MINISTRY OF EDUCATION
TE TĀHUHU O TE MĀTAURANGA

Supporting NCEA Numeracy in Music

This resource is aligned to the New Zealand Curriculum (2007) and provides support for the teaching and learning of literacy and numeracy in preparation for the NCEA Co-requisite. It aims to support those students who are using the NCEA qualification pathway.

Music provides opportunities for ākonga to develop their understanding of numeracy in ways that are creative, accessible, physical, and social.

It draws on the diverse cultural knowledge of ākonga and the community to explore ways that number patterns and relationships are evident in beats, rhythms, rests, melody, harmony, and pitch.

In Music ākonga develop their numeracy skills when they:

- explore ways to represent sound and musical ideas
- use their understanding of fractions to read and write different representations of note length e.g., piano roll or staff notation
- learn about scales, harmony, time signatures, tuning systems, beat, rhythm, metre, and acoustics
- recognise and use patterns and sequences when composing, performing, and listening to music.

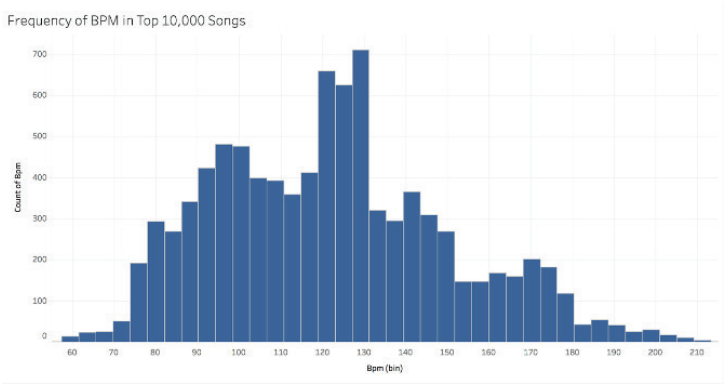
As a music teacher you will already be supporting your ākonga to improve their numeracy. This Numeracy Pedagogy Guide (NPG) takes a selection of mathematical and statistical content ideas from Unpacking Numeracy[1] and illustrates small, effective steps that you can trial and weave into your teaching practice.

Music Numeracy Pedagogy Guide

Operations with numbers	What can this look like in Music?	What can I do as a kaiako of Music?
Work with whole numbers up to billions, fractions, decimals to 3 places, percentages, and integers	Work with fractions such as halves, thirds, quarters, eighths, and sixteenths. *Ākonga use a range of differentiated body percussion to create beats divided into halves, quarters, eights, and sixteenths.* *Ākonga create a polyrhythm, with one group stamping a beat, one group clapping out beats in thirds, and another group slapping thighs in fourths.* *Ākonga use their knowledge of halves to work out how long to hold a dotted rest or beat.* *Ākonga use fractions such as halves (½), thirds (⅓), quarters (¼), eighths (⅛) and sixteenths (1/16) to adjust note values based on time signatures.* *Ākonga choose a song and invent their own number and note length system in order to recreate it with others.*	Explain how many cultures (including some Pacific Island nations) have used numbers and gestures to notate pitch, melodic movement, and harmony. Provide opportunities for ākonga to experience a range of different beats and rhythms. Make connections between beats and fractions such as a half (½), third (⅓) and quarter (¼) and beats by explaining that both involve dividing something into equal parts. Provide examples of beats and rhythms combinations, for example: » videos of performances such as sāsā and kapa haka (available on the ASB Polyfest website and Māori Television) » body percussion videos (available on YouTube). Provide opportunities for ākonga to explore aural and visual combinations of beat divisions using tools such as: » Groove Pizza, a tool for creating music using shapes, angles, and patterns » Make Beats (Ableton Learn music), a tool for creating grid-based step sequences that assign beats to different parts of a drum kit » the piano roll feature of Chrome Music Lab or another Digital Audio Workstation (DAW), which provides an opportunity to combine pitch and rhythmic subdivision. When creating and recreating music, experiment with simple and compound time signatures and note values, for example, the doubling of note values from 4/4 time to 2/2 or 5/8 to 5/4 time.

