

## Contact

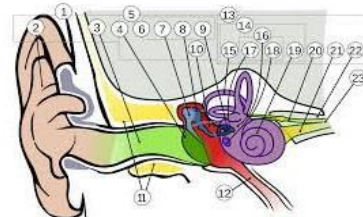


Mark was in a large laboratory alone, analyzing the signals sent from Mars three weeks ago. The signal received by Auriga has five different frequencies, and these frequencies just happen to be audible to human ear. So Mark saved waveform data of the signal into the computer, and play the sound through the loudspeaker...

### Learning Objectives

This chapter is to recognize the buzzer on Me Auriga. We will learn how to use mBlock to play a piece of music with Ranger. With the buzzer, Ranger will be able to make a beep sound, play some well-known songs, and express its emotions freely. The sound of the buzzer can also become a small debugging tool for programs. Let's start from the five notes of Close Encounters of the Third Kind to creating your own music by practicing “forever” and “repeat...times” block in mBlock.

### Scientific knowledge



An object produces vibration (source), compresses the surrounding air (medium), and radiates outward as waves (sound wave). Then sound waves travel into the ear canal until they reach the eardrum. The eardrum passes the vibrations through the middle ear bones or ossicles into the inner ear. Hair cells in the inner ear then change the vibrations into electrical signals that are sent to the brain through the hearing nerve. This is how we hear the sound.

The hearing range of human is commonly given as 20 HZ to 20000 HZ, hence we can't hear the sound with very low or very high frequency. (Hz is the unit of frequency, defined as the times of change per second.)

However, the sound we usually hear not only includes different frequencies, but also includes different intensity and tones.

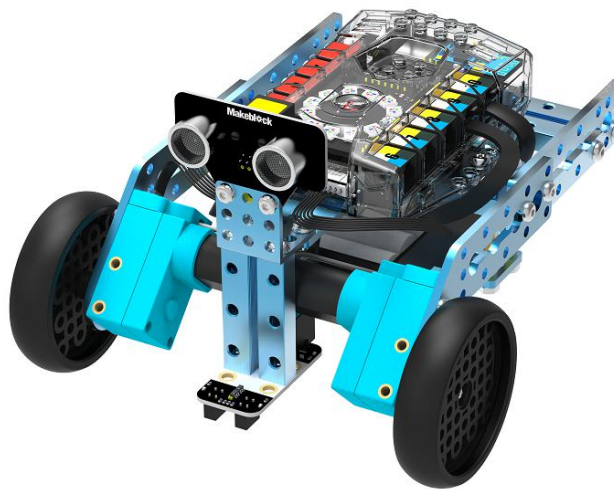
Sound volume: the loudness of the sound (intensity).

Pitch: the pitch (low/high) of the sound. It depends on frequency of the sound wave. The higher the frequency of a waveform, the higher the pitch of the sound you hear.

Tone: the characteristics of the sound. Different instruments have different tones.

## **Assembly Preparation**

We will use a three-wheeled racing robot in this chapter.

