



ACTIVITY: Digital Music

ACTIVITY OVERVIEW

Music is important to our lives. Our brains link music to special memories and feelings, and it can motivate us to move our bodies more – to keep us active! Additionally, the process of creating music gives students the opportunity to explore elements of computational thinking skills as they tackle the music in parts (decomposing), create choruses (recognising patterns), identifying what is important and disregarding the unnecessary, and putting together instructions for how the music is to be played (algorithms).

Online music creation can be accessed by anyone with an internet connection, so don't worry if your music room is not full of keyboards, drums, and clarinets. Students will explore music as a form of data found in our devices, think about the hardware and software involved in recording and playing music, and enjoy their own music-making activity.

SYNOPSIS

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Foundation – Year 2

- Identify and explore digital systems (hardware and software components) for a purpose (VCDTDS013)
- Sing and play instruments to create and practise chants, songs and rhymes including those used by cultural groups in the local community (VCAMUM018) (Music)

Year 3 – 4

- Explore a range of digital systems with peripheral devices for different purposes, and transmit different types of data (VCDTDS019)
- Recognise different types of data and explore how the same data can be represented in different ways (VCDTDI020)
- Explain how student-developed solutions and existing information systems meet common personal, school or community needs (VCDTCD025)
- Use voice and instruments to sing, play and arrange music from different cultures, times and locations, and improvise and compose music in different forms (VCAMUM026) (Music)

Year 5 – 6

- Examine the main components of common digital systems, and how such digital systems may connect together to form networks to transmit data (VCDTDS026)
- Explain how student-developed solutions and existing information systems meet current and future community and sustainability needs (VCDTCD034)
- Develop and practise technical skills and use of expressive elements of music in singing, playing instruments, improvising, arranging and composing (VCAMUM030) (Music)

ACTIVITY, MATERIALS AND INSTRUCTIONS

Activity

Create your own digital music using an online program. Make your music to accompany a classroom activity and test it out on your classmates and teachers.

Materials (for 30 students working individually)

- Device (tablet, laptop, computer) x 30
- Headphones x 30
- Internet access

Instructions

1. Go to website for Chrome Music Lab
<https://musiclab.chromeexperiments.com/Experiments>
2. Choose the 'Song Maker' program
3. Students will probably be able to experiment with this program, without too much instruction, however, here are a few tips.

Enter notes in the music grid by clicking in a box. Higher notes are at the top of the screen, lower at the bottom.

You can play as many notes as you like at the same time (although this won't be very nice to listen to).

You can choose from five different instruments for your melody: marimba, piano, strings, woodwind, or synthesiser. Change the instrument by clicking on the blue instrument button.

At the bottom of the grid, there are two rows with dots, to place the rhythm part of your song.

The rhythm section can be played by four different instruments: blocks, drum kit, conga drum, electronic.

Change the rhythm instrument by clicking on the blue instrument button.

Use the tempo slider to change the speed of your song (drag left for slower, right for faster).

The Mic (microphone) can be used to sing your own notes into the song. This will fill one note per column and needs to hear a clear note to register.

'Undo' will remove the last note or beat added to your song.

Press the 'Play' button to hear your song.

The 'Save' button will give you choices to:

- copy the link to your song (useful if you want to share your music with someone else by email, e.g. teacher, fellow classmate)
- embed code (if you want to add your music to a website)
- download midi (midi files are usually used in music-making programs)
- download wav (wav files are larger, high quality, but should be able to be played on most devices)

Use the download options if you want to use your music in another program later (e.g. background music in movie or presentation).

This activity is best completed with students working while wearing headphones, or with the opportunity to be spaced out.

4. Instruct students to create their own piece of music to accompany a school activity. Suggested activities to create music for include:

- wet day at school
- packing up quickly
- line up at the door
- silent reading time
- there is an important notice to listen to
- the principal enters the room
- someone's birthday
- the end of the school day
- music that goes with the school houses
- sit on the floor
- make a circle
- end of a test
- teacher needs someone to go to the office
- teacher is angry
- teacher is very happy

Considerations when composing music:

- working out the song in parts (phrases)
 - creating patterns that can be repeated
 - reviewing the piece from time to time (e.g. re-ordering phrases, creating new tunes)
5. Students share their music with the teacher (either by sharing link in an email or downloading).
6. Teacher to play music at the appropriate time (e.g. when the principal next enters the room, when it's time for students to line up).

