

- The value of a proximity sensor gets (higher / lower) if the distance to the obstacle gets closer.
- The value of a proximity sensor gets (higher / lower) if the distance to the obstacle gets further.

Which results would we have if we do the same activity using the floor sensor, which is located at the bottom of the hamster?

Try it yourselves, and write down the results briefly.

Let's find out the characteristics of a light sensor.

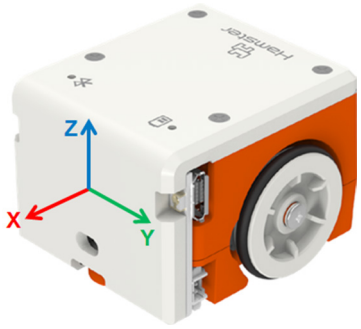


Just like the picture, in the front side of the hamster, in the same place where a phototransistor is located, there's a light sensor that detects the brightness of light. Light sensor gets the values from 0 to 65535, and if it gets brighter, the value increases.

Block the hamster robot's light sensor with your hand, and have the robot face a brighter place using a flash or a bulb to see how the values of the sensor change.

- The value of a light sensor gets (higher / lower) if it gets brighter.
- The value of a light sensor gets (higher / lower) if it gets darker.

Let's find out the characteristics of an acceleration sensor.



In the hamster robot, there's a 3-axis acceleration sensor as the pictures shows. For x-axis of the acceleration sensor, front direction of the robot gets a positive value, and back direction gets a negative value. For y-axis, left direction gets a positive value, and right direction gets a negative value, and for z-axis, up direction gets a positive value, and down direction gets a negative value.

If you raise the front part of the hamster robot upward, x-axis acceleration gets a negative value, while if you lower the front part, x-axis acceleration gets a positive value and this will go higher as you lower the front part more and more. This is because the direction of the gravity is to the ground.

Let's find the blocks that we can use to check the value of acceleration of each axis.

D-3 : Let's design our own Jukebox (T, A, Visual Thinking)

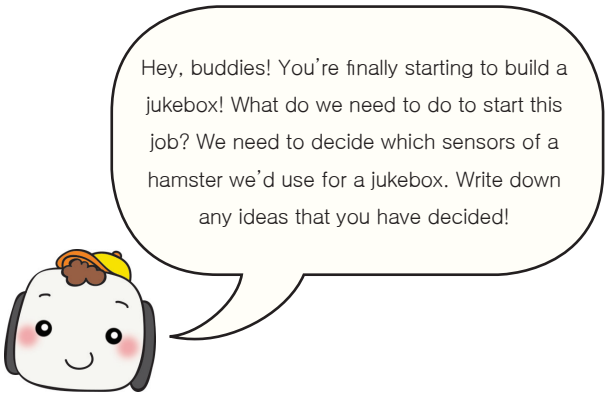
Visual-Algorithm Thinking

Group Activity

Now let's think about various forms of jukeboxes that we can build using a hamster robot. Things you must consider are:

1. Using various sensors of a hamster robot
2. Completing a music using more than one note of the sounds.

Let's try to present various forms of jukeboxes using a hamster robot.



1. Choose a sensor we would use.

(e.g.) A jukebox using a proximity sensor

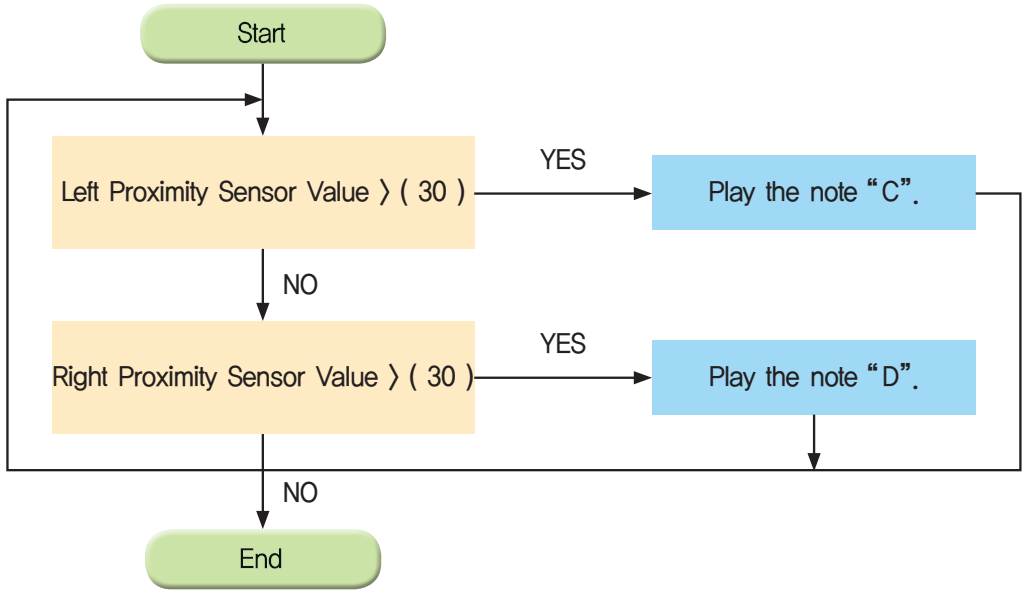
2. Draw a picture of it.

3. Think on how it would work.

(e.g.) I will use left, right proximity sensors so if a hand comes near the sensors, it would play music.

D-4 : Designing an algorithm using the sensors of a hamster robot (SW, M)

Let's play music using the values of both proximity sensors (IR-LED).



Check the flowchart above, and complete an algorithm that plays music using the values of both proximity sensors (IR-LED).

Repeat infinitely

If Left Proximity Sensor Value 〉( )

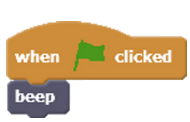
Play the note 'C, 4' for '0.5' beat.

If Right Proximity Sensor Value 〉( )

Play the note 'D, 4' for '0.5' beat.

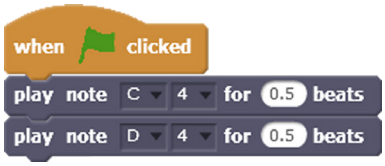
I-1 : Making a sound with a hamster robot

Make various sounds using a hamster robot.



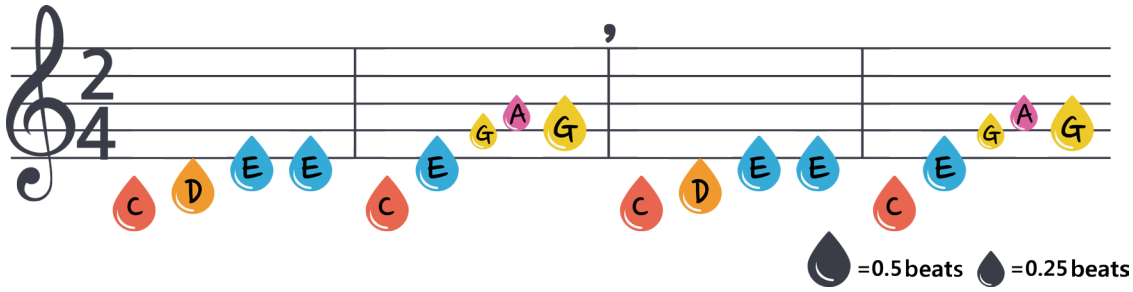
Beep

Buzzer Sound

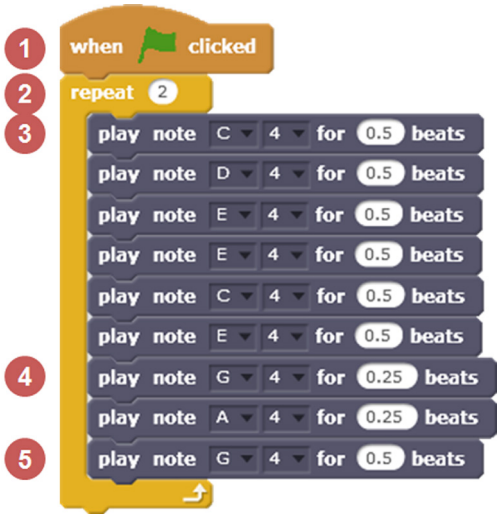


Play a Piano Key

Using the hamster robot's various sounds, play given music.



Try coding the given code below!



① When "green flag" button is clicked, the program runs.

② As the 2 bars in the beginning and 2 bars at the end are the same, "repeat 2" block is used.

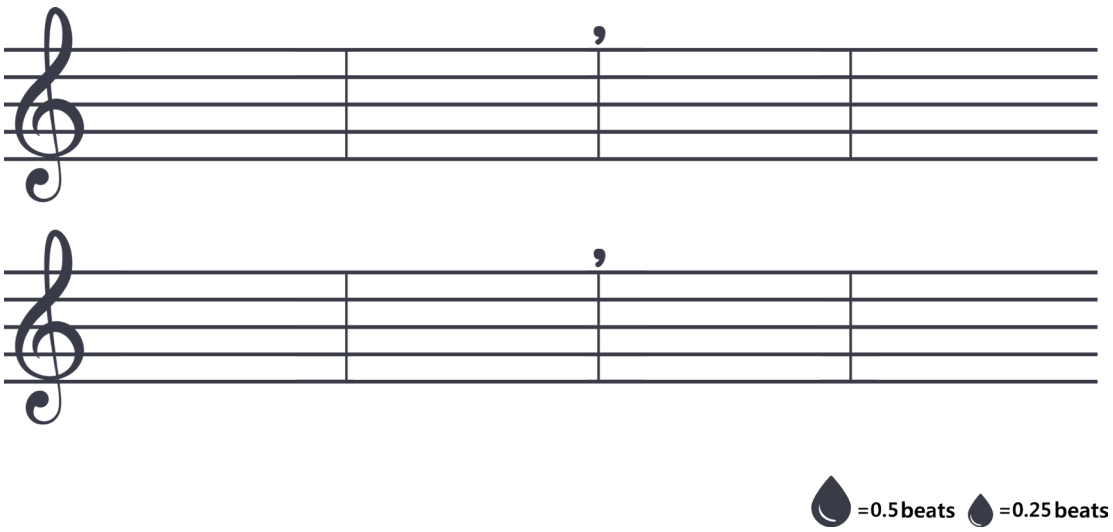
③ Connect the notes of "C, D, E, E, C, E" part in order using "play note for 0.5 beats" block.

④ Connect the notes of "G, A" part in order using "play note for 0.25 beats" block.

⑤ Connect the note of "G" part using "play note for 0.5 beats" block.

Let's create my own music using various sounds of a hamster robot.

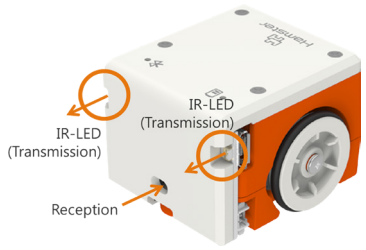
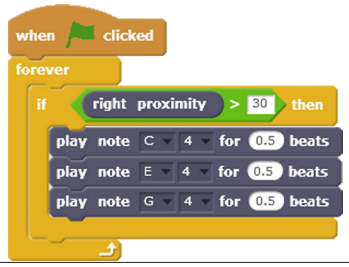
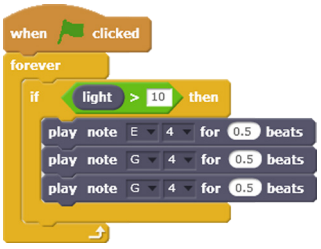
Let's show my own music using water drop shapes on an empty music score.



Coding for my own music

I-2 : Programming a hamster robot using sensors (SW)

Find out how to play music using sensors of a hamster robot.

	Proximity Sensors	Light Sensors
Location of Sensors		
Scratch Code		

Try programming a hamster jukebox using a proximity sensor.

Try coding the given code below!

① When “green flag” button is clicked, the program runs.

② Run all the command blocks repeatedly.

③ Play music based on the value of a right (or left) proximity sensor.

④ Play music in a sequential order using the notes from C to B, in various beats.

This time, you can utilize “repeat” blocks in the structure where music is playing.