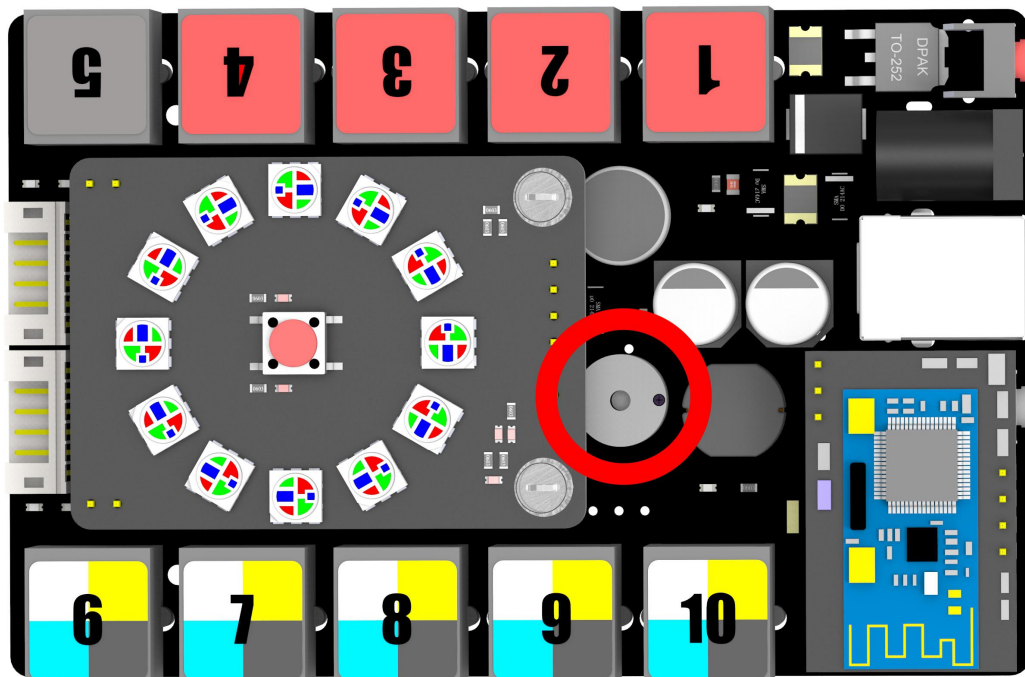


## Learning Task

### Learning Task 1 - Buzzer



Me Auriga uses a passive buzzer as the sound device. “Passive” means the buzzer does not contain an oscillator circuit, hence the frequency of the sound made by this buzzer is fully determined by the output signal of Me Auriga.

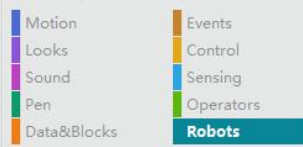
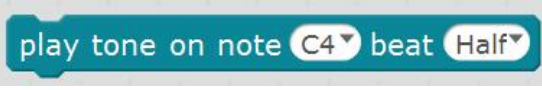


The buzzer locates between the expansion port 9 and port 2 on Me Auriga. Connect a power supply to Me Auriga via USB cable, then write a program to make a specific tone with buzzer in order to start your music journey!

### Learning Task 2- Play Tones with Buzzer

We can connect Me Auriga with mBlock via USB or Bluetooth. We will use “when green flag clicked” block to implement programs in this task.

Note: You can use hat block "Auriga Program" to implement programs when in offline mode (Me Auriga not connected to computer).

		play tone command
<p>The function of this block: control the sound of the buzzer on Me Auriga</p> <p>Parameter Selection</p> <p>Tone: set the tone (low or high) of sound, expressed as note names (C4 stands for Do).</p> <p>Beat: set the length of sound, expressed as fractions (half beat represents 0.5 milliseconds)</p> <p>Click the inverted triangle to select different values in the drop-down list.</p>		

### Tone & Frequency Table

Syllable	Do	Re	Mi	Fa	Sol	La	Si
Note	C2	D2	E2	F2	G2	A2	B2
Frequency Hz	65.4	73.4	82.4	87.3	98.0	110.0	123.5
Note	C3	D3	E3	F3	G3	A3	B3
Frequency Hz	130.8	146.8	164.8	174.6	196.0	220.0	246.9
Note	C4	D4	E4	F4	G4	A4	B4
Frequency Hz	261.6	293.6	329.6	349.2	392.0	440.0	493.9
Note	C5	D5	E5	F5	G5	A5	B5
Frequency Hz	523.2	587.3	659.3	698.5	784.0	880.0	987.8
Note	C6	D6	E6	F6	G6	A6	B6
Frequency Hz	1046.5	1174.7	1318.5	1397.0	1568.0	1760.0	1975.5
Note	C7	D7	E7	F7	G7	A7	B7
Frequency Hz	2093.0	2349.3	2637.0	2793.8	3136.0	3520.0	3951.1

Note	C8	D8	E8	F8	G8	A8	B8
Frequency Hz	4186.0	4698.6	5274.0	5587.7	6271.9	7040.0	7902.1

The buzzer will stop according to the beat you set.

