

MATHS WEEK SCOTLAND  
TEACHERS PACK

# A FRACTION MUSICAL!

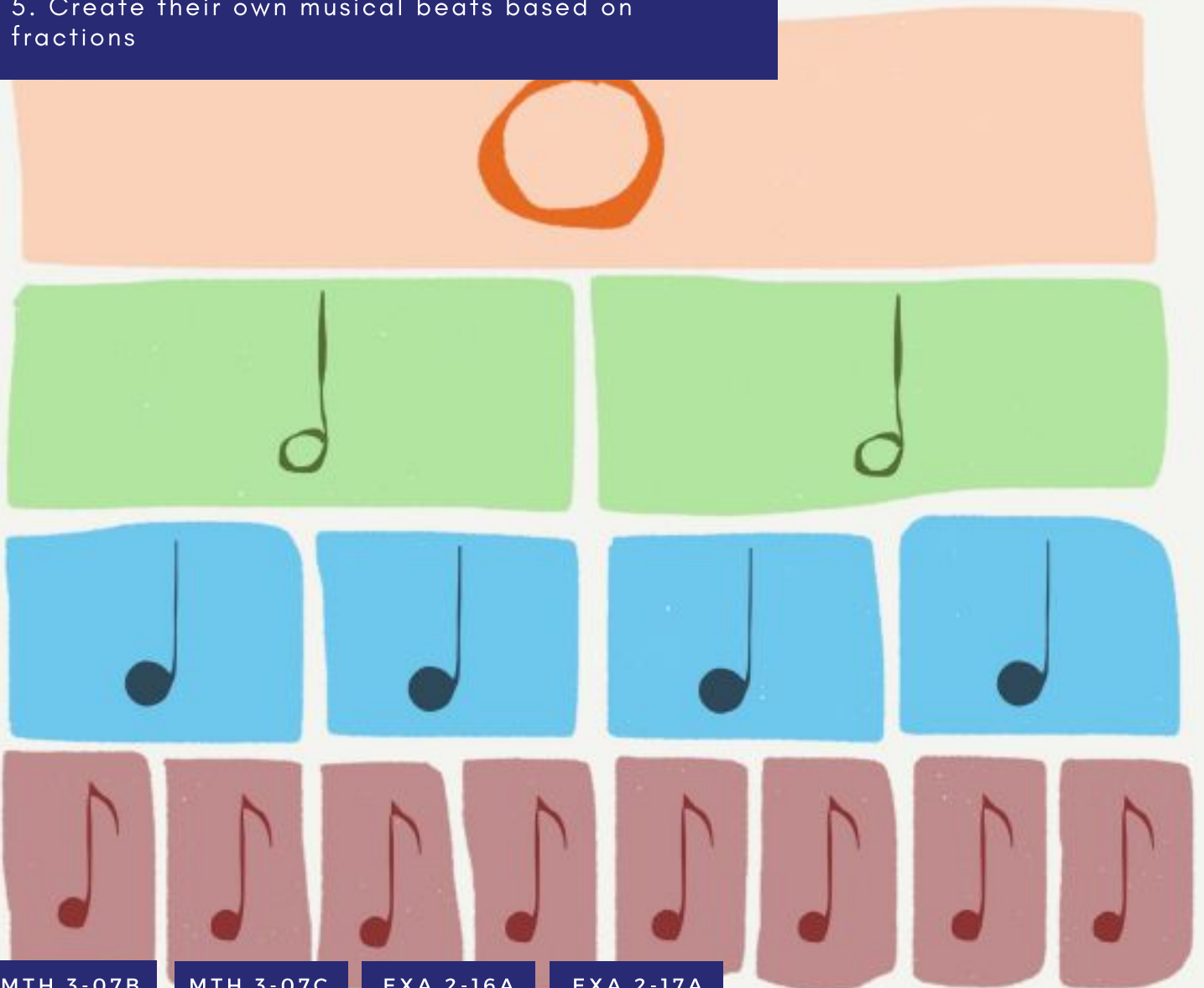
CONNECTING CREATIVITY & MATHS BY EXPLORING  
FRACTIONS AND MUSIC

## LEARNING INTENTIONS:

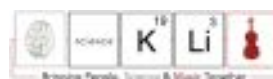
Pupils are learning to:

1. Link creativity, music and maths
2. Name different musical notes and identify their time values
3. Evaluate equivalent fractions
4. Add simple fractions using common denominators
5. Create their own musical beats based on fractions

NO MUSIC AND MATHS  
SPECIALISM REQUIRED



#MATHSWEEKSCOT FREELY ACCESSIBLE  
[SCIENCECEILIDH.COM/MATHS](https://www.scienceceilidh.com/maths)



## SUCCESS CRITERIA

By the end of the lesson, pupils can:

- Name musical notes and their fractional values
- Create equivalent fractions using musical notes
- Add fractions by finding common denominators
- Create their own music based on the fractional value of different musical notes

## RESOURCES

- Dominoes print-out
- Projector, laptop, video & music (online)\*
- Blank sheets of A3 paper & pens
- Instruments or drums (optional)


### INTRODUCTION

5 mins

Introduce that we're exploring creativity, music and maths. How could they be linked?

 *How is maths creative? How does music involve maths?*


Listen to a tune, can you find the beat and clap along? We've included some suggestions at the end of this resource but any music with a steady beat would work.

 *Did the notes in the music feel short or long?*


### MUSIC THEORY

10 mins

Introduce pupils to the different musical note values by working through the accompanying Powerpoint up to Slide 6 (before the dotted notes section). For each note value there is an accompanying audio file to demonstrate their relative lengths.

 *There may be students who already know some musical theory - there are more differentiation ideas later in this book around rests & different time signatures*


Pupils can fill in their exercise sheet to reinforce this learning.

 *For each of the given fractions can you write three equivalent fractions?*

### DOTTED NOTES

10 mins

Introduce the concept of dotted notes (which increase the length of a note by half again). This will lead to the concept of adding fractions and forming equivalent fractions, e.g. if you have a dotted half note then you have  $\frac{1}{2} + \frac{1}{4} = \frac{2}{4} + \frac{1}{4} = \frac{3}{4}$ .


 *What would happen if a note was double dotted? Can you work it out?*

Encourage the learners to work out the values for other dotted notes in pairs and fill in their sheet.

### MUSIC CREATION

20 mins


Using what they've learned, pupils can come up with their own pieces of music by filling in the empty bars on the worksheet provided. They should write them both ways (musically and in fractions). Remember that every bar has to add up to 1! These can then be played back using software such as MuseScore (more information overleaf) or could even be played live by a teacher on an instrument of their choice!

 *Learners who can play music might even be able to play the pieces! Otherwise, you could also focus on the rhythm rather than the pitch and play some examples together on a drum or even just clapping or beating the table.*

### DOMINOES

10 mins


As a final plenary activity split the class into small groups - four pupils per group is ideal - and play the dominoes game included in this resource. As there is a coop and competitive version, it's a good revision activity to carry over to future lessons. Learners could even make their own!

 *Could students also try to work out the beats and fractions involved in their favourite song! This can be difficult as it may require 1/16th notes too (semiquavers) but a good challenge!*

### PLENARY

5 mins

Recap what we've covered about adding fractions and musical notes and how music and maths are so connected!