※ Using various sensors, have your hamster robot play different songs.

I-3 : Run and modify problems (SW)

Run your program and check.

Is your jukebox working fine?

Yes

Write down the functions that you want to add.

1. Add LED.
2. Add movements.
3. Others:

No

Check on the points below.

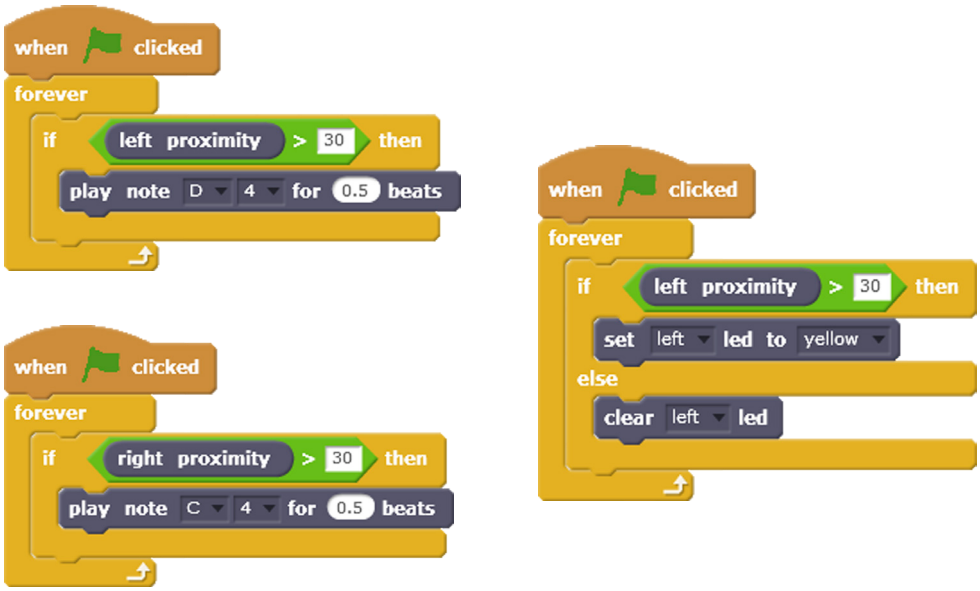
1. Is your condition correct?
2. Do you have the correct sound according to the change of sensor values?
3. Others:

Think of the new functions you'd like to add and the things that you need to modify, and re-program it.

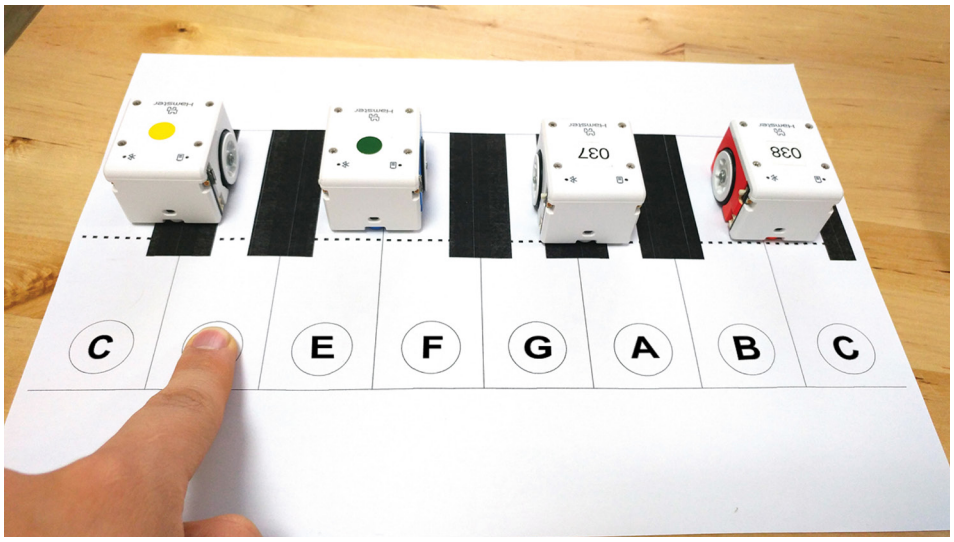
I-4 : [Advanced] : Building a hamster piano

Program a hamster piano using proximity sensors.

Check below command blocks and try them.



Let's play the hamster piano. (Appendix – Hamster Board 6)



S-1 : Self-evaluate the result of the activity and share it with friends

••• Try to self-evaluate the result of the activity.

Self Evaluation Points	Evaluation		
	Good	Average	Not Good
Did you find out the characteristics of sensors and read the values of the sensors?			
Did you design programs using an appropriate selection structure according to the changes of the sensor values?			
Did you run programs, find problems, and modify them?			
Did you fairly divide your roles with your friends and have fun doing activities?			
Did you cooperate and talk to each other to solve problems?			
What do you think you did especially well during activities? Write them down below, and do the presentation.			

••• Self-evaluate the results of activities.

Edit some of the videos and pictures of activities, and upload them on Facebook or YouTube to share.

And share it further by replying on your friends' results of activities as well.

Examples of Answers

N2

- A piano, a jukebox, an audio, and etc,.
- It's a machine that gets a signal or an input to play music or make sounds.
- It needs a function to get a signal to make sounds.

D2

Distances to an obstacle (hand)	0cm	1cm	5cm	15cm	20cm
Values of left proximity sensor	0 to 10	greater than 50	40 to 50	5 to 15	0 to 5
Values of right proximity sensor	0 to 10	greater than 50	40 to 50	5 to 15	0 to 5

- higher, lower
  higher, lower

D3

- Ex) A morning call using a light sensor.
- Ex) An audio signal to prevent speeding using an acceleration sensor.

Unit 6.

Building a Bumper Car

Activity Objective	Will be able to build a bumper car using a hamster robot.	
Target Students	Elementary Students Grade 5-6th	〈Applying NDIS Model〉 It is a project-based instruction model to solve problems through design and development, in order to boost computational thinking, based on problem recognition in a real life. This model consists of the procedures of Need, Design, Implementation, and Share.
Suggested Time	3 Classes	
Module Level	Intermediate	

Activities of Blended Subjects

Science (S)

Getting to know of the reflection amount of infrared light according to brightness, using an IR sensor.

Technology (T)

Change directions using the difference of the speed of both wheels of a bumper car.

Practical Course (SW)

Design and implement an algorithm to solve a problematic situation.

Art (A)

Decorate a bumper car robot in various ways.

Math (M)

Find out speed using speed formula.

※ Before starting the activity, check on the things that you already know.

- I understand the sequence, selection, and iteration structure. (Algorithm) ☐
- I can run a hamster robot using Scratch. (Function) ☐
- I can handle the sensors of a hamster robot using Scratch. (Function) ☐

N-1 : What shall we do in this class?

Hamzzi's friends want to be as fancy as the fancy cars that they've seen.
They also found out how the rules of wrestling in Japan are different from Korea.
Why don't you decorate a bumper car using a hamster robot?
Then, just like the wrestling in Japan, have them to push each other out.

◆ **Let's decorate bumper cars using a cute hamster robot, and play a game.** ◆

N-2 : Who are you, Bumper Car?

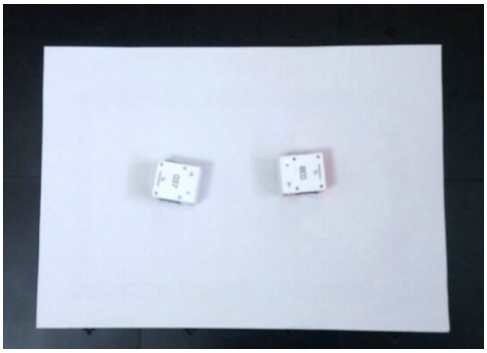
Look at the given pictures below and think about the questions.

What are the pictures above about?

Which stuffs around you can you think of, after looking at the pictures?

What functions would you need to build a bumper car using a hamster robot?

Design a bumper car game that one would lose if it is pushed out of the white paper.



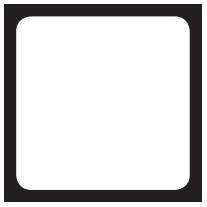
Let's think of some elements that you'd need for the given game.

① Directions should be able to be controlled using the arrow keys on a keyboard.

② The robot should stop if the spacebar on a keyboard is pressed.

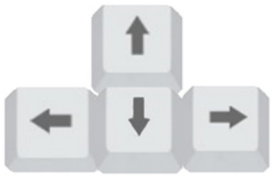
③ If the robot is pushed out of the arena, it will stop with a beep. (To express its lost situation)

Compare the roles of a hamster robot and a real bumper car.



ⓐ •

• ① A Bumper Car



ⓑ •

• ② An Arena

ⓒ •

• ③ A Break

Space Bar

ⓓ •

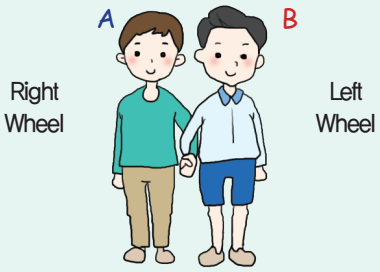
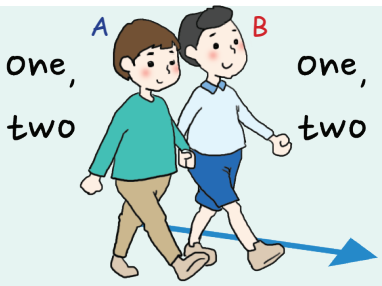
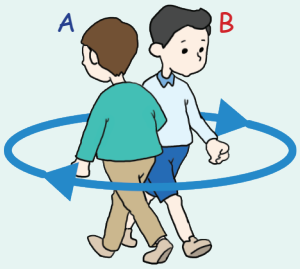
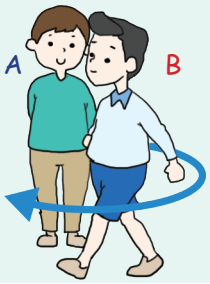
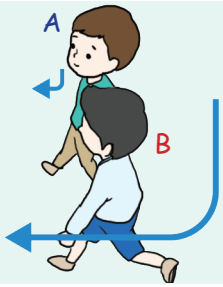
• ④ A Bumper Car Handle

D-1 : Let's try to be the two wheels of a hamster robot

(Groups of 2, Unplugged activity, Role-play)

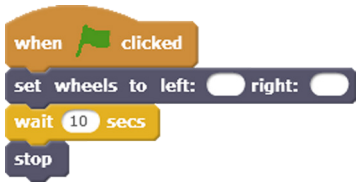
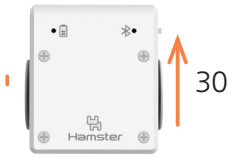
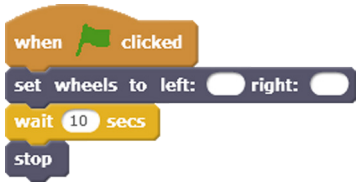
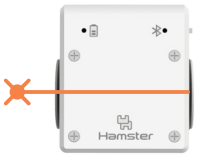
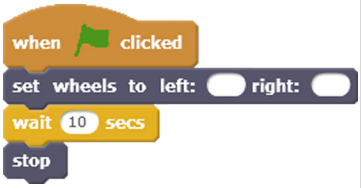
Be the wheels of a robot yourselves, and find out the principle of the rotation of a robot.

Game Rules

Activity Figures	Activity Explanation
	① Two people (A, B) stand up holding hands. (Right person will be the right wheel, and left person will be the left wheel.)
	② Two people (A, B) walks straight forward, counting beats, in the same speed.
	③ One person (A) turns around to see the opposite direction. Moving forward in the same speed, try to spin around.
	④ This time again, two people (A, B) face the same direction. While one person (A) stands still, the other (B) makes a pivot turn by moving around.
	⑤ One person (A) moves slowly, and the other (B) moves faster to make a round turn.

D-2 : Changing directions of a hamster robot

Considering the movement of two wheels, change the direction of a hamster robot.