Beat & Time Table

Beat	Length of Time
1/2 beat	500 ms (0.5 second)
1/4 beat	250 ms (0.25 second)
1/8 beat	125 ms (0.125 second)
1 beat	1000 ms (1 second)
2 beats	2000 ms (2 second)

First of all, we write a program to test the sound of Ranger:

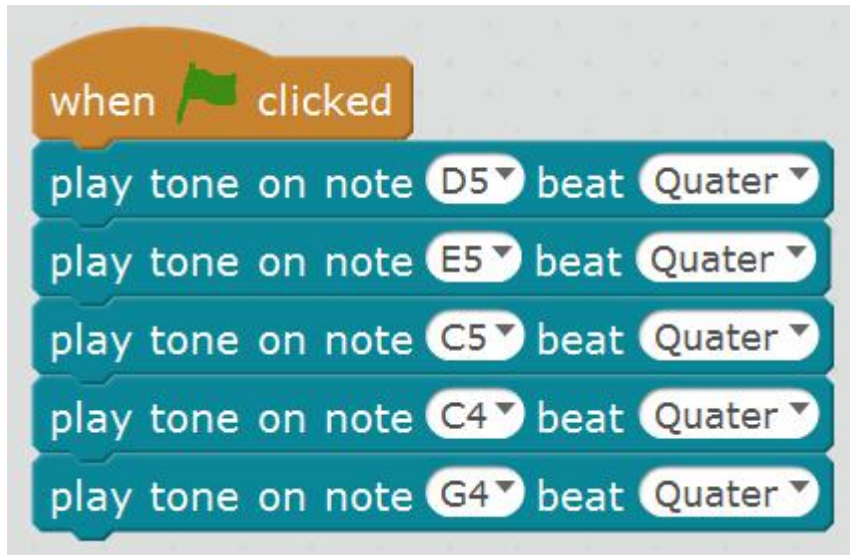


Can you hear a Do Re Mi sound from Ranger?

## Task

### Task 1 - First Contact with Mars

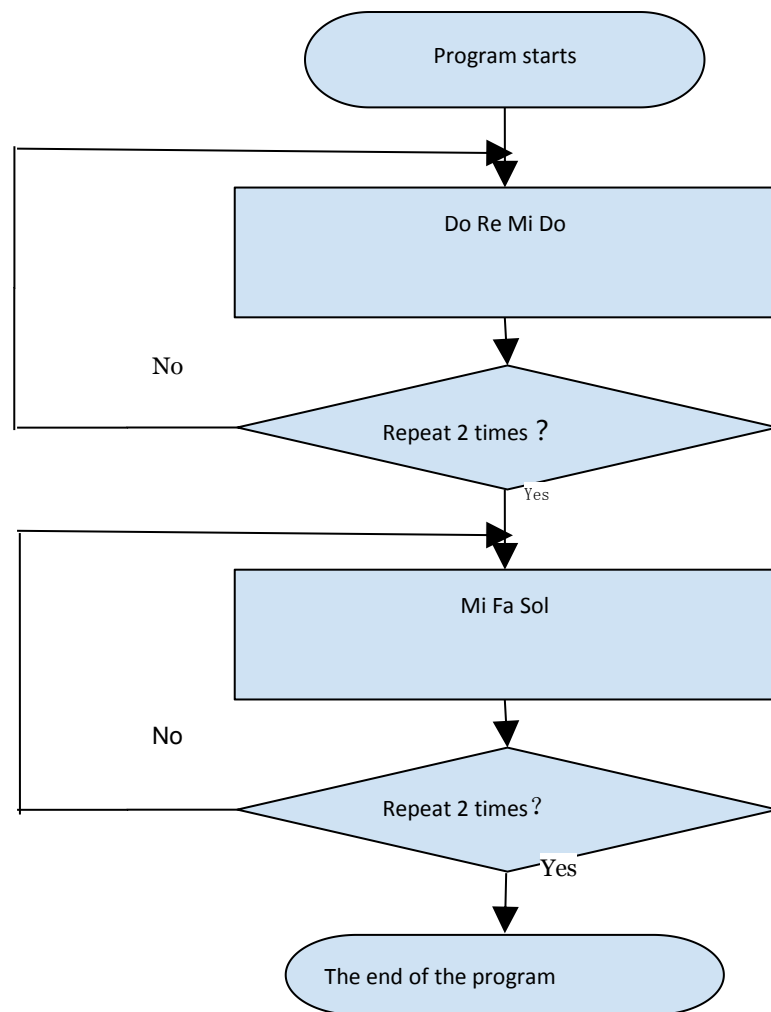
Here is a piece of music sent from Mars. Can you recognize the tones of this music?



