

# Workshop digital movement instrument (DMI)

## Workshop description:

The goal of this workshop is for girls to have fun playing with music and programming. The girls will learn how to create a music instrument by programming it to make sound by movement. To enable this they will use a micro:bit and its compass and accelerometer.

*Target audience: 12 -24 year*

*Participants: 8-12*

*Time: 3 hours*

*Skill level: Medium*

## *21st century skills learned:*

- Collaboration
- Creativity
- Social skills
- Communication
- Problem solving
- Technology literacy
- ICT Literacy

## *Specific skills learned:*

- Input/Outputs
- Basic programming
- Basic musical elements
- How to use a microcontroller (Micro:bit)



## Material list:

### Workshop supervisor:

- Beamer / TV



- Wifi

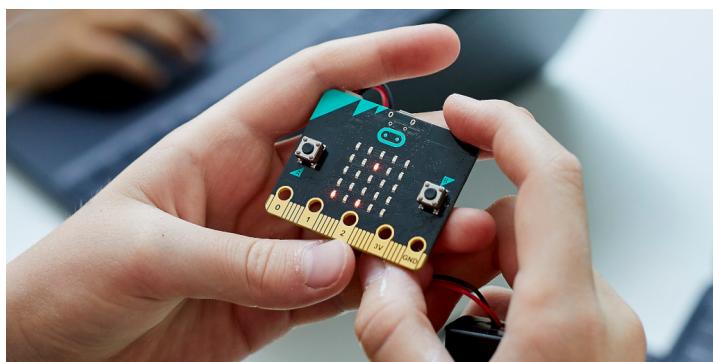


### Warm up exercise:

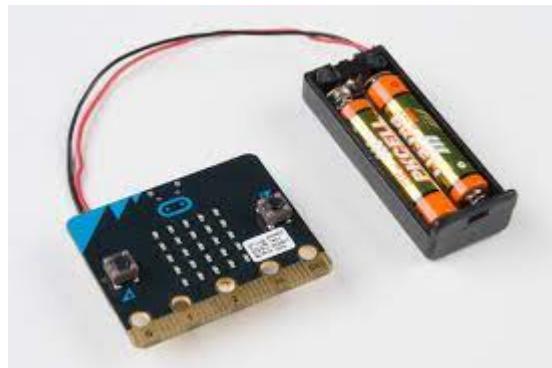
- Kristal glasses or glass bottles to make sound ( at least 5 of them)

### Making a digital music machine:

- Micro:Bit ( 1/ participant or 1/ 2 participants when working in teams)



- Micro:Bit battery pack and batteries (1/ Micro:Bit)



- Crocodile clips ( 5 / participant)



- Wired headphones, buzzer or powered speaker, make sure they have a 3,5mm headphone jack like shown in the picture. (1 for each participant)



- Cardboard (Enough for each participant to make their DMI)



- Tin foil (1 roll is more than enough)



- Pens & markers, glue sticks, scissors (For each participant to pimp their DMI)



## Software

- [MakeCode Editor](#)

## Workshop progress:

Warm up exercise (40 min)

Making a digital movement instrument (40 min)

Designing your digital movement instrument(40 min)

Trying out our own digital movement instrument (20 min)

Extra exercises (30)

## Warm up exercise (40 Min)

### **Introduction:**

Today we are going to make our very own Digital Movement Instrument. We will learn about inputs and outputs, how to code with blocks and how to program music.

To practice we will experiment with the basic components of music.

### **Exercise:**

Ask the question: Who knows some of the basic components of music? (There are more, but the focus today lies on the elements below. [Via this link](#) you can find more information)

- Rhythm
- PITCH or NOTE or TONE
- Melody ( A coherent succession of pitches. )
- Harmony ( The relationship of pitches as they sound simultaneously.)

As a warm up we will explore each of these elements with some little exercises together.

- Lets start with rhythm

The participants will create music by clapping to a certain rhythm. Like Steve Reich's music. ( See [this video](#) for inspiration on how it looks.)

You start off with telling one participant to clap her hands to a certain rhythm. Then you ask the next participant to clap her hands to a double rhythm. Then ask the next participant to join in, either on the same rhythm as 1 of the first 2, or propose another rhythm. They can also freestyle. The goal is just to have some fun searching to a good rhythm together.

