

Lesson 11

mBot the Musician

Overview

Lesson 11 will revisit the composition play, however, via using different coding blocks and algorithms. First, students need to explore how to utilize the “light sensor” Sensing block as a condition in the conditional algorithm. Students can control and compare different kinds of methods that affect the brightness situations around the light sensor of mBot. Building on this experiment and the collected data, students will then explore how to use the values of light intensity in the conditional algorithms to play different notes.

Objectives

By the end of class, students will be able to...

- Demonstrate the understanding of setting up a condition that combines Sensing and Operators blocks;
- Select appropriate programming scripts to design sound effects via looping and conditional algorithms;
- Clarify how the sequential, looping, and conditional construct work in a different part of an executable program.

Materials

- mBot
- mBlock
- Lesson 11 Activity Sheet
- Lesson 11 Slideshow

Content Standards

Type	Indicator	Standard
ISTE	1d	Students leverage technology to take an active role in choosing, achieving and demonstrating competency in their learning goals, informed by the learning sciences.
	3a, 3d	Students critically curate a variety of resources using digital tools to construct knowledge, produce creative artifacts and make meaningful learning experiences for themselves and others.
	5c	Students develop and employ strategies for understanding and solving problems in ways that leverage the power of technological methods to develop and test solutions.
CSTA	1B-CS-01	Describe how internal and external parts of computing devices function to form a system.
	1B-CS-02	Model how computer hardware and software work together as a system to accomplish tasks.
	1B-AP-10	Create programs that include sequences, events, loops, and conditionals.
	1B-AP-11	Decompose (break down) problems into smaller, manageable subproblems to facilitate the program development process.



Vocabulary

Term	Definition
Operators*	Logical Operators are the blocks that perform math functions – for example, whether a value is less than (or greater than) the other, whether they are equal or not, etc.
AND Operator*	The “... and ...” Operators block can join two (and even more) conditions to check whether both will happen at the same time.

* New term



Pre-lesson Checklist

- Print out and/or digitally distribute the Lesson 11 Activity Sheet.
 - If students will use paper versions of activity sheets, make sure the resources are easily available for students. This can be done by providing the links on your LMS, etc., or printing the resources out for each group to utilize during the class.
- Make sure any necessary computer equipment (installed with mBlock) are ready to go.
- Familiarize yourself with key points and notes detailed within this lesson plan and Lesson 11 slideshow as well as the demo programs shown below:

```

if (light sensor on-board light intensity < 90) then
  Action C
endif

if (90 < light sensor on-board light intensity and light sensor on-board light intensity < 900) then
  Action B
endif

if (light sensor on-board light intensity > 900) then
  Action C
endif
    
```

```

if (light sensor on-board light intensity < 90) then
  Action A
else
  if (light sensor on-board light intensity > 900) then
    Action C
  else
    Action B
  endif
endif
    
```

```

forever
  if (light sensor on-board light intensity < 60) then
    play note C4 for 0.25 beats
  endif

  if (60 < light sensor on-board light intensity and light sensor on-board light intensity < 110) then
    play note D4 for 0.25 beats
  endif

  if (110 < light sensor on-board light intensity and light sensor on-board light intensity < 170) then
    play note E4 for 0.25 beats
  endif

  if (170 < light sensor on-board light intensity and light sensor on-board light intensity < 220) then
    play note F4 for 0.25 beats
  endif

  if (220 < light sensor on-board light intensity and light sensor on-board light intensity < 300) then
    play note G4 for 0.25 beats
  endif

  if (300 < light sensor on-board light intensity and light sensor on-board light intensity < 400) then
    play note A4 for 0.25 beats
  endif

  if (400 < light sensor on-board light intensity and light sensor on-board light intensity < 900) then
    play note B4 for 0.25 beats
  endif

  if (light sensor on-board light intensity > 900) then
    play note C5 for 0.25 beats
  endif
endforever
    
```

 Agenda (60 minutes)

Time Interval	Content
5 minutes	Warm Up This phase begins with brainstorming about how to make “music” without musical instruments. Students need to associate with their real-life experience to propose possible ways of creating sound effects.
15 minutes	Phase 1 This phase aims to introduce the use of logical operators in association with conditional constructs. Students will explore how to use Operators blocks to create and set up more conditions – in particular, when they need to create more than two pathways based on the input from a single sensor or any other kind of input device and electronics.
15 minutes	Phase 2 This phase will focus on the combination of logical operators and conditional constructs in the case of the use of nested conditional algorithms. Students will compare the two kinds of conditional algorithms in certain depth – the parallel “if..., then...” and the nested “if..., then...; else...”.
15 minutes	Practice Building on their previous experiment and findings, students will use conditional algorithms to create a “Light Piano”, which means the notes are generated due to different kinds of brightness circumstances.
5 minutes	Wrap Up
5 minutes	Clean Up

Activities

Warm Up: Slides 2-5 [8 minutes]

Objectives:

- This phase begins with brainstorming about how to make “music” without musical instruments. Students need to associate with their real-life experience to propose possible ways of creating sound effects.