(Answer: high Re, high Mi, high Do, Do, Sol)

### Task 2 - Reply the Message Sent from Mars

It is really good to hear the music message sent from Mars! If you want to write a song that has repeated melody, all you need to do is copy the block of that melody to create another melody, but the whole program will be too long. How to complete this task? Please see the flow chart below:



Yes, we can use "repeat...times" command that we have learned before to design the program. We can design the program as below:





Using "repeat...times" command will help us to implement the same program easily.

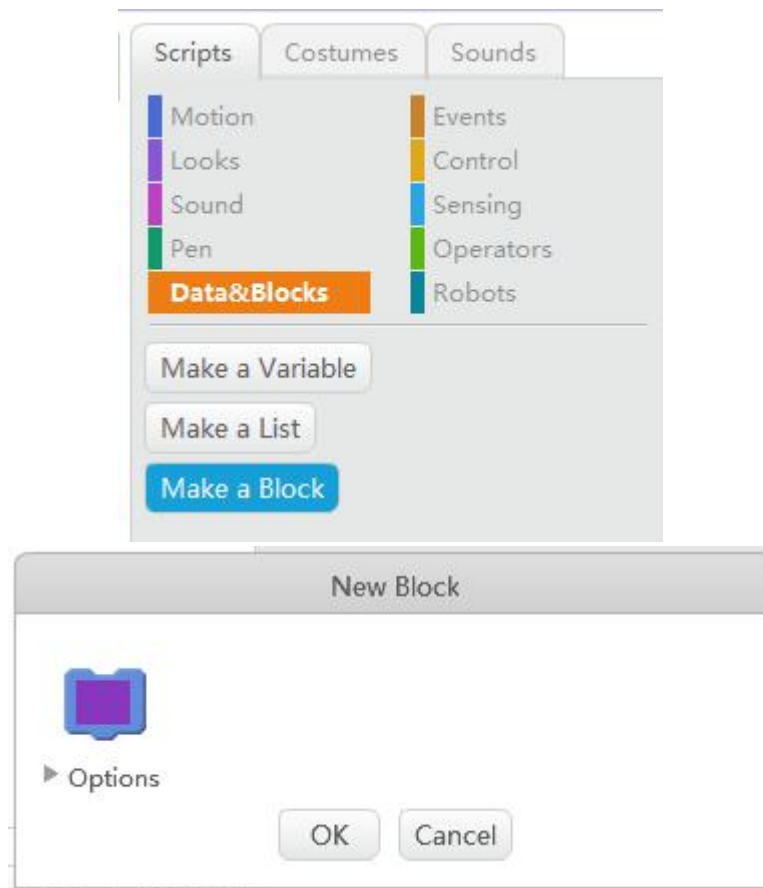
### Task 3 - How to Make a Program More Concise

It may not be very convenient for us to read when a program includes too many blocks, hence we can use a tool to make the program more concise. This will help us maintain the program easily in the future.

It is a very simple tool, all you need to do is:

Click "Data & Blocks" in block type area→click "Make a block"→then you will see a pop-up window as below:



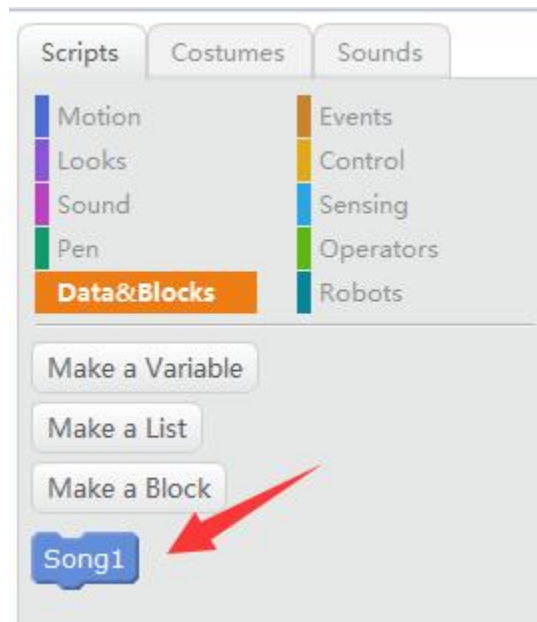


Input a name for this new block in the pink area. The name must begin with a letter and can only contain letters, numbers and underscores.