- PITCH or NOTE or TONE

Watch this short clip of the comedy series 'The big bang theory' to explain the difference in high or low tone.

<https://www.youtube.com/watch?v=Supu0IB71d4>

After you watch this video practice talking in higher and lower tones.

To demonstrate tone height in another way, use water bottles or kristal glasses with different levels of fluid in them.

This is shown in the video below:

<https://www.youtube.com/watch?v=0YSyrotk3SI>

You can also blow on the bottles instead of using a spoon.

- Melody ( A coherent succession of pitches. )

Once you have the bottles or glasses set up, you can demonstrate a melody. You can even play a little song. Let the participants play with the setup.

- Harmony (*The relationship of pitches as they sound simultaneously.*)

To demonstrate harmony, you can let the participants use the bottles or glasses to play different sounds at the same time. Do they sound good together or not? Try to find sounds that sound good together, “Now that’s harmony!”.

## Making a digital movement instrument

### Creating sound by changing the Micro:Bit directions (40 min):

#### ***Introduction:***

Now is the time to create our DINSTRUMENT – Direction music INSTRUMENT! First we have to program the Micro:Bit so that it makes sound when it moves. We will first simulate this on the computer and then test it on the micro:bits themselves. To start, surf to the [MakeCode editor](#) and create a new project.



*Tip: You can first do the other exercises from the Micro:bit workshop to practice working with the Micro:bit and MakeCode editor.*

#### ***Exercise:***

To make music with the microbit we will start off with programming it to play 4 notes, one for each direction.

Show the 4 notes on the microbit

Use blocks:

Forever

Set 'Variable' to map 'input' from low ... high ... to low ... high ...

if 'Variable' > .. and 'Variable' < ... then ...

Ring tone = note 1

Else if ..

Ring tone = note 2

```
forever
  set direction to compass heading (°)
  show number direction
  if direction > 0 and direction ≤ 90 then
    ring tone (Hz) Low C
  else if direction > 91 and direction ≤ 180 then
    ring tone (Hz) Low E
  else if direction > 181 and direction ≤ 270 then
    ring tone (Hz) Low G
  else
    ring tone (Hz) Low A#
```

Explanation:

In order to show the notes they first need to define a variable, which we named 'direction'. We will write the compass heading ( $^{\circ}$ ) to this variable.

We use the function 'set direction to ...'.

Since one circle is  $360^{\circ}$ , we need to split it into 4 pieces for 4 notes. That means that for every  $90^{\circ}$  there is 1 note.

To split the  $360^{\circ}$  in 4 we use the function 'map compass heading ( $^{\circ}$ ) This maps:

- 1 as  $0^{\circ}$  to  $90^{\circ}$  note C
- 2 as  $91^{\circ}$  to  $180^{\circ}$  note E
- 3 as  $181^{\circ}$  to  $270^{\circ}$  note B
- 4 as  $271^{\circ}$  to  $360^{\circ}$  note A#

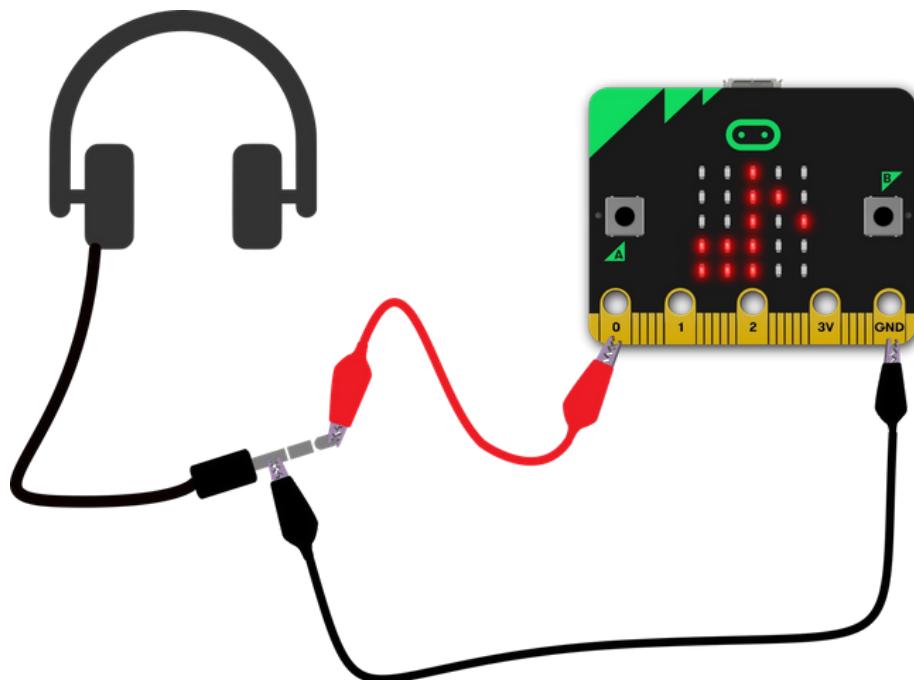
*Tip: You can test this in the makecode virtual simulator or when you download the code to the microbit.*

