THE MATHEMATICAL
ASSOCIATION OF VICTORIA

MATHS TREATS

MUSIC AND GEOMETRY

BY LUCIANA
THE POSSUM

Both music and mathematics can be investigated in terms of patterns and symmetry. A musical melody consists of rhythm and pitch. The rhythm is a pattern of sounds which depend on when and for how long each note is played. This is represented by the kind of note drawn, and where it appears in the sequence of notes. The pitch of a note is how high or low the note sounds. It is represented on music lines (staff lines) and is related to frequency.

We can superimpose axes on the staff lines so that the horizontal axis indicates the passage of time and the vertical axis indicates pitch. Several geometric transformations can be identified in musical compositions. Famous composers such Bach used symmetry extensively in their music.

MUSICAL TRANSLATIONS

A geometric translation (slide) might manifest in music as a horizontal shift where a series of notes is repeated in the melody with the same tune and pitch, or a vertical shift where the same pattern of notes is played simultaneously at a higher or lower pitch, or a combination of both.

ACTIVITY

Find a piece of music written in musical notation. Once you have become familiar with what the different music symbols mean, look for patterns. Can you find a sequence of notes which are repeated more than once? Has the tune been repeated at the same or a different pitch? Compose your own music using horizontal and vertical translations.

MUSICAL REFLECTIONS

A geometric reflection in music occurs when a sequence of notes is flipped. A horizontal reflection (in pitch) means that a rising sequence of notes will be inverted into a descending sequence of notes. A vertical reflection (in time) means that the notes will be played in the reverse order. A geometric dilation in music occurs when the theme speeds up or slows down (horizontal) or the difference in pitch of the notes is stretched or compressed (vertical).

ACTIVITY

Watch the video *Music + Math: Symmetry* (https://youtu.be/V5tUM5aLHPA). Can you identify the translations, reflections and dilations in the music (starting at 3.40)? Listen to some of your favourite music. Can you find any transformations in it?

REFERENCES AND FURTHER READING

Sante Fe series of 'Music + Math'
www.youtube.com/playlist?list=PLZlVBTf7N6GoLgWE7abewWPGKu2mdXepI

Transformations
www.mathsisfun.com/geometry/transformations.html

List of musical symbols (Wikipedia)
https://en.wikipedia.org/wiki/List_of_musical_symbols

Music, Math, and Patterns
http://mathcentral.uregina.ca/beyond/articles/music/music1.html

Roel's World: Music + Geometry
https://roelhollander.eu/en/blog-music/music-geometry/

Geometry in Music
https://youtu.be/2A4Tt62pWaI

A more detailed analysis of the mathematics of music
http://jackhdavid.thehouseofdavid.com/papers/math.html

IMAGES
Leadbeater possum - Steve Kuiter
Other images - Pixabay