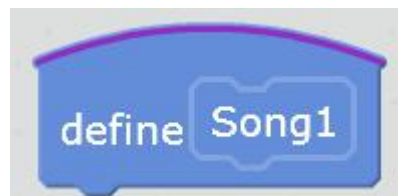
Input a name and press “OK” as shown below (In this example, we input a name “Song1” for this new block).



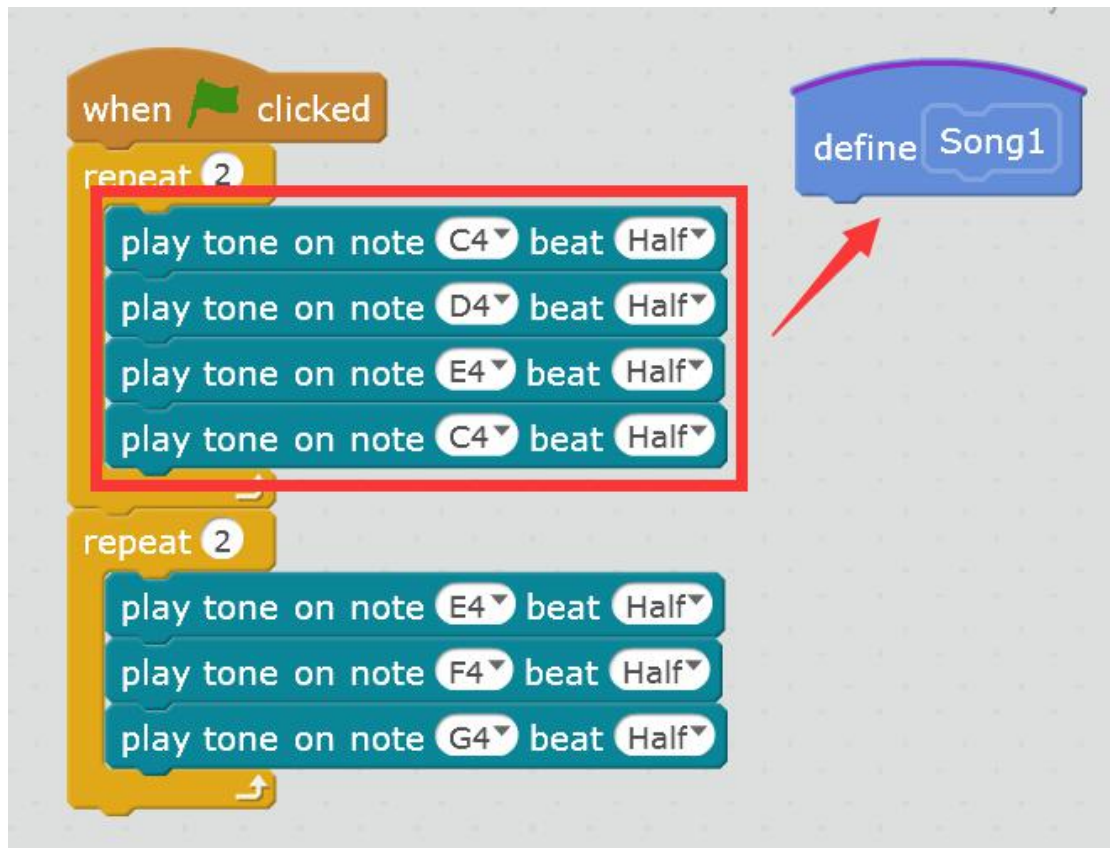
This new block will then appear under “Data & Blocks”, as shown below:



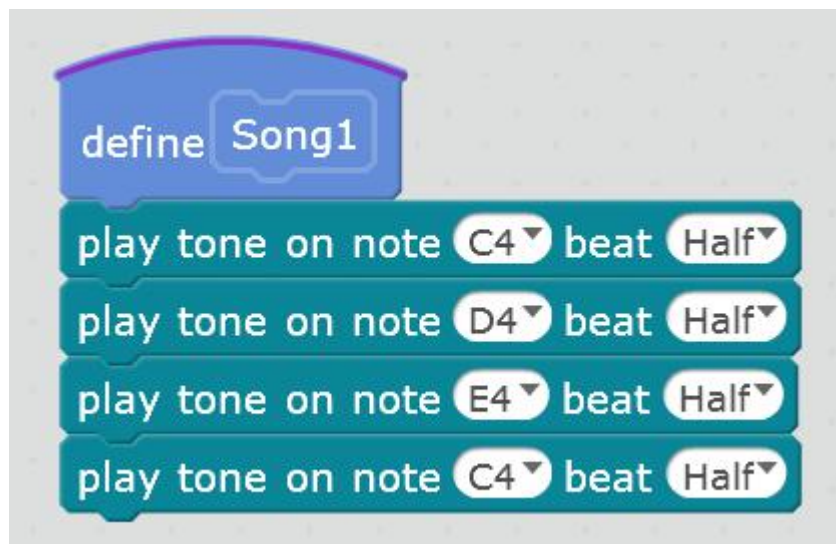
This block will also appear in the Script Area.



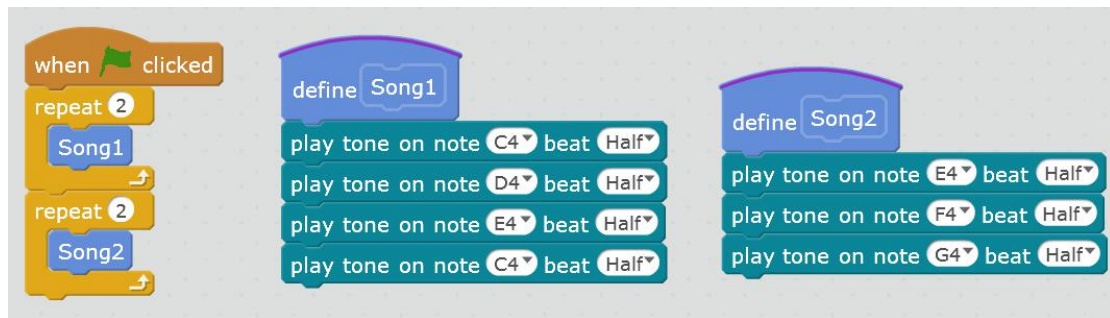
Drag the series of block that you want to “simplify” under hat block “Song1”, as shown below:



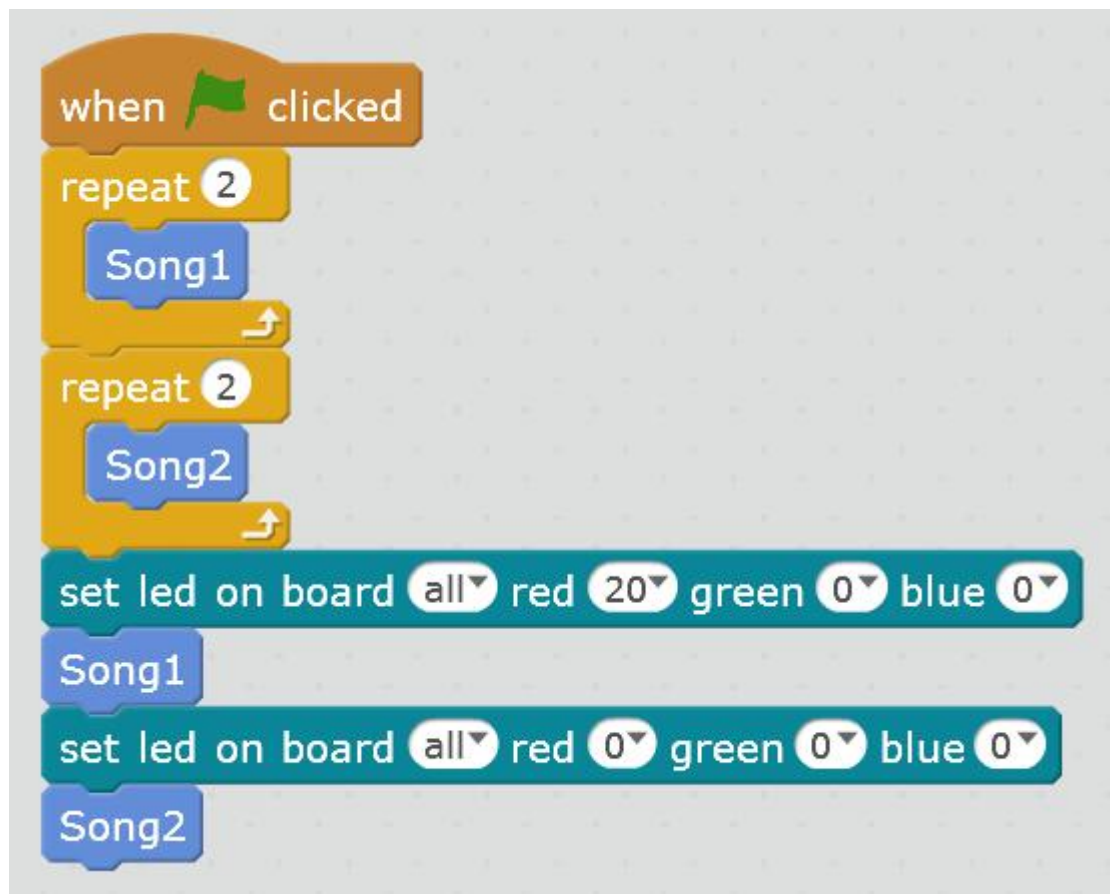
At this time, we finished setting “Song1” block. When we implement Song1, it means that we implement that series of block. In this example, we set the tone as C4, D4, E4 and C4, which means the buzzer on Ranger will make Do, Re, Me and Do respectively.



Finally, please design the whole program as below:



Take a look at the program above, is it concise to you? "Make a block" can also make it very simple for us to use the same program, see below:



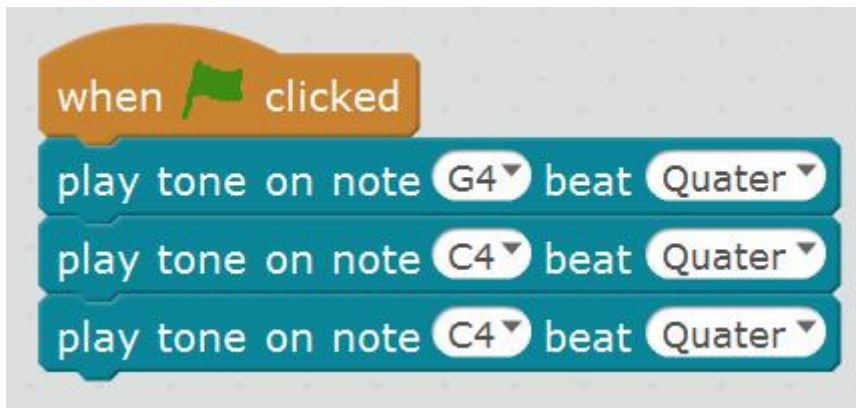
### Challenging Task 1 - how to let music take a "rest"

Think about it, Ranger can play different lengths of tones, but how to let the music take a "rest"?

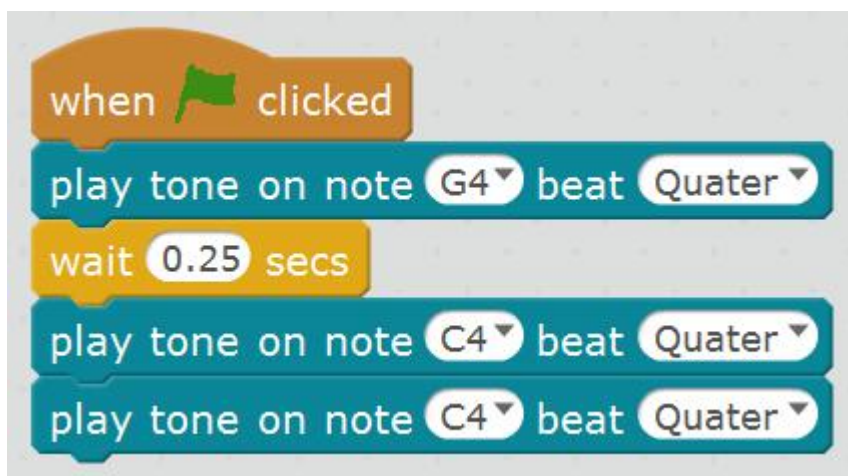
Reference:

We can use "wait...seconds" command to accomplish this task.

The original program:



Add a "wait 0.25 second" block, then you will feel a pause when playing the music.



## Challenging Task 2 - Control the RGB LEDs with the rhythm of the music

Reference:

We can put the blocks that control the RGB LEDs inside the whole program, as shown below:

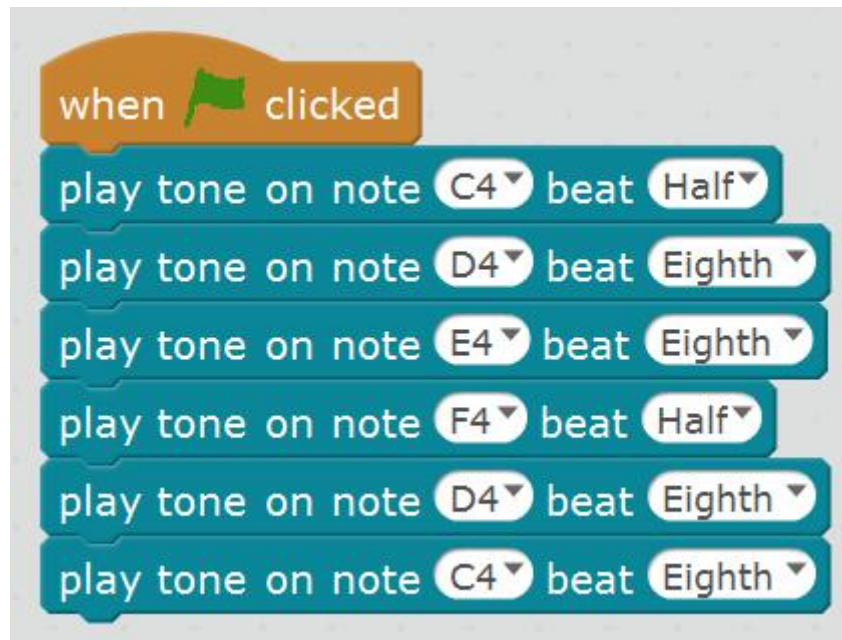




### Challenging Task 3 - design your own music

Reference:

We can use the simplest tone “Do Re Mi Mi Re Do” with different beats to create a piece of music. Now get started to design your own music and send it to the outer space!



## Conclusion of This Chapter

Using “make a block” will make the whole program more concise. When we set a proper name for this block, it will help us read complicated programs easily.

Mark played the sound again and again, it seems that he had heard that sound before.

"I can sort of remember that sound, but I can't remember where I heard it. I think that sound has something to do with the signal sent from Mars," said Mark, turning to Rex and commanding him to do a research, "Please do a comparison research for me and list all the possibilities between this sound and the signal."

"Mark, D5 E5 C5 C4 G4 note, Mars, correlation analysis, is that right?" Rex repeated the command.

"Why put me in the correlation analysis, it's unreasonable." Mark said, looking a little unhappy.

"Having analyzed twenty-seven billion, two hundred and ninety-six million, five hundred and three thousand, two hundred and sixty-five groups of data. There's only a group of data related to you, and there are 15210 groups of data that have nothing to do with you. Should I delete the data related to you?" Rex answered.

"Wait, wait a minute! Don't delete it!" Mark tried to stop Rex to delete that data. The only reason that he stopped Rex is because he didn't have the patience to hear Rex reporting all 15210 groups of data one by one.

"Just report the data related to me." Mark said, breathing a big sigh of relief.