Connect the micro:bit to headphones or a speaker

Connect your micro:bit to headphones or a speaker so you can hear sound.

The gold pins on the bottom of the micro:bit are used for inputs and outputs. Here we use pin 0 as an output. The micro:bit sends pulses of electrical signals from pin 0 when it plays the tune. The headphones must also be connected to the GND pin on the micro:bit to complete the electrical circuit.

Use 2 crocodile clips to clip the tip of the headphone plug to pin 0 on micro:bit. Clip the longer part of the headphone plug to the GND pin on micro:bit.



Test the DINSTRUMENT – Direction music INSTRUMENT

Now we can test DINSTRUMENT by putting on the headphones or speaker and facing the microbit in different directions while connecting pin P1 with the GND pin.

You can make the connection with a crocodile clip.

## Designing our own Digital Music Instrument (40 min):

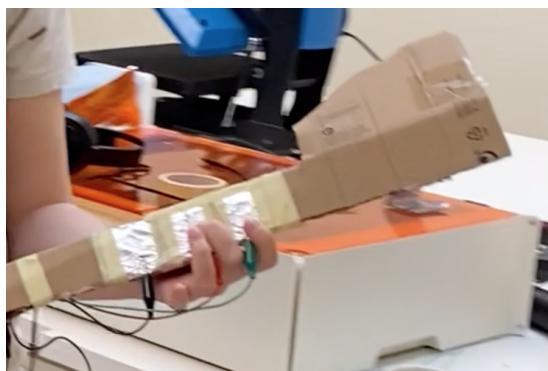
### ***Introduction:***

We just tried out the microbit with headphones or speaker. But now we want to integrate it into a full Digital Music Instrument. We will show this by making a guitar-like instrument, but the participants can get creative and create their own version of the instrument.



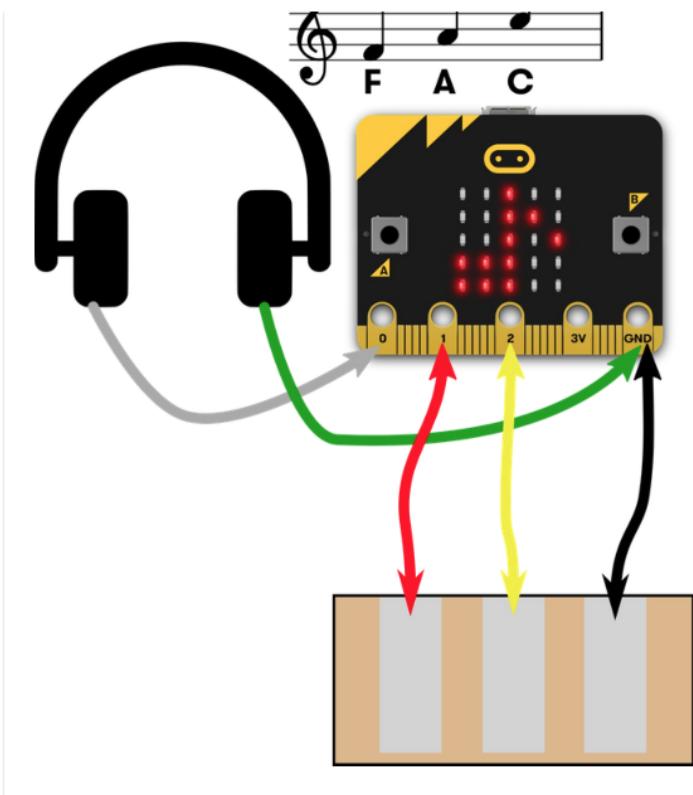
### ***Exercise:***

Cut out a guitar shaped instrument and use 3 stripes of silver paper at the neck to use as frets. It's important that these silver paper frets don't touch each other. Also make sure there is room to clip the crocodile clips to the frets.