	Rotation Speed and Direction	Center of Rotation	Scratch Code
1. Spin			
2. Pivot Turn			
3. Round Turn			

Try to run a program that changes the hamster robot's directions using the example codes, and talk about their differences.

D-3 : Measuring the speed of a hamster robot (S, M)

Measure the hamster robot's moving distance during one second.

Use Appendix - Hamster Board 7 or a ruler

1. Have the hamster at the start line.
2. Run the code using Scratch.
3. Measure the moved distance.
4. Repeat it 5 times.

Vary the numbers in the yellow circles, and have the hamster move forward for 1 second and stop.

Number of Times	1st	2nd	3rd	4th	5th
Distance (mm)	mm	mm	mm	mm	mm

Let's find out the speed of a hamster robot.

References

What's speed? It refers to the distance that an object moved during unit time (1second, 1minute, 1hour).

e.g.) a distance that a thing moved for one second, for one minute, for one hour

- ☐ If an object moved 3cm during one second, its speed is 3cm/s.
- ☐ If an object moved 100cm during 10 seconds, its speed is 10cm/s.

Units of speed As it refers to the distance of movement during unit time, its unit is "unit distance / unit time". m/s , m/m, m/h km/s , km/m, km/h

※ There are many other units, too.

What is the smallest number among the numbers in yellow spaces that helps the hamster robot move the most during 1 second?

Find out the speed of a hamster robot when it is moving the fastest. (mm/s or cm/s for a unit)

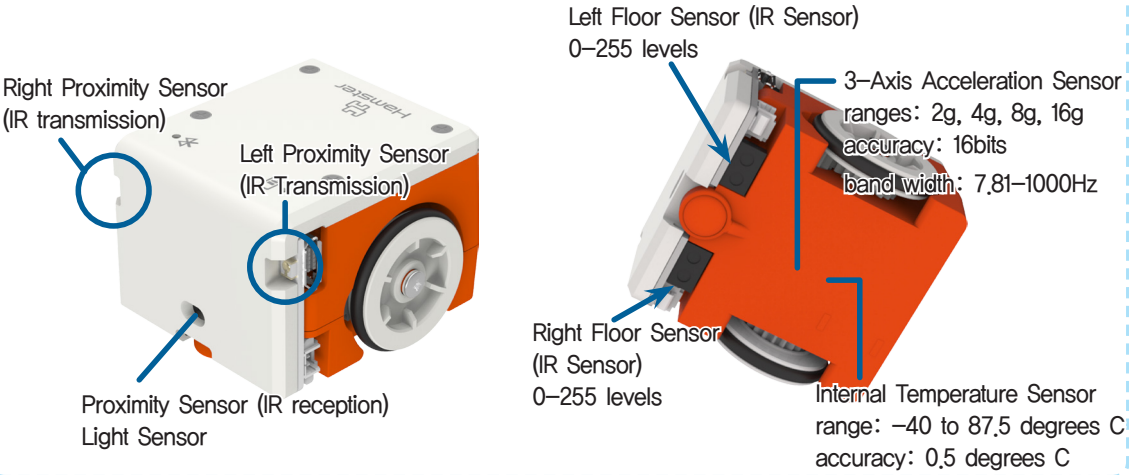
D-4 : Finding out the characteristics of the floor sensor of a hamster robot (S, T)

Reading Material

What is a sensor? It refers to an instrument which senses or measures certain physical amount such as heat, light, temperature, pressure, or sound, and notifies them through signals.

Just like a human recognizes his external environment through his eyes, nose, and ears, a machine or robot can recognize its external environment through its sensors. And a hamster robot can react in various ways according to the values of its sensors.

Then, let's find out which sensors are included in the hamster.



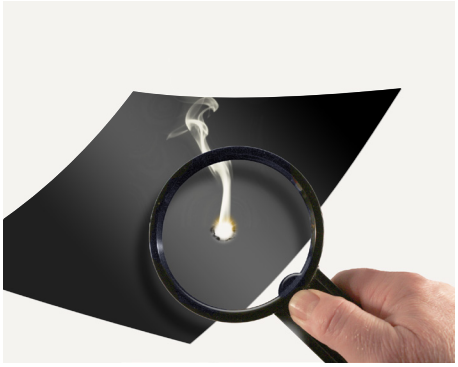
Sensor Blocks in Scratch

Reading Materials

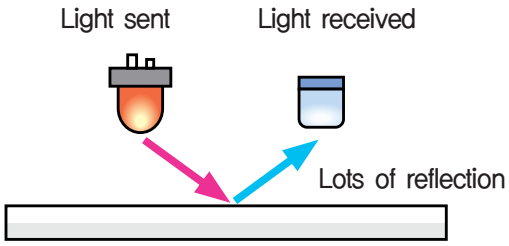
Principles of a floor IR sensor

Have you ever tried burning a black paper using a magnifying glass?

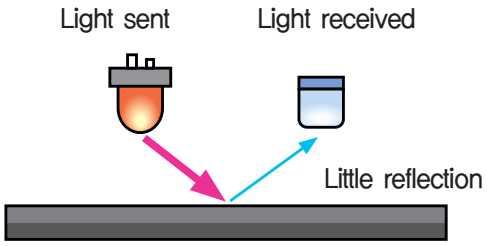
If you have a magnifying glass on a black paper on a sunny day, you will soon see the paper being burned giving off smoke. This wouldn't happen to a white paper, but only to a black paper, and this feature will be able to be seen in a hamster's sensor, too.



Principles of an IR sensor



Most of the light received on a white floor would be reflected and returned.

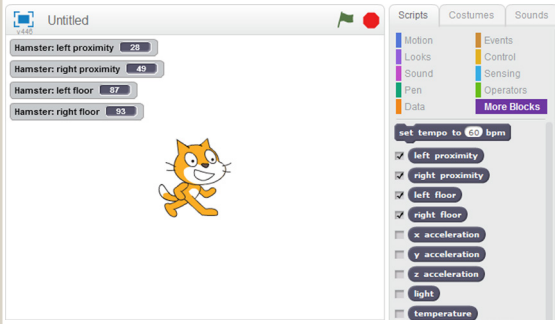


Most of the light received on a black floor would hardly be reflected.

The reason why only a black paper would be burned is because the amount of absorbed light is different. Black color would absorb most of the received light while white color would reflect most of it. Did you find this principle on the values of the hamster?

Since the amount of reflection is little in black color, the values of the IR sensor would be 10 to 30, while in white color, as its amount of reflection is a lot, the values of the IR sensor would be 80 to100.

Find out how you can show the values of sensors on "Scene Window" of Scratch.



① Click on 'More blocks' tab.
② Check a checkbox in the left of a block of which you want to observe its value.
③ On the stage, you can see the value of a sensor that keep changing!
④ If you want to observe more than one sensor value at once, you can check all of them.

Find out the characteristics of a floor sensor (IR–LED).

※ A floor sensor (IR-LED) consists of two parts: one that sends light and the other that receives light. The value of the sensor would show the amount of the reflected light in numbers. If the amount of the reflected light becomes more, the number will increase, and if the amount of the reflected light becomes less, the number will decrease.

Find out the changes of the floor sensor value according to the color of the floor. (Use a colored paper.)

Colors	White colored paper	Gray colored paper	Black colored paper
Values of left floor sensor			

Which color reflects light the most? ( )

Which color absorbs light the most? ( )

The value of a floor sensor gets (higher / lower) if the floor is light colored, and gets (higher / lower) if the floor is dark colored.

Which feature of the light (infrared light) can you find from this experiment?

D-5 : Making an algorithm of a bumper car using sensors (SW)

Design an algorithm of a bumper car game, which you will lose if your hamster robot is out of a white floor.

```
Repeat forever                                  ← Repeat forever checking the belows.
    If the value of a left floor sensor < 30    ← Using a left floor sensor, check if the
                                                  hamster robot stepped on a black floor.
        Stop
        Beep                                    ← If the robot stepped on a black floor,
        Set both LEDs to red                      have it stop, beep, and light on both
                                                  LEDs.
```

Put an appropriate command in the brackets, and make an algorithm to control a hamster robot.

```
Repeat forever
    If the value of a left floor sensor > (     )   ← Using a floor sensor, think of values to
                                                        decide whether a hamster robot is in the
                                                        arena, and put the value in the brackets.
        If "Up" arrow key is pressed,
                                                    ← Function that controls the movement
        If "Down" arrow key is pressed,               direction using arrow keys on a
                                                      keyboard.
        If "Right" arrow key is pressed,
        If "Left" arrow key is pressed,
        If spacebar is pressed,                     ← A break function using spacebar.
```

D-6 : Designing our own bumper cars (T, A, Visual Thinking)

Visual-Algorithm Thinking

Group Activity

••• Think about a bumper car game that makes two hamster robots bump into each other.

1. Play a game that you'd win if you push the other team's bumper car out of a certain area (a white plate).
2. Think on how you will decorate your bumper car robot to push the other team's bumper car robot better.
3. Make your own bumper in front of your bumper car robot.

••• Refer to the various cars and military vehicles.

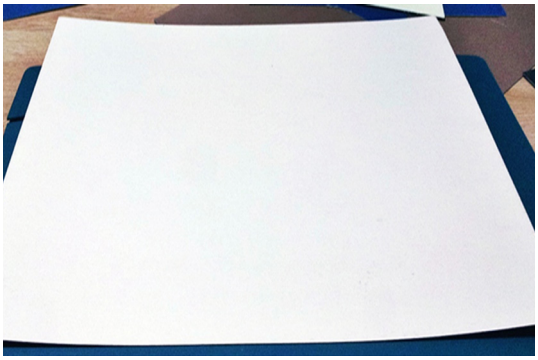



••• Design your own bumper car so that it would push the other team's robot better.

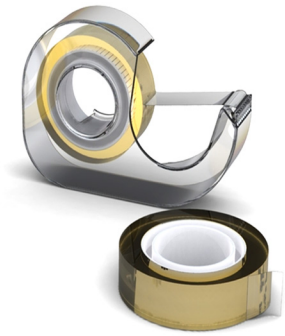
I-1 : Decorating a bumper car for an effective offense and defense (A, T)

••• Make your own bumper car that you designed in 'D–6: Designing our own bumper cars'.

♣ Preperation ♣

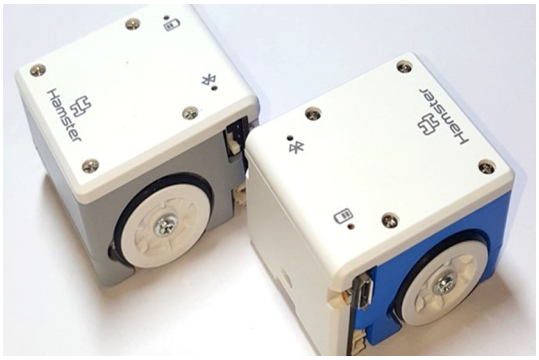


Hardboard papers



Sticky tapes (width around 1–1.5cm)

Black marker



Hamster Robot

••• Self–evaluate the result of the activity.

Evaluating my own picture	Answers	Think again with a teacher
Did you come up with your own unique design?	Yes / No	
Did you consider an effective defense?	Yes / No	
Did you consider an effective offense?	Yes / No	
Wasn't it too heavy or too weak?	Yes / No	

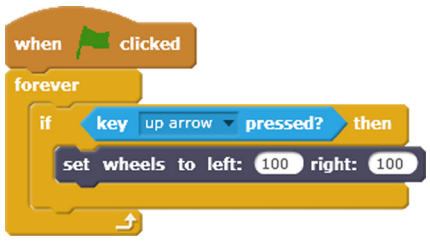
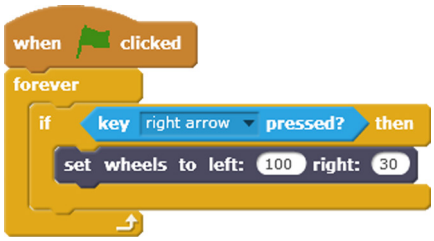
••• Think for a moment!

- (Basic) Did you design a bumper of your bumper car using a piece of hardboard paper?
- (Advanced) Think about other materials except for hardboard papers that you can use considering their weights.