What do the students think of the different music? Does it fit well with the mood that goes with that activity? Can you guess which activity a piece of music fits? Students can vote with thumbs up, thumbs down, or in the middle.

Time permitting – allow students free time to explore the other programs in Chrome Music Lab. Younger students (F – 2) are likely to enjoy Rhythm, Spectrogram, Oscillator, Sound Waves and Kandinsky. Students in Years 3 – 6 are likely to enjoy Shared Piano, Rhythm, Piano Roll, Spectrogram, Oscillator, Sound Waves, Kandinsky and Voice Spinner.

HOW TO USE THIS ACTIVITY WITH YOUR STUDENTS

Foundation – Year 2

Let's look at the parts of our computers that we use to make and record sounds. Highlight different computer hardware and software on your school devices that are used when creating digital music. Can you find where the speakers in your device are? Can you see any little holes that sound comes from? Where do headphones plug into your device? Can you find where a microphone is on your device? Do you know how to play a song on your device? What programs are on your computer that make music and sounds? Explore the parts of your devices.

Note – if you have an old, non-working, device (computer, tablet, phone), consider pulling this apart to investigate the components inside. Be careful not to cut yourself on any sharp parts.

After completing the music making activity, link this activity to The Arts curriculum with an extension activity.

Extend this activity by working in small groups to make a short dance to accompany your digital music. Think about the tempo (speed) and rhythm of your music and make sure it fits with your movements. Perform your dance for your class.

Years 3/4

How is music and sound used on computers? When does my phone make a sound? What part of these devices makes the sounds? Discuss these ideas with students before or after completing this activity.

Extend this activity by using your digital music to accompany a simple animation. You will need to download the music file from the Song Maker program and import it into the program you are using. For example, in Scratch, choose the Sounds tab, then the 'Choose a Sound' button, then 'Upload Sound'. You will be able to use this sound with your programming.

Years 5/6

Students in Years 5 and 6 will enjoy exploring the Chrome Music Lab programs. The different programs all have different ways of representing sound online, including movements, colours, and changes in shape. These students should also consider the energy transformations involved in the activity, linking to the Science curriculum. Can they explain the transformations between sound and electrical energy involved in electronic music making? Watch the video on Smartphone speakers in the links below, to further students' understanding of speakers.

Time permitting, use the 'Voice Spinner' program in Chrome Music Lab to explore changes to data. Record yourself saying a sentence. This program can change the speed of a recording (slower, faster) and

reverse the sound. Think about what instructions the program is using to make these changes. Write your sentence down on paper. Can you make transformations to a sentence, in the same way that the computer is changing the sound? For example, to reverse the sound, write the sentence backwards. What does it sound like when you say this aloud? Record yourself saying the backwards sentence and then play it in reverse. Did you get it right? This activity will definitely make you laugh.

DISCUSSION SECTION AND KEY THEMES

KEY THEMES

Hardware used to create digital music

Hardware is all the physical components of a computer system.

Speaker – transforms electrical energy into sound energy. Speakers are usually built into a computer/tablet/phone, but sometimes an external speaker is added to improve sound quality.

This connects to the device with wires, so that the electrical energy can travel from the computer to the speaker.

Screen – gives us a visual display of the music we are creating. On the screen, we can see notes, length of notes, pitch (low or high), information about the tempo (speed), and types of instruments.

Sometimes the visual display looks like the instrument (e.g. keys of a piano), the music staff (the lines that music notes are written on), or a grid (boxes representing music notes).

Microphone – transforms sound energy into electrical energy.

Microphones are used to convert sounds into digital format, to save into the computer.

Headphones – have tiny speakers inside the parts that sit over or in your ears, so work the same way as speakers, converting electrical energy into sound energy.

Software for creating digital music

Software is all the instructions that tell a computer what to do, contained within a computer program. Software that students may use regularly include programs like Minecraft, Mathletics, Reading Eggs and Google Classroom. All the apps (applications) that we have on our phones or tablets are different types of software.

The software that we are using in this activity is called Chrome Music Lab. This is free software that we can access online.

Saving music files

Music files will usually be saved as three types.

- .WAV (Waveform Audio) – is a large, high-quality file
- .MP3 (Moving Pictures Experts Group Audio Layer 3) – a music file that has been compressed using an algorithm that reduces the file size. It still sounds ok, and you can fit more songs in this format on your device.
- .MIDI (Musical Instrument Digital Interface) – these files are smaller and are made up of code that tells you the notes to play, the timing of the notes and the volume. MIDI files are made to be read by digital music software.