*Tip: You can first make a prototype of the instrument before creating a beautiful one.*

Connect the frets to the microbit as shown in the picture below.



Connect a battery to the Micro:Bit so that you can play around without being connected to the computer. When touching pint 1 or pin2 make sure you also press pin 0.

## Trying out our own Digital Movement Instrument (20 min)

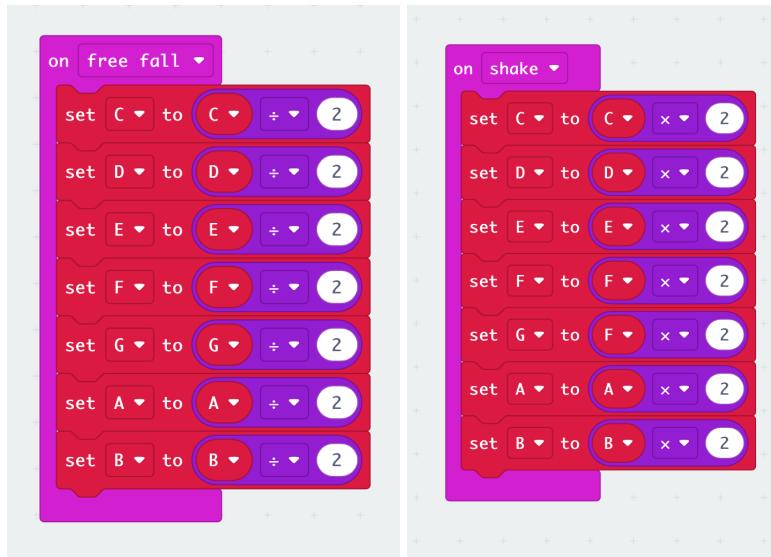
Try playing music with the digital movement instrument.

Ask the participants what they think of their designs and the sound it makes. Can they make it sound even better?

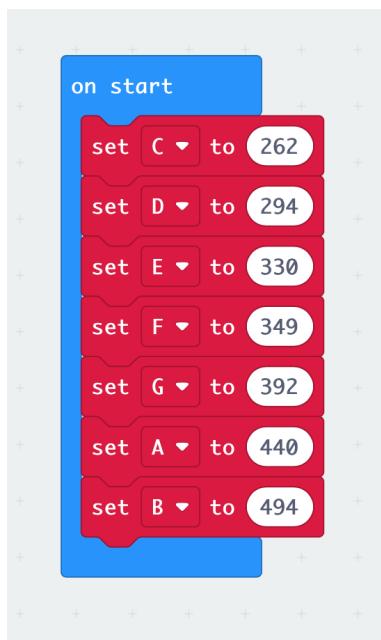
**Make it beautiful!**

## Extra exercises

Change the pitch of the Digital Music instrument



Play chords on the Digital Music Instrument



A Scratch script consisting of three nested `if` blocks. Each `if` block has `pin P2 is pressed` as its condition. The first loop has a `Direction` variable set to 1, the second to 2, and the third to 3. Each loop contains a series of `ring tone (Hz)` blocks:

- Loop 1 (Direction 1): C, E, G
- Loop 2 (Direction 2): D, F, A
- Loop 3 (Direction 3): E, B, G

The script concludes with an `else if` block that also triggers on `pin P2 is pressed`, setting `Direction` to 4 and performing no actions.

```
when green flag clicked
    [if   
 [pin P2 v  
 is pressed  
 ]  
 [and  
 [Direction v  
 < v  
 4  
 ]  
 [then  
 [ring tone (Hz)  
 G  
 ]  
 [ring tone (Hz)  
 B  
 ]  
 [ring tone (Hz)  
 D  
 ]  
 ]  
 [else if  
 [not  
 [pin P2 v  
 is pressed  
 ]  
 [then  
 [stop all sounds  
 ]  
 ]  
 ]
```

Change the shape of the Digital Music instrument

### **TOUCHMI - Touch Musical Instrument**

Let the students design their own musical instrument with cardboard and other materials  
The important requirement is to have the three frets to play the notes or melodies.