I-2 : Programming a hamster robot using its sensors (SW)

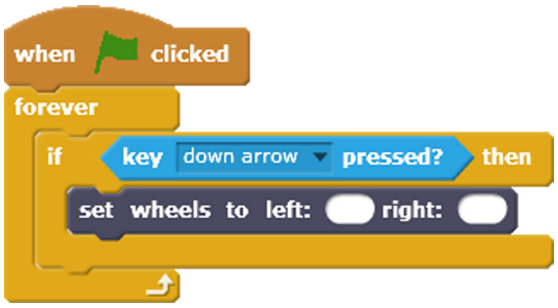
Think of the coding to move a hamster robot using the arrow keys.

Think of the direction of a hamster bumper car and the arrow keys of a keyboard to come up with its movement.

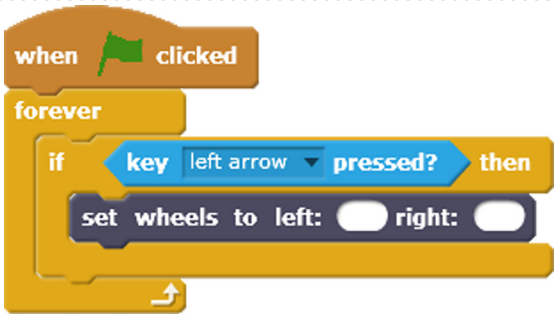
구분	When moving forward	When turning right
Arrow key to use	↑ (Up arrow key of a keyboard)	→ (Right arrow key of a keyboard)
Questions to consider	In which speed does it need to move? (Check with "D-3 Measuring the speed of a hamster robot")	How does each wheel need to move? (Check with "D-1 Unplugged activity")
Scratch code		

Using the example codes, think of the code for moving backward and turning left, and fill in the blanks given.

↓ Down arrow key of a keyboard
(,)

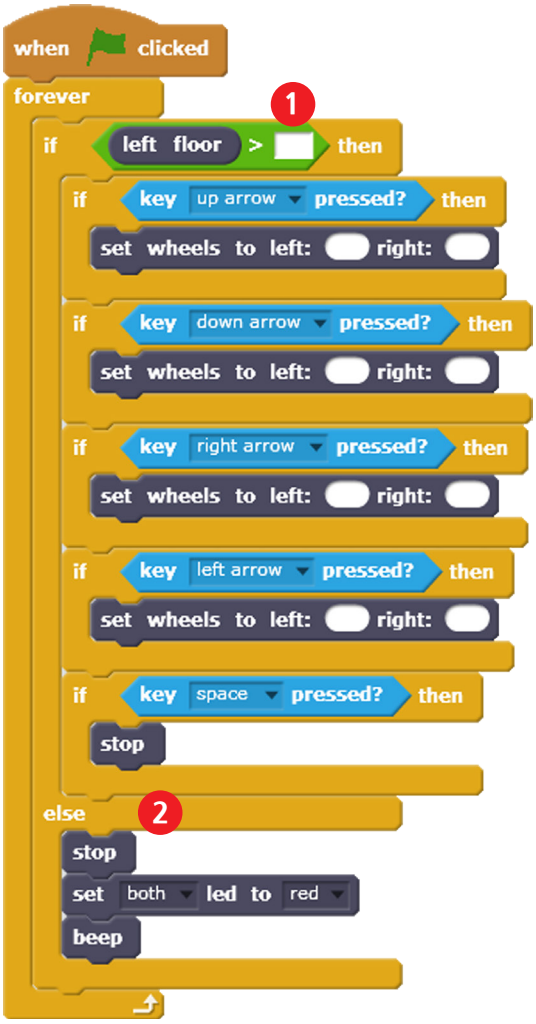


← Left arrow key of a keyboard
(,)



Find out how to move a bumper car using a hamster robot's sensor.

Fill in the blanks to complete the given command blocks.



ⓐ Think about which value should be put in ❶ in order to stop the code according to the value of the left floor sensor.

ⓑ ❷ If a hamster robot is out to the black colored side (out of the arena), have it stop with a beep and LED on.

ⓒ When the code is complete, have the hamster robot move freely as a bumper car using the arrow keys we learned previously.

※ Put various speed of the wheels to create our own bumper cars. (Refer to "D-2 Changing directions of a hamster robot")

I-3 : Run and modify problems (SW)

Run the program to check.

Does a hamster robot move easily according to the arrow keys?

Yes

If the robot touches the black colored paper, does it beep and on LED lights?

Yes

■ Talk about the function that you want to add.

e.g. 1) I want to have the robots bump into each other, varying the speed of wheels.

e.g. 2)
I want to find out which would be a better type of an offense: a robot bumping into the other while running or while staying still.

No

1. Does LED not work?
2. Does it make no sound?

■ Look at your code again and think about which part would be a problem.

If you cannot find out any problems, refer to the "Examples of Answers".

No

Check below points.

1. Under which arrow key did the robot not move? Try I-2 activity once again and modify.

2. Is it difficult to change the directions to left or right? Think about the activities of D-1, D-2 and modify.

Think about some functions you want to add or things to modify and re-program it.

S-1 : Self-evaluating the results of activities and sharing it with friends.

••• Self-evaluate the results of activities yourselves.

Self Evaluation Points	Evaluation		
	Good	Average	Not Good
Did you build a bumper car program that is controlled by arrow keys?			
Does LED work when it is out on the black colored floor according to the changes of the sensor value?			
Does it beep when it is out on the black colored floor according to the changes of the sensor value?			
Did you run the program, find problems, and modify them?			
Did you fairly divide your roles with your friends and have fun doing activities?			
Did you cooperate and talk to each other to solve problems?			
What do you think you did especially well during activities? Write them down below, and do the presentation.			

••• Self-evaluate the results of activities.

Edit some of the videos and pictures of activities, and upload them on Facebook or YouTube to share.

And share it further by replying on your friends' results of activities as well.

Examples of Answers

N2

- A joystick, a handle, a great car
- A car controlled by a remote controller
- You need to decorate it so that it would push out the other hamster robot better. Think on how to control them.

- ⓐ - ②
- ⓑ - ④
- ⓒ - ①
- ⓓ - ③

D2

- A radius of rotation gets bigger as the number increases from 1 to 3.

D3

- 100 140mm/s or 14cm/s

D4

Colors	White colored paper	Gray colored paper	Black colored paper
Value of left floor sensor	80 to 100	30 to 60	Less than 15

- White
- Black
- Higher, lower
- The amount of the reflected light will get lower as the brightness gets darker

I2

- (-100,-100)
- e.g. (0,100)
- Left floor sensor
- 30 to 40

e. g.

- (100,100) : forward
- (-100,-100) : backward
- (100,30) : right
- (30,100) : left

Unit 7.

Building a Monorail

Activity Objective	Will be able to build a monorail using a hamster robot.	
Target Students	Elementary Students Grade 5–6th	〈Applying NDIS Model〉 It is a project-based instruction model to solve problems through design and development, in order to boost computational thinking, based on problem recognition in a real life. This model consists of the procedures of Need, Design, Implementation, and Share.
Suggested Time	3 Classes	
Module Level	Intermediate	

Activities of Blended Subjects

Science (S)

Getting to know of the reflection amount of infrared light according to brightness, using an IR sensor.

Technology (T)

Design a monorail.

Practical Course (SW)

Design and implement an algorithm to solve a problematic situation.

Art (A)

Decorate lines and a robot in various ways.

Math (M)

A formula that compares the values of sensors.

※ Before starting the activity, check on the things that you already know.

- I understand the sequence, selection, and iteration structure. (Algorithm) ☐
- I can run a hamster robot using Scratch. (Function) ☐
- I can handle the sensors of a hamster robot using Scratch. (Function) ☐

N-1 : What shall we do in this class?

Hamzzi's friends are in an amusement park. But the rides can only move if they know how it works. Help Hamzzi's friends so that they can have fun riding the rides. Using a hamster robot in front of you, find out how a monorail works and build a ride yourselves.

◆ **Let's find out how a monorail works and build one using a hamster robot!** ◆

N-2 : Monorail, who are you?

Look at the given pictures below, and think about them by answering the questions.

What are the given pictures about?

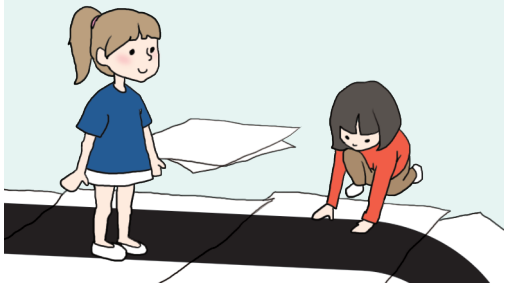
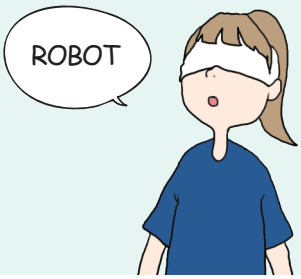
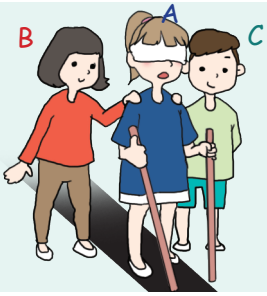
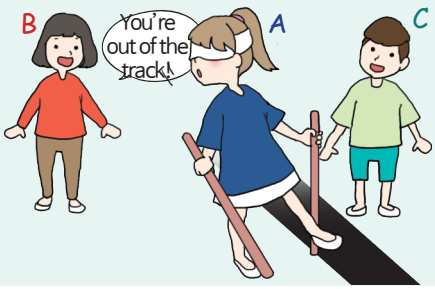
What do the pictures have in common?

What functions would you need to build a line tracer[1], which is similar to a monorail, with your hamster robot?

1) A line tracer is an autonomous mobile robot that follows certain driving lanes, which is also called an AGV (Automatic Guided Vehicle). The basic principle of a line tracer is to detect the marked line on the floor and moves through it.

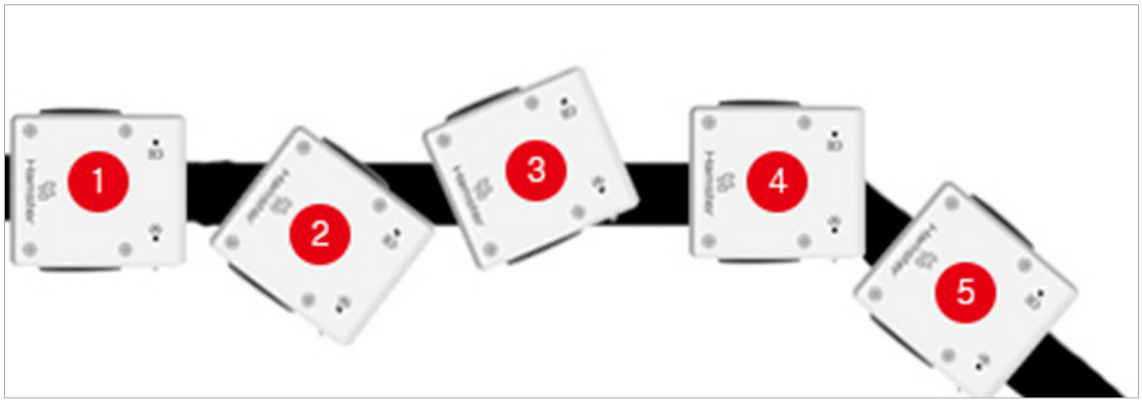
D-1 : Being a robot that follows a line (Unplugged activity, Groups of 3, Role Play)

Game Rules

Activity Examples	Activity Explanations
	① Prepare a curved line of a shoulder width. (Spread newspapers or cardboard papers that are about a shoulder width)
	② One of the group members (A) covers his/her eyes to be a robot.
	③ The group member, playing a robot (A), grabs sticks (long enough to touch the ground) in his/her both hands.
	④ The rest two group members (B and C) stand at the back of the robot (A), side by side. (ex. B at the back of A's right side, C at the back of A's left side)
	⑤ B and C, side by side, follow the robot from the back, and if the sticks that robot (A) is holding get out of the line, they would let robot (A) know saying "Out of the way."