The earliest electronic music

The Telharmonium (also called Dynamophon) was invented by Thaddeus Cahill in 1895, who worked on it for the next 20 years. He wanted to make music concerts available to everyone, not just rich people. It was a huge machine - more than 18m long - that was made for producing and sharing music over the telephone wires. This was the world's first significant electronic instrument. The Telharmonium imitated organ, piano and violin and was advertised as "The Music of the Year 2000".

QUESTIONS AND ANSWERS

Do they record instruments to make digital music sounds?

Yes and no. Some virtual instruments are totally created by mathematical equations, made to sound as realistic as possible. But other digital music software uses many recordings of different instruments. To provide high-quality music development software, real instruments are recorded playing different notes at different volumes and using different techniques. When you record a musician playing a real instrument, this is called sampling. A sample library is full of different musical sounds that can be put together to create songs.

How does sound come out of my computer?

Speakers are a physical component of a computer's hardware. Sound travels through vibrations in the air, moving from the source of the sound to our ears, where the vibrations make our inner ear move, then send signals to our brain that we can translate into sounds.

So, a speaker needs to have a moving part. Tiny speakers found in computers, tablets and phones are made up of tiny parts (the copper wire coil, magnet and diaphragm are key parts), but they still need to move and cause vibrations through the air. An electrical signal is sent to the speaker copper wire. When electricity travels through a copper wire coil near a magnet, this transforms into movement energy.

The computer processor sends many repeated electrical signals to the speaker, that are transformed into tiny vibrations from the diaphragm, which is attached to the moving magnet. The electrical message sent to the speaker is the specific code for a certain sound.

Can computers make music on their own?

Yes, there are computer programs that can create songs for us. When the computer makes its own choices and creates something, we call this artificial intelligence. People who don't have any music theory knowledge and cannot play instruments can use a computer program (made up of algorithms, including many mathematical equations), to create their own songs.

In 2019, a group of artists, musicians and programmers worked together to make a Eurovision song created by artificial intelligence. They put hundreds of past Eurovision Song Contest melodies and lyrics into their program, which used algorithms to create a new song. You can listen to it here: https://www.youtube.com/watch?v=4MKAf6YX_7M

How does Spotify know which songs to suggest to me?

Spotify suggests music for you to listen to, based on your music-listening history. There are many different algorithms at work here. Spotify considers what songs you've skipped, playlists you've made and your location.

But, it also adds into its algorithm the music choices that other listeners make. Included in your suggestions will be songs that other people, who like similar music to you, have been listening to. Spotify studies all your actions on the app and uses this information to learn more about people's music listening preferences, so that it makes relevant song recommendations to you.

How do musicians use technology in their work?

There are very few musicians who do not use some type of technology these days. Home musicians use the internet to access sheet music, online tutorials and use video communication tools. Some students may have had online music lessons during the COVID pandemic lockdowns. Performing bands usually use microphones and amplifiers to provide sound to a larger audience. When a musician plays without having instruments connected to electronic devices, we call this acoustic music (e.g. your class learning recorders in the music room). Musicians can tune their instruments using digital tuners, rather than the old method of striking tuning forks to get the correct notes. Electronic musicians will use technology in all aspects of their work, particularly the virtual instruments and mixing software. Computer technology has made it possible for people with all levels of music ability, including school students, to be able to create their own songs.

How is music used in Minecraft?

When you are playing Minecraft there are many different songs that may be playing in the background. The game has different songs for different parts of the game including the menu, going underwater, being in the Nether, being in the Overworld, when you reach the End with the ender dragon undefeated, or when you reach the End, and the ender dragon has been defeated.

Music helps set the mood for these different parts of the gameplay. Some of your students may be interested in a career making music for computer games.

You can also have fun with note blocks in Minecraft. These will make different sounds of different instruments depending on what surface you place them on. Try out a note block on a tree compared to a note block on sand!

What are some interesting electronic instruments?

The theremin is the only instrument that does not use physical contact from a musician. The theremin looks like a box with two antennae sticking out.

The vertical antennae control the pitch of the notes, while the horizontal antennae control the volume. When the theremin is operating, electromagnetic fields are formed around the two antennae, due to radio frequency oscillating circuits. The musician moves their hands into known positions (shape and distance from antennae), which will disrupt the magnetic field, creating the notes of the theremin. The disruption of the magnetic fields by the hands of the player changes the tone and volume produced.

Theremin music has been used in horror and science fiction films, and adds an eerie sound to the scenes.

Learn some theremin basics here

<https://www.youtube.com/watch?v=ha8rerckieA>

Clara Rockmore, performing "The Swan" from Carnival of the Animals

<https://www.youtube.com/watch?v=pSzTPGINa5U>

Over the Rainbow

<https://www.youtube.com/watch?v=K6KbEnGnymk>

Singing Tesla coil

You may have seen a Tesla coil at work if you have been to a lightning show at a science museum. Learn more about Tesla coils here: <https://www.livescience.com/46745-how-tesla-coil-works.html>

Tesla coils produce high-voltage electricity. Electricity (in the form of mini lightning bolts) causes superheating of air, which makes air molecules spread out and vibrate, forming sound waves.

A higher frequency (number of vibrations per second) increases the pitch (how high or low a note is) of the sound. Specific frequencies are assigned to music notes, and you can play music with electricity and air! Watch Fox, from the Franklin Institute explain this in more detail here <https://www.youtube.com/watch?v=XgdPwH6ExpE>

Here are some movie themes played by singing Tesla coils (starting with Harry Potter):

<https://www.youtube.com/watch?v=R15t7iQkV3o>

Is a virtual instrument as good as a real instrument?

A virtual instrument (VST) is a digital replica of a real-world instrument that you can play online. Some instruments translate well to being used online, especially if you cannot meet up with other musicians. Using VSTs, you will be able to make music, even if you are on your own. Some musicians prefer to play real instruments, particularly lead guitar and brass, which are more difficult to replicate well with digital sound. Many movies use sample libraries of instruments, instead of real musicians.

Here are some websites with virtual instruments:

- <https://www.virtualmusicalinstruments.com/>
- <https://hiphopmakers.com/best-free-online-music-instruments>

What's the difference between internet, digital and analogue radio?

Radio is the transmission of energy using waves.

Analogue radio

- Has a transmitter (sends out radio waves)
- Has a receiver (picks up radio waves using an antennae and detector)
- Radio waves move through the air at the speed of light, in an up and down motion. Programs are added onto radio waves and transmitted out.
- Information is sent by changing the shape of radio waves (AM and FM)

Digital radio

- Is transmitted as binary data (0s and 1s), received, decoded, then processed by a small computer processor into music/sound
- Takes longer to reach you, due to extra processing time (where binary data is converted back into sound)
- Travels on a much broader range of radio waves and can travel greater distances
- Is probably in your car
- Can provide song and weather information (because data is converted into binary and can be reassembled as text)
- Is broadcast from a transmission site and does not require an internet connection
- Is free
- Can have lots of channels existing in one place without interfering with each other because a complex sequence of mathematical equations (algorithms) keeps the signals separate

Internet radio

- Needs to have a good internet connection and might drop out if the network is congested
- Is a stream of data that is received through internet connection, via computer or mobile device
- Must be paid for (included in your internet data plan)

Are there songs with messages in the lyrics when you play them backwards?

Some people think that they can hear strange backward messages in several songs. If you start playing sounds in reverse (like with the Voice Spinner program in Chrome Music Lab) you may hear something that sounds a bit like a word you recognise. Some artists do this on purpose, it is called backmasking. But most music artists are not hiding secret backwards messages in their music. You can read more about this at:

<https://www.abc.net.au/doublej/music-reads/features/songs-with-backwards-lyrics-subliminal-messages-beatles-slayer/13584052>

OUTSIDE OR SUPPLEMENTARY READING

Music, Makers, Machines: A brief history of electronic music

- <https://artsandculture.google.com/project/music-makers-and-machines>

Learn about Smartphone speakers in this video clip. How do speakers work? Incredibly small, yet impressively loud.

- <https://www.youtube.com/watch?v=jhg90zsjqt4>

Electronic instruments

- <https://www.britannica.com/art/electronic-instrument>

What are virtual instruments?

- <https://medium.com/pragmatic-sound/what-are-virtual-instruments-c762055ddf71>

More information about Spotify, data collection and algorithms

- <https://onezero.medium.com/how-spotifys-algorithm-knows-exactly-what-you-want-to-listen-to-4b6991462c5c#:~:text=When%20you%20stream%20a%20song,recommendation%20is%20determined%20to%20be>

TOPIC WORDS

- music
- sound
- speaker
- software
- hardware
- headphones
- instrument
- sampling
- data



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