Spatial properties and representations of objects	What can this look like in Music?	What can I do as a kaiako of Music?
Recognise symmetry **Transform objects to design for purpose (i.e. enlarge, reflect, rotate, and translate)**	Use repetition as form of translation in composition *Ākonga identify ways in which repetition is used in pre-existing music (including music they listen to and/or perform) and explore ways to use repetition in compositions, in rhythm, melody, and structure.* Manipulate a musical motif by using compositional devices such as reflection and translation. *Ākonga develop a musical motif and experiment with retrograde inversion (reflection), transposition (translation), augmentation (doubling) and diminution (halving) as part of a creative process to create a composition for others to play and enjoy.*	Explore symmetry and asymmetry in Rhythm necklaces. See this Ethan Hein blog post for additional information. Watch Music + Math: Symmetry (from 3:26 onwards). Provide opportunities for ākonga to listen to, explore, and create answering phrases that mirror each other. Explore repetition in rhythm, melody, and structure in a range of music genres, for example, using material on this Ethan Hein blog post Four bars of Mozart explains everything humans like in music. Make connections between auditory repetition and its visual parallel, translation of shapes. For more information, see Ethan Hein's blog post Repetition defines music. Alternative links related to the use of repetition in music include: » The Power of Musical Repetition » Scott Rickard: The beautiful math behind the world's ugliest music (TED Talk) As part of composition exercises, encourage ākonga to use symmetry, translation and reflection to make pitch patterns, and notice their effects.

Measurement	What can this look like in Music?	What can I do as a kaiako of Music?
Use and interpret results of measurement (including timetables and time charts)	Use and interpret measurements related to instruments. *Ākonga use computer programmes to explore the wavelengths and inherent unique acoustic personality of different instruments.* *Ākonga use measurement to explore the relationship between instrument breadth, length, and pitch (including string length and pitch) when creating their own instruments.* *Ākonga explore ways that measurements in instruments might be standardised (for example, the distance between keys in a Western wind instrument) or personalised (for example, taonga pūoro, in which koauau finger holes might be spaced out according to the maker's forefinger joints, knuckles or the pattern of a group of stars[2]).* Use measurement to investigate instrumental introductions to songs *Ākonga compare the duration of instrumental introductions in songs recorded in the 1980s with those used in contemporary songs.*	Provide opportunities for ākonga to explore the basics of acoustics, for example, by observing the relationship between the length of a vibrating string or column of air, or the surface area of a drum-head and the pitch of a sound (longer/larger = lower). See The Science Behind the Arts: The Maths Behind Music for an example. Provide opportunities for ākonga to explore the sounds of instruments by measuring, designing, shaping and structuring materials to make their own unique instruments to play together. Consider the sound, purpose and cultural impact of a range of instruments made by humans over time. Remind ākonga how to convert measurements from millimetres to centimetres and vice versa. Discuss the impact of streaming services on the length of instrumental intros to songs (see The Guardian article Speed of sound – how Spotify killed the long intro for supporting information). Debate whether the financial need to get listeners to listen to more than 30 seconds of a song has had an impact on people's creativity. Provide opportunities for ākonga to investigate whether this effect is evident in pop and rock songs composed in Aotearoa.

Statistics	What can this look like in Music?	What can I do as a kaiako of Music?
Interpret data displays using features such as clustering, centrality, spread, unusual pieces of data, frequencies, and patterns	Identify and interpret the features of visual displays. *Ākonga explore the relationship between beats per minute of popular songs and resting heart rates. Groove is in the Heart: Matching Beats Per Minute to Heart Rate | by Spotify Medium*  *For example:* *What I notice: Most of the top 10,000 streamed songs have a tempo that is higher than the average resting heart rate* *Evidence: Most of the top 10,000 streamed songs have a tempo of 75 to 180 beats per minute, but there is a spike around 120 to 130 beats per minute.* *Relate to context: This aligns with a walking tempo and also the tempo of crowd applause.*	Give ākonga a statistical question they can use in pairs or small groups to discuss and interpret their data displays, for example: » What do you notice? » What patterns can you see? » What does it make you wonder? » What conclusions can you draw from this display? » What gaps might there be in the information it provides?

Footnotes

[1] The Unpacking Numeracy document outlines key content that ākonga will need to understand in order to achieve NCEA Numeracy.

[2] Māori musical concepts – Te Ara Encyclopedia of New Zealand