D-2 : What if I control a robot myself?

Write down command blocks that you need in each stage to have the robot follow a line without getting out of the way.



Given command blocks


Move forward


Turn right


Turn left

① Move forward → ② → ③ → ④ → ⑤

D-3 : Finding out the sensors of a hamster robot (S, T)

Find out the characteristics of a floor sensor (IR-LED).

※ A floor sensor (IR-LED) consists of two parts: one that sends light and the other that receives light. The value of the sensor would show the amount of the reflected light in numbers. If the amount of the reflected light becomes more, the number will increase, and if the amount of the reflected light becomes less, the number will decrease.

Find out the changes of the floor sensor value according to the color of the floor. (Use a colored paper.)

Colors	White colored paper	Gray colored paper	Black colored paper
Values of left floor sensor			
Values of right floor sensor			

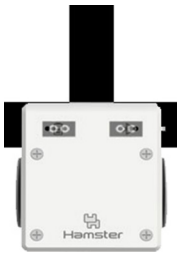
The value of a floor sensor gets (higher / lower) if the floor is light colored, and gets (higher / lower) if the floor is dark colored.

Which color reflects light the most? ( )

Which color reflects light the least? ( )

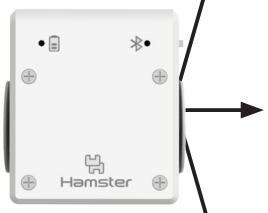
Which feature of the light (infrared light) can you find from this experiment? _____

Find out the changes of the values of floor sensors according to the location of a black line (width 1–1.5cm)

Location of the black line and floor sensors				
Values of left floor sensor				
Values of right floor sensor				

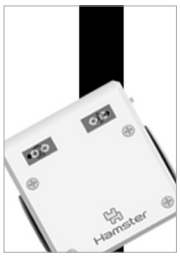
D-4 : Creating an algorithm to follow a line (width 1–1.5cm), using sensors (SW, M)

Compare the values of both floor (IR) sensors and try to move the robot.



To which direction does the robot should move to?
( )

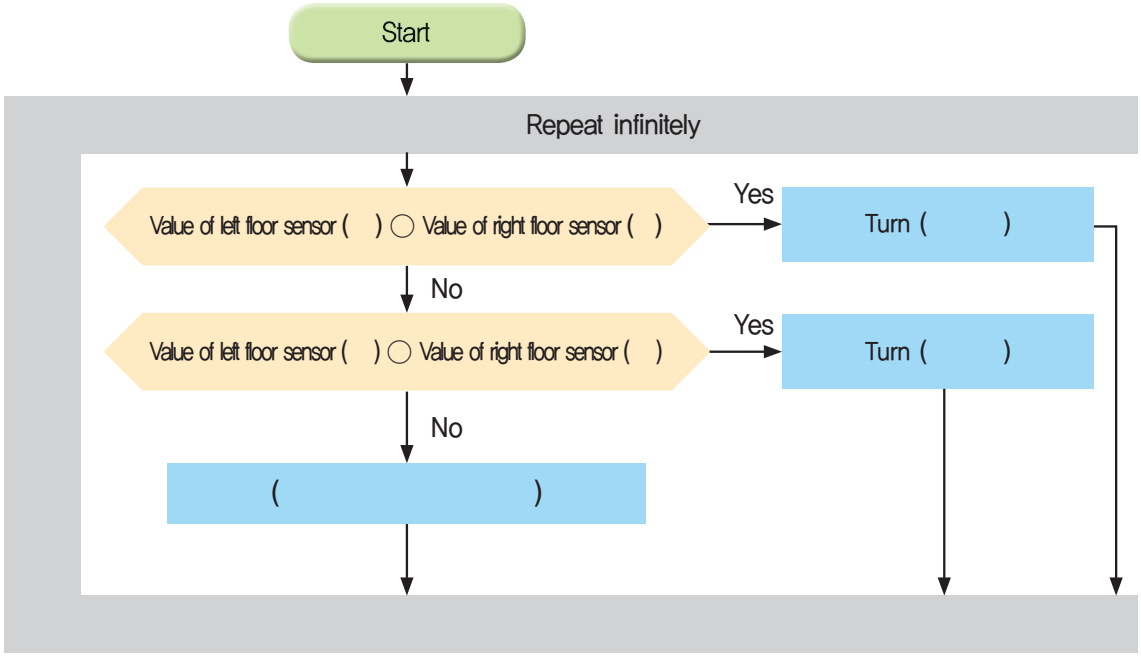
Value of left floor sensor ( ) ◯ Value of right floor sensor ( )



To which direction does the robot should move to?
( )

Value of left floor sensor ( ) ◯ Value of right floor sensor ( )

Find a location of a hamster robot when it is on the black line on the floor, so that the values of the left floor sensor and right floor sensor would be either the same or to be the most similar.
Draw its location in the blank.



Complete an algorithm for a robot to follow a line using the values of both floor (IR) sensors.

Repeat infinitely

If value of left floor sensor 〈 value of right floor sensor

Turn the hamster robot to the (right / left)

Else (If value of left floor sensor is not smaller than values of right floor sensor)

If value of left floor sensor 〉 value of right floor sensor

Turn the hamster robot to the (right / left)

Else (If value of left floor sensor equals to value of right floor sensor)

( )

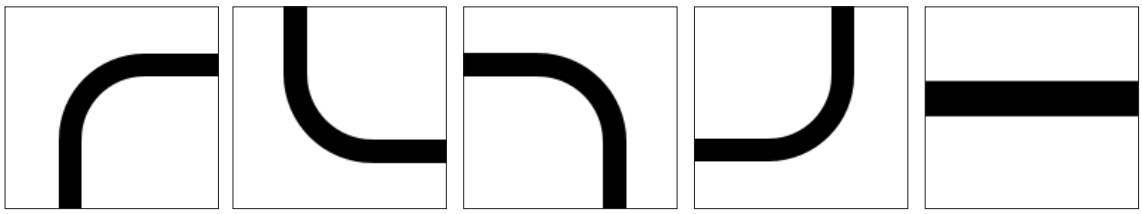
Visual-Algorithm Thinking

Group Activity

Now, make a rail (a black colored line) for the robot to follow. What you must consider are:

1. Set the departure and destination points.
2. Draw a rail for the robot as a continuous line.
3. Set stations for people to get on and get off.

Rail boards you can use are as below. Use the following five forms of boards to make a rail.



Rail 1 Rail 2 Rail 3 Rail 4 Rail 5

Show a monorail that your hamster robot will move by drawing rail boards 1–5.

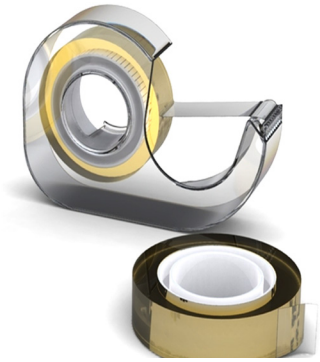
Think for a moment!

- Did you set the departure and destination points? (Yes / No)
- Are all the lines connected to each other? (Yes / No)

I-1 : Draw and decorate a rail for a robot to follow (A)

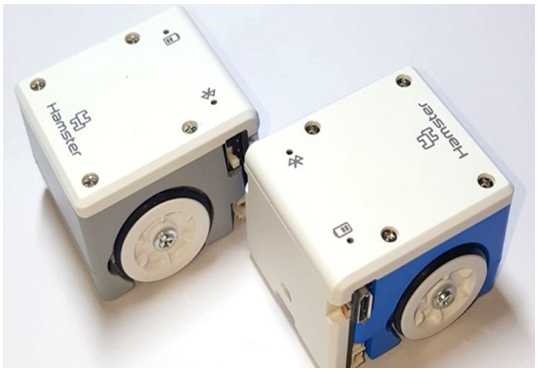
••• Prepare some things to decorate a rail.

A large paper (or a woodrock board)



A black sticky tape (width 1-1.5cm)

A black marker



A hamster robot

••• Work with your group members to create an actual rail on a large paper.

••• Using various materials and tools, decorate your hamster robot nicely.

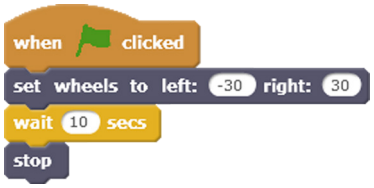
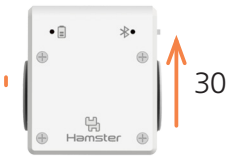
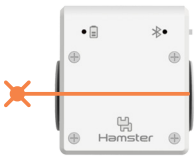
••• Self-evaluate the result of the activity.

Evaluating my own picture	Answers	Think again with a teacher
Did you set the departure and destination points?	Yes / No	
Are all the lines connected to each other?	Yes / No	
Are all the width of the lines in between 1-1.5cm?	Yes / No	

I-2 : Programming a hamster robot using sensors (SW)

Find out how you can turn the direction of a hamster robot.

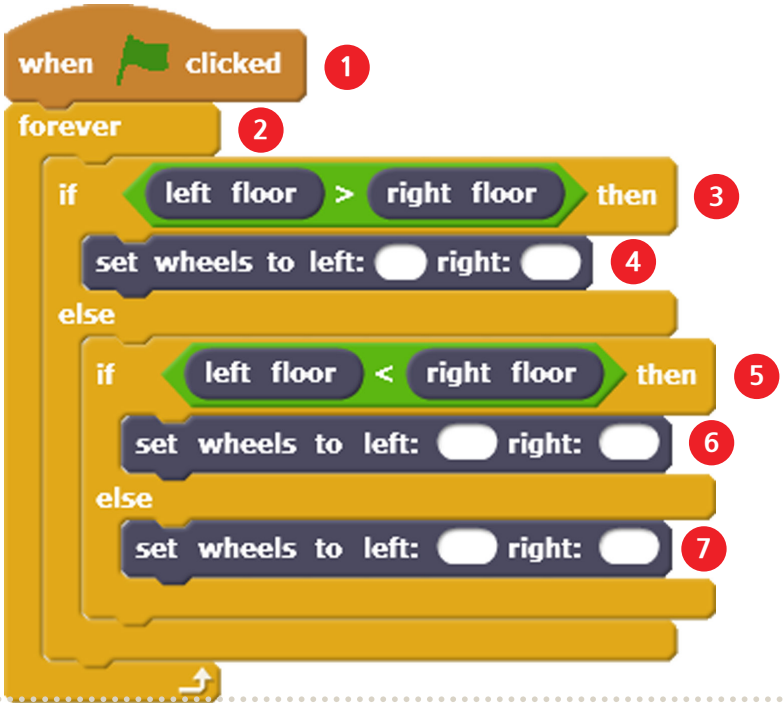
How to change the direction of a hamster robot by controlling both wheels of the robot

	Rotation speed and directions of wheels	center of rotation	Scratch code
Spin (A)			
Pivot Turn (B)			
Round Turn (C)			

Implement and run a program that changes the direction of a hamster robot using example codes, and talk about the differences.

Program a robot that follows a line using sensors.

Complete the command blocks by filling the blanks.



① When “green flag” button is clicked, the program runs.

② Run all the command blocks repeatedly.

③ Compare the values of left and right floor sensors. If the left floor sensor value is greater, have block ④ run, or have block ⑤ run.

④ Vary the speed of the left wheel and right wheel so that a hamster robot could turn its direction to the right.

⑤ Compare the values of left and right floor sensors. If the right floor sensor value is greater, have block ⑥ run, or have block ⑦ run.

⑥ Vary the speed of the left wheel and right wheel so that a hamster robot could turn its direction to the left.

⑦ Set the same speed for both wheels of the hamster robot. If the number increases, the speed will be faster.

I-3 : Run and modify problems (SW)

••• Run your program and check.

Does your hamster robot follow the line just fine?

Yes

Write down the functions that you want to add.

1. Turn on LED ( )
2. Make sounds using a speaker ( )
3. Have it stop and go at a certain point ( )
4. Others:

No

Check on the points below.

1. Does your robot turn right when it is out of the line to the left? ( )
2. Does your robot turn left when it is out of the line to the right? ( )
3. Does your robot turn too fast and face the opposite direction? ( )
4. Others:

••• Think of the new functions you'd like to add and the things that you need to modify, and re-program it.

S-1 : Self-evaluating the results of activities and sharing it with friends

••• Self-evaluate the results of activities yourselves.

Self Evaluation Points	Evaluation		
	Good	Average	Not Good
Did you design your program with appropriate selection structure according to the changes of sensor values?			
Did you run the program, find problems and modify them?			
Did you decorate the robot according to its topic?			
Did you fairly divide your roles with your friends appropriately?			
Did you cooperate and talk to each other to solve problems?			
What do you think you did especially well during activities? Write them down below, and do the presentation.			

••• Self-evaluate the results of activities yourselves.

Run the "robot that follows a line" that you and your group members built together in front of other friends. After running the robot, the presenters can also share the ideas and feelings they had during the activity. Listeners can evaluation your friends' work while listening.

••• Self-evaluate the results of activities yourselves.

Edit some of the videos and pictures of activities, and upload them on Facebook or YouTube to share. And share it further by replying on your friends' results of activities as well.

Examples of Answers

N-2

- A monorail, a cable car, a line tracer
- It follows on a given line.
- It is a function that follows on a given line, not getting out of the line.

D-2

- Turn left → Turn right → Turn right → Move forward

D-3

Colors	White colored paper	Gray colored paper	Black colored paper
Values of left floor sensor	80 to 100	30 to 60	Less than 15
Values of right floor sensor	80 to 100	30 to 60	Less than 15

- Gets (higher) if the floor is light colored, and gets (lower) if the floor is dark colored.
- White colored
- Black colored
- The amount of the reflected light will get lower as the brightness gets darker.

Location of the black line and floor sensors				
Value of left floor sensor	70 to 80	0 to 20	80 to 100	0 to 15
Values of right floor sensor	70 to 80	80 to 100	0 to 20	0 to 15

D-4

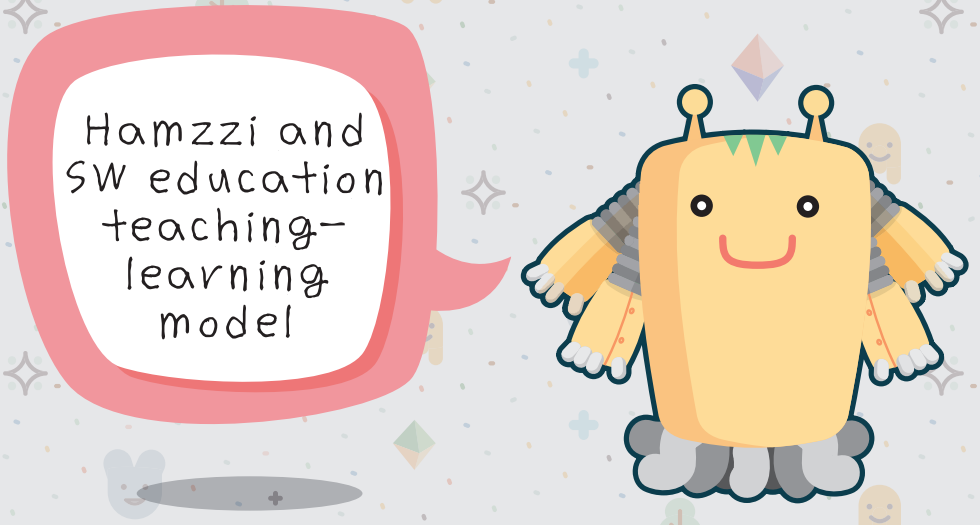
- Left, <
- Right, >
- (In order, from the top) <, Left, >, Right, Move forward
- Left, Right, Move forward

I-2

- A radius of rotation gets bigger as it moves from A to C. The speed of changing direction will be faster as the number in the yellow blank increases.
- e.g. > , (50, 20)
  < , (20, 50)
  (30, 30)

Welcome to HAMZZI WORLD

Here are the pages for ‘parents’ and ‘teachers’. Let’s talk about software education teaching-learning model of ‘hamster lesson plan’.



Unit. 1

Need for an instruction model and a SW education teaching-learning model

Let's find out about an instruction model to see why we need it.

If a model refers to the abstraction of the characteristics of an actual thing or phenomenon, an instruction model systemizes important and simplified characteristics of a phenomenon called instruction. If a teacher wants to apply this instruction model to a real class, he/she would need background knowledge on an instruction model.[1)]

Here, an instruction model is based on a human learning theory, and the procedures to help students learn will be reinterpreted by a teacher through the instruction model. Since the teacher would be responsible to achieve the activity objective, an instruction model would provide the teacher a structure and direction of the class, while this cannot provide every details of his/her teaching. Rather, the teacher needs to bring a lot of his/her own creativity to lead the class based on his/her basic knowledge on the instruction.

Thus, an instruction model plays a role of a blueprint of a class, and in this blueprint, the teacher, using all of his/her knowledge and technique, can get his/her class effective. This is why we need an instruction model, as a foundation of an instruction, and in order to get the best result of the instruction, it is also necessary to understand the instruction model.

1) Nakwon Kwon (Korea National University of Education), Teaching-Learning Theory and Instruction Model

Why do we need a SW education teaching-learning model?

Educational Curriculum Revision for 2015, which was announced in last September, 2014, emphasizes software education and lets it be applied to actual classes. For this, government developed software education management guidelines, and produced textbooks to be used in specialized schools for software education or research, which will be expanded from 2016.

Previously we've already mentioned that understanding an instrunction model is very important for the success of a class, and this is why it is necessary to provide software education teaching-learning method which will be used in software education environment for the teachers who will actually handle the class.

Here among all the software education teaching-learning models, which have been developed by simplifying the components of computational thinking and to be used in teaching-learning, we chose 'Design-based Model (NDIS Model)' to develop class materials using a hamster robot.

Unit. 2

Software education teaching-learning model

What is ‘computational thinking’ in software education purposes?

• • • Recently, many information education researches focus on ‘enhancing computational thinking’ as a goal of the education, believing this should be what software education should pursue, and in fact, even the goal of the ‘information’ subject of Educational Curriculum Revision for 2015, is to focus on ‘enhancing computational thinking’ as well.

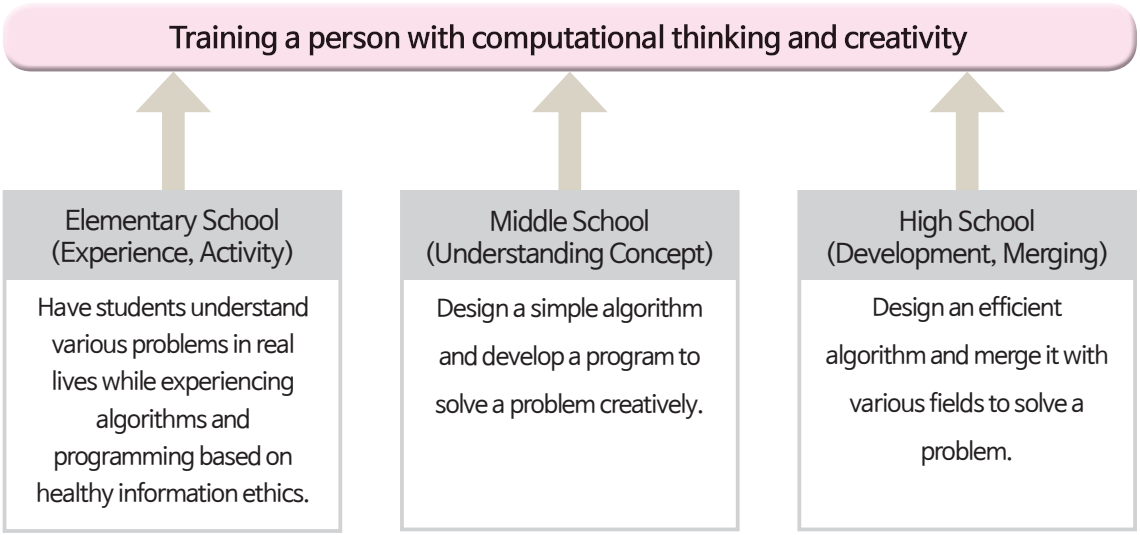
• • • There are various definitions of computational thinking, depending on the researchers, but in Korea, through the recent studies, we have defined it as ‘The thinking ability that is able to solve a problem based on the basic principles and concepts of computing efficiently.[2)]

• • • There are 4 components of computational thinking: Decomposition (D), pattern recognition (P), abstraction (A), algorithm (A) and in some cases, programming (P) could be included.[3)]

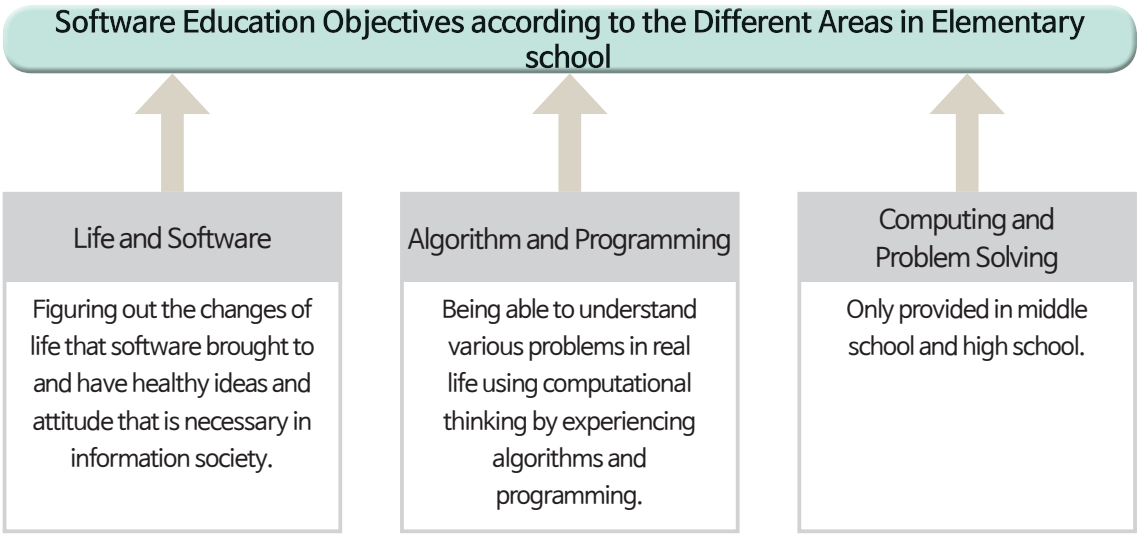
2) KERIS (Korea Education and Research Information Service), Software Education Management Guidelines, 2015

3) Jin Sook Kim et al., Development of SW Education Teaching-Learning Model, CR 2015-35, Funded by Korean Educational Development Institute & Korea Education and Research Information Service, 2015

According to software education management guideline, software education pursues to 'train a person with computational thinking and creativity'.[4)]



According to the software education management guideline, software education is divided into three different fields: 'Life and Software', 'Algorithm and Programming', and 'Computing and Solving Problems.[5)]



4) 5) KERIS (Korea Education and Research Information Service), Software Education Management Guidelines, 2015

Regarding Design-based Model (NDIS Model) to improve CT

• • • Here, we are planning classes based on 'design-based model (NDIS model)' to develop class materials using a hamster robot, among all the software education teaching-learning models.[6)]

• • • This instruction model is based on 'project-based instruction model', which refers to the student-centered instruction model; students choose the topic, do the research, and present and evaluate their research.

• • • Most of the time, there are 6 learning procedure of the project-based instruction model: 'choosing a topic' → 'collecting data' → 'making a plan' → 'performing the assignment' → 'writing a report' → 'evaluation'.

Learning procedure and methods of 'design-based model (NDIS model)'

Level	Learning methods	Learning procedure
Needs	• Problem understanding • Human-centered needs analysis	• Need to research on the given topic and users • Human-centered approach is important when analyzing user's needs • Programs/systems should be able to help human life
Design	• Creative design • Engineering design	• Before writing in programming language, make a plan on the story of the project, objects in need, the characteristics and roles of the objects, and interaction of the objects to be easily understood • Have students think about the algorithms in a more detailed way. Refer to the flowchart, pseudo code, etc. • Include objectives to enhance CT in this design procedure.
Implemen-tation	• Development and implementation • Unplugged strategy • EPL • Physical computing	• Actualize learning contents using the areas of unplugged, EPL, physical computing. • First understand related knowledge of computer science using unplugged. • Then actualize the planned project through EPL. • Lastly, through the physical computing activity, which expresses digital to analog information or vice versa using an external object, connect it to the integrated activities. • This is an activity that students plan and actualize themselves to understand various examples of computing, which is used in real life and integrate what they've learned with other areas or technology. • When integrating what they've learned with real life, students can improve their skill to solve a problem.
Share	• Share, • Feedback	• Share the developed program • Feedback of the program • Self-examining on the process of the development

6) Jin Sook Kim et al, Development of SW Education Teaching-Learning Model, CR 2015-35, Funded by Korean Educational Development Institute & Korea Education and Research Information Service, 2015

Unit 5. Building a Jukebox with Hamzzi – Lesson Plan

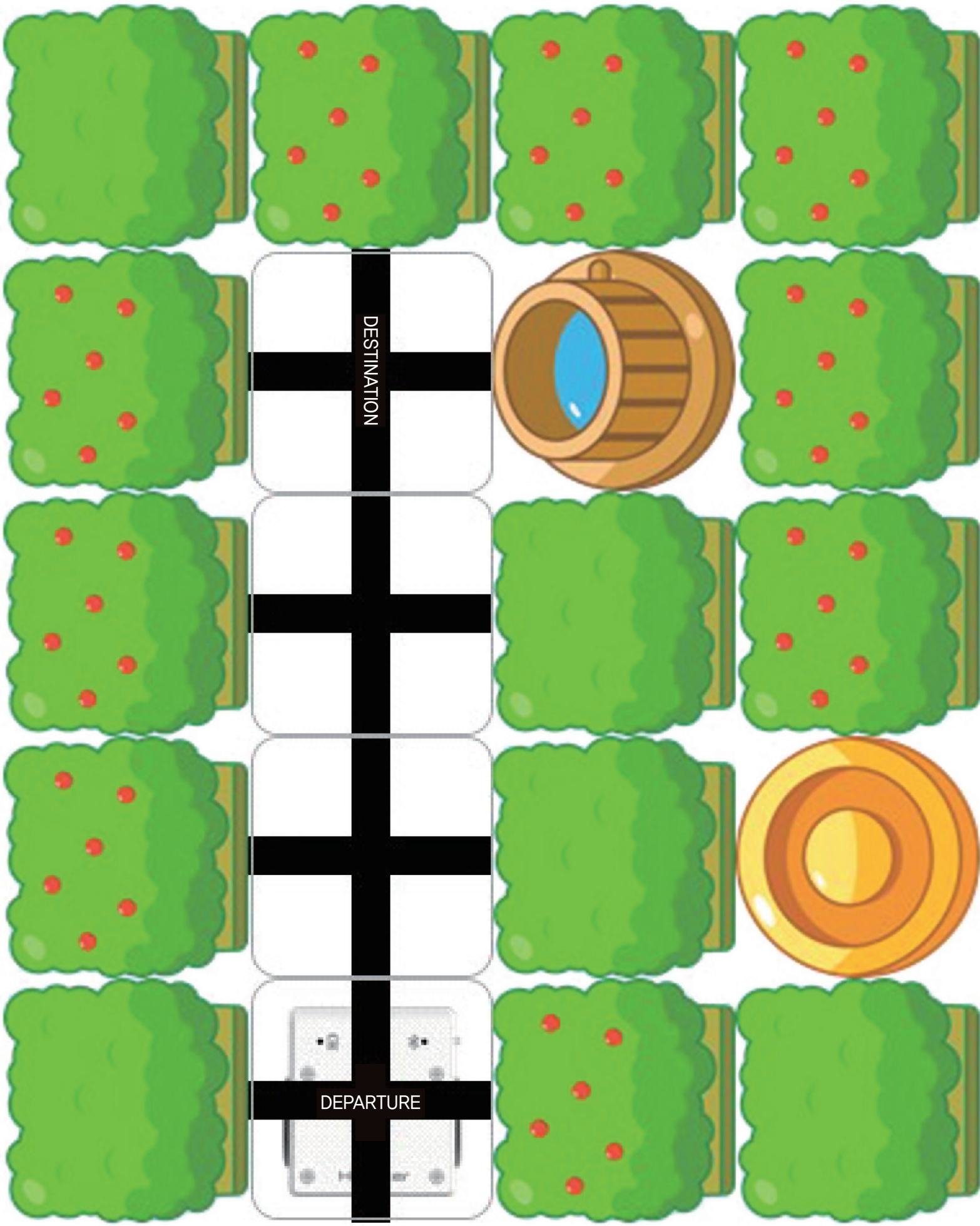
Overview	Topic	• Building a jukebox		
	Activity Objective	• Will be able to build a jukebox using a hamster robot.		
	Blended Subjects	• SW: Design and implement an algorithm to solve a problematic situation. • S: Getting to know of the reflection amount of infrared light according to distance, using a proximity sensor. • T: Run a jukebox using a proximity sensor and a light sensor. • A: Play and create music using sensors of a hamster robot.		
	Check points before the activity	• Understand the sequence, selection, and iteration structure. (Algorithm) • Can run a hamster robot using Scratch. (Function)		
Teaching-Learning Plan	Class Procedure	Teaching-Learning Procedure	Time	※Attention Points ♠Materials
	Needs	▮N-1: Find out a problematic situation. - Introduction to produce a jukebox using a story ▮N-2: Analyze the problematic situation. - Understanding the problematic situation by looking at the pictures - Getting the activity objectives by analyzing the problematic situation **Let's make a jukebox using a hamster robot.**	10′	
	Design	▮D-1: Make a sound according to the instruction. Take Turns Singing (unplugged activity) ▮D-2: Find out about sensors of a hamster robot which can be used for a jukebox. (S, T) ▮D-3: Design a jukebox algorithm using the sensors of a hamster robot. (T, A, Visual Thinking) ▮D-4: Let's design our own jukebox. (SW, M)	50′	※Roles need to be given according to the activity for D-1 ♠Pointer
	Implemen-tation	▮I-1: Make a sound with a hamster robot. ▮I-2: Play a music with a hamster robot. (SW) ▮I-3: Program a hamster robot using sensors. (SW) ▮I-4: Build a hamster piano. (Advanced)	40′	♠Computer ♠Hamster robot ♠Piano board
	Share	▮S-1: Share the activity and evaluate - Self-evaluate by looking back the activity - Present the result of the activity and share it through online	20′	
Self-Evaluation	Sections	Evaluation Points (Elements)		Methods
	CT	• Are they able to design an algorithm of a jukebox?		Performance Assessment
	Physical Computing	• Are they able to actualize the designed program through physical computing?		Performance Assessment
	Attitude	• Do they actively participate in the activity and want to share and give feedback?		Observation

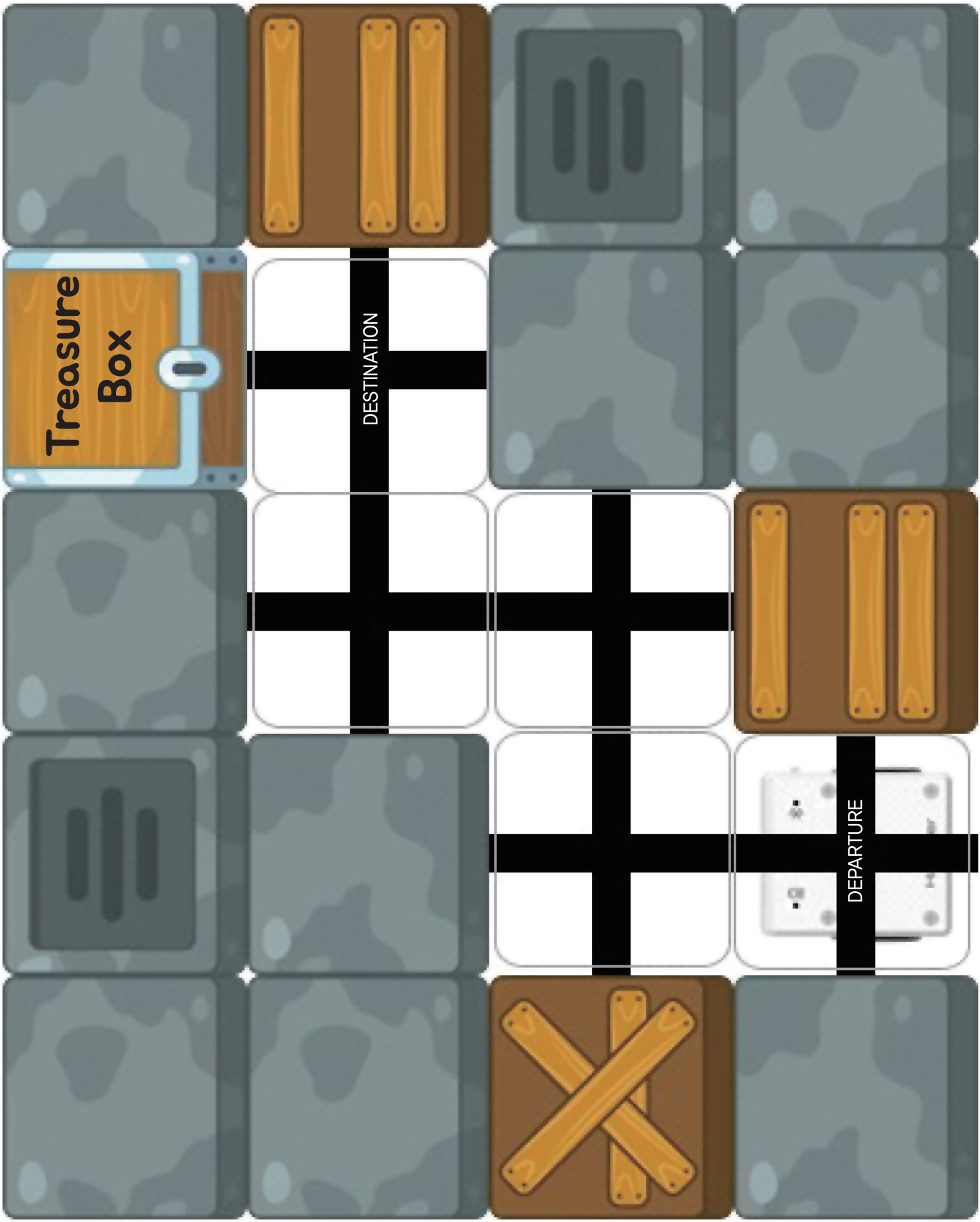
Unit 6. Building a Bumper Car with Hamzzi – Teaching Guide

Overview	Topic	• Building a bumper car		
	Activity Objective	• Will be able to build a bumper car using a hamster robot.		
	Blended Subjects	• SW: Design and implement an algorithm to solve a problematic situation. • S: Getting to know of the reflection amount of infrared light according to brightness, using an IR sensor. • T: Change directions using the difference of the speed of both wheels of a bumper car. • A: Decorate a bumper car robot in various ways. • M: Find out speed using speed formula.		
	Check points before the activity	• Understand the sequence, selection, and iteration structure. (Algorithm) • Can run a hamster robot using Scratch. (Function) • Can handle the sensors of a hamster robot using Scratch. (Function)		
Teaching-Learning Plan	Class Procedure	Teaching-Learning Procedure	Time	※Attention Points ♠Materials
	Needs	▮N-1: Find out a problematic situation. - Introduction to produce a bumper car using a story ▮N-2: Analyze the problematic situation. - Understanding the problematic situation by looking at the pictures - Getting the activity objectives by analyzing the problematic situation **Let's make a bumper car using a hamster robot.**	10′	
	Design	▮D-1: Let's try to be the two wheels of a hamster robot. (Groups of 2, unplugged activity) ▮D-2: Change directions of a hamster robot. ▮D-3: Measure the speed of a hamster robot. (S, M) ▮D-4: Finde out the characteristics of the floor sensor of a hamster robot. (S, T) ▮D-5: Make a bumper car algorithm using sensors. (SW) ▮D-6: Desig our own bumper cars. (T, A, Visual Thinking)	50′	※Roles need to be given according to the activity for D-1 ♠Hamster robot ♠Decoration tools
	Implemen -tation	▮I-1: Decorate a bumper car for an effective offense and defense. (A, T) ▮I-2: Program a hamster robot using its sensors. (SW) ▮I-3 : Run and modify problems (SW)	40′	※Roles can be given in the group members for I-1 and I-2 ♠Computer ♠Hamster robot ♠Paper boards ♠Double-sided tape ♠Decoration tools
	Share	▮S-1: Share the activity and evaluate. - Self-evaluate by looking back the activity - Present the result of the activity and share it through online	20′	
Self-Evaluation	Sections	Evaluation Points (Elements)		Methods
	CT	• Are they able to design an algorithm of a bumper car?		Performance Assessment
	Physical Computing	• Are they able to actualize the designed program through physical computing?		Performance Assessment
	Attitude	• Do they actively participate in the activity and want to share and give feedback?		Observation

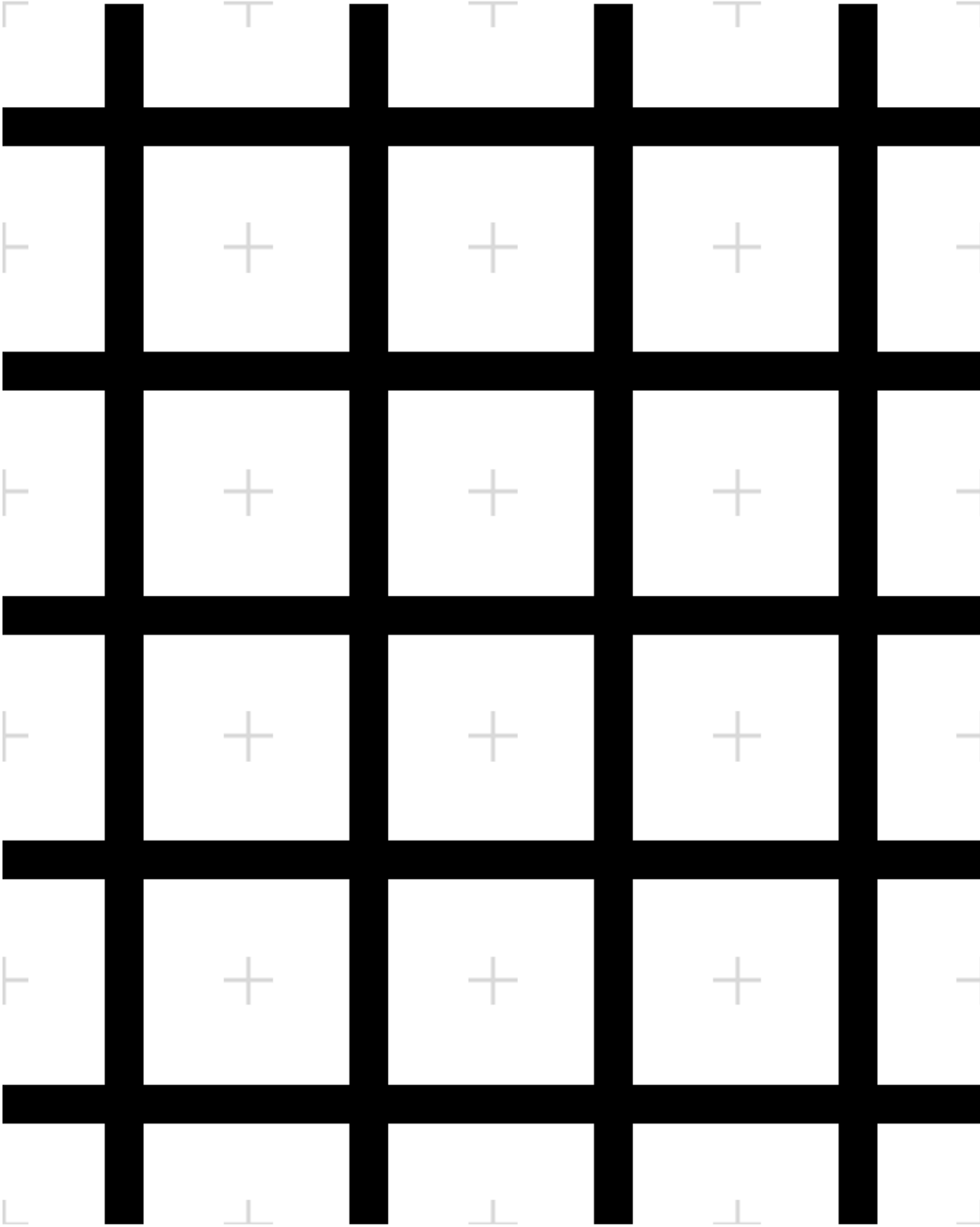
Unit 7. Building a Monorail with Hamzzi – Teaching Guide

Overview	Topic	• Building a monorail		
	Activity Objective	• Will be able to build a monorail using a hamster robot.		
	Blended Subjects	• SW: Design and implement an algorithm to solve a problematic situation. • S: Getting to know of the reflection amount of infrared light according to brightness, using an IR sensor. • T, A: Design a monorail. • A: Decorate lines and a robot in various ways. • M: A formula that compares the values of sensors.		
	Check points before the activity	• Understand the sequence, selection, and iteration structure. (Algorithm) • Can run a hamster robot using Scratch. (Function) • Can handle the sensors of a hamster robot using Scratch. (Function)		
Teaching-Learning Plan	Class Procedure	Teaching-Learning Procedure	Time	※Attention Points ♠Materials
	Need	▌N-1: Find out a problematic situation. - Introduction to produce a monorail using a story ▌N-2: Analyze the problematic situation. - Understanding the problematic situation by looking at the pictures - Providing the activity objectives by analyzing the problematic situation **Let's make a monorail using a hamster robot.**	10′	
	Design	▌D-1: Be a robot that follows a line. (unplugged activity, groups of 3, role play) ▌D-2 : Control the robot to follow the line. ▌D-3 : Find out the characteristics of sensors of a hamster robot. (S, T) ▌D-4 : Design an algorithm to follow a line using the sensors of a hamster robot. (SW, M) ▌D-5 : Design our own monorails. (T, A, Visual Thinking)	50′	※Roles need to be given according to the activity for D-1 ♠Hamster robot ♠Decoration tools
	Implemen -tation	▌I-1 : Draw and decorate a rail for a robot to follow. (A) ▌I-2 : Program a hamster robot using sensors. (SW) ▌I-3 : Run and modify problems. (SW)	40′	※Roles can be given in the group members for I-1 and I-2 ♠Computer ♠Hamster robot ♠Paper boards ♠Double-sided tape
	Share	▌S-1 : Share the activity and evaluate. - Self-evaluate by looking back the activity - Present the result of the activity and share it through online	20′	
Self-Evaluation	Sections	Evaluation Points (Elements)		Methods
	CT	• Are they able to design an algorithm of a monorail?		Performance Assessment
	Physical Computing	• Are they able to actualize the designed program through physical computing?		Performance Assessment
	Attitude	• Do they actively participate in the activity and want to share and give feedback?		Observation

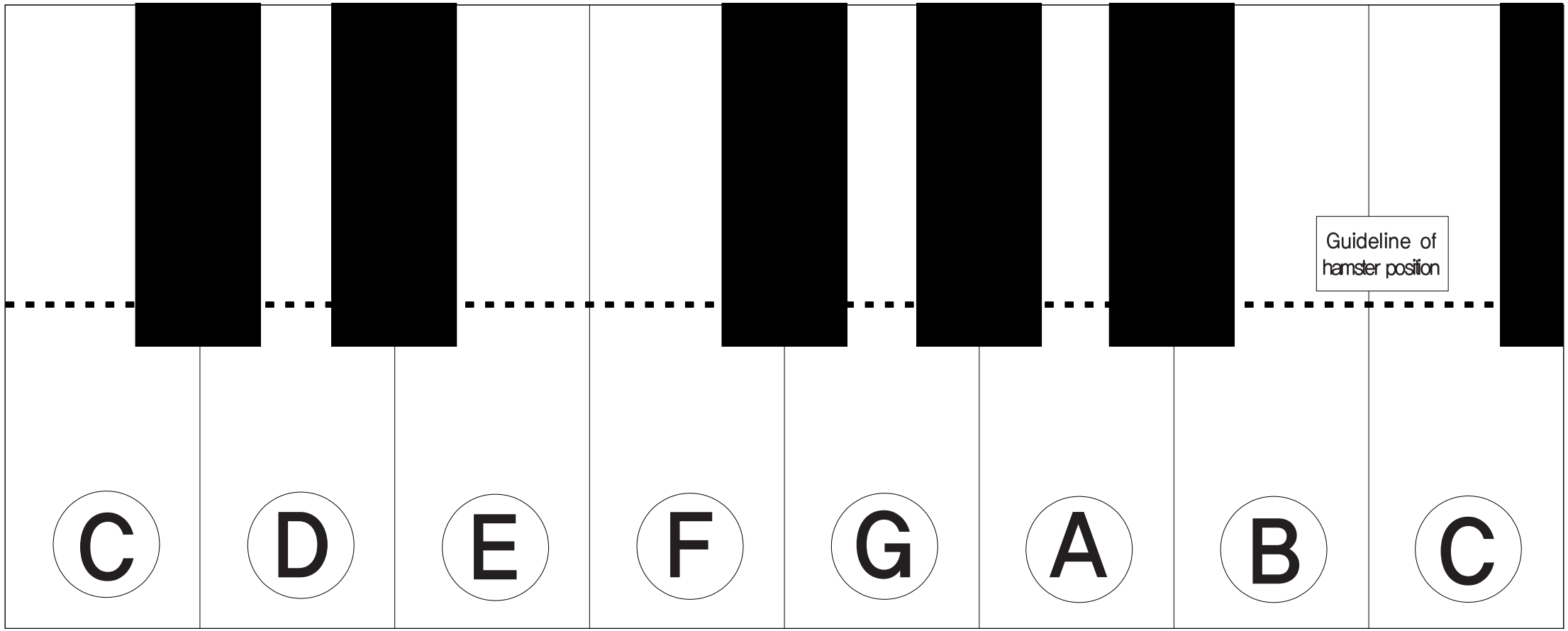

DESTINATION
DEPARTURE

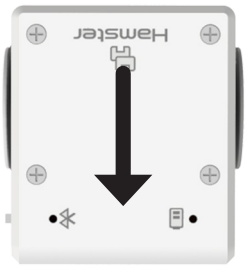

Treasure Box
DESTINATION
DEPARTURE


Treasure
Box

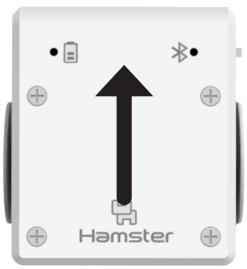


Hamster Piano Keys





0cm 20cm
1cm 19cm
2cm 18cm
3cm 17cm
4cm 16cm
5cm 15cm
6cm 14cm
7cm 13cm
8cm 12cm
9cm 11cm
10cm 10cm
11cm 9cm
12cm 8cm
13cm 7cm
14cm 6cm
15cm 5cm
16cm 4cm
17cm 3cm
18cm 2cm
19cm 1cm
20cm 0cm



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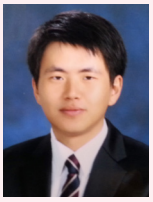

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