Procedures:

Slide 2

- Show Slide 2 to inform the class about the agenda and tasks in this lesson.

Slides 4-5

- Pose a question for discussion:
 - “*Apart from musical instruments, could you make ‘music’ (or easy listening sounds) by using everyday objects?*”
 - For reference, play a video clip that people use cups to make music. Display the example to spark the thought and encourage students to brainstorm possible ideas.
 - In Slide 5 there is an example of making music with cups.
 - Due to the copyright, the slideshow cannot provide the video clip.
 - However, a recommended source is indicated in this slide which is available from: <https://youtu.be/dM6vnN4pXygg>.

Phase 1: Slides 6-12 [12 minutes]

Objectives:

- This phase aims to introduce the use of logical operators in association with conditional constructs. Students will explore how to use Operators blocks to create and set up more conditions – in particular, when they need to create more than two pathways based on the input from a single sensor or any other kind of input device and electronics.

Procedures:

Slide 7

- Ask students to model the situation shown in the slide in mBlock.
 - Ask students to drag the “if..., then...” Control block and the “light sensor” Sensing block, try whether they could place the “light sensor” block inside the “if..., then...” block’s condition.
 - Have students go back to the Block Area in mBlock and figure out what kinds of shapes of the blocks may be able to combine the “light sensor” block and the “if..., then...” block.
 - Remind students that pay careful attention to the shape of the block.
 - Also, indicate that they could go to the Operators category first. This category is relatively new and not explained specifically during the previous lessons.
- Ask students to report their findings and try to predict the possible functions of the script.

Slide 8

- Explain the meaning of logical operators.

Slides 9-10

- Show Slide 9 to display the three kinds of common Operators blocks that can perform math functions.

- Indicate these three blocks can compare the value of the brightness input from mBot's light sensor with another set-up number.
- Give some examples that combine the "light sensor" block and an Operators block.
 - Display two kinds of examples: one is if the value of the brightness is less than 90, and the other is the value of the brightness is greater than 900.

Slides 11-12

- Pose a question for discussion:
 - *"If we want to measure the range between 90 and 900, what should we do?"*
- Show Slide 11 to introduce how to use the "... and ..." Operators as a possible solution to the above question.
 - Show Slide 12 to give the code:



Phase 2: Slides 13-17 [10 minutes]

Objectives:

- This phase will focus on the combination of logical operators and conditional constructs in the case of the use of nested conditional algorithms. Students will compare the two kinds of conditional algorithms – the parallel "if..., then..." and the nested "if..., then...; else...".

Procedures:

Slide 14

- Instruct students to add the "if..., then..." conditional constructs and create the conditional constructs shown in Slide 14.

Slides 15-17 (Optional)

- Ask students to think of how to combine the three conditional scripts to make an executable program.
 - In this stage, students only need to experiment by defining three pathways.
 - Instruct students to decide the content of "Action 1", "Action 2", and "Action 3":
 - For example, make mBot's LED panel display different patterns or words; make the buzzer play different sound effects, etc.
- Show Slide 15 and 16 and ask students to discuss whether the two example programs are different from each other or not?
 - Please note that the different format may lead to the same result; however, the latter example program can make the code more efficient.

Practice: Slides 18-27 [20 minutes]

Objectives:

- Building on their previous experiment and findings, students will use conditional algorithms to create a "Light Piano", which means the notes are generated due to different kinds of brightness circumstances.

Procedures:

Slides 19-20

- Inform the class about the "Light Piano" they will create in this phase.
 - Show Slides 19 and 20 to review the music fundamentals learned in Lesson 7.
 - Students only need to generate sound effects within the scale of C Major.

- For advanced students who have sufficient musical knowledge, encourage them to challenge themselves and help instruct their peers when someone needs help.

Slides 21-22

- Instruct students to create and test the “Light Piano” by using conditional algorithms with logical operators.
 - Remind students that they can refer to the brightness data they have recorded at the beginning of this lesson. Set up no more than eight scales for note-playing.



Slides 23-24

- Ask students to consider the following questions:
 - “How did you construct the conditional algorithm in the project?”
 - “Why should we use the Forever block?”
 - “Is it easy for mBot to play the notes?”

Slide 26

- Instruct students to reflect on how the key concepts are embodied in the project. Importantly, ask them to elaborate on their experience of combining looping and conditional constructs.

Wrap Up & Clean Up [10 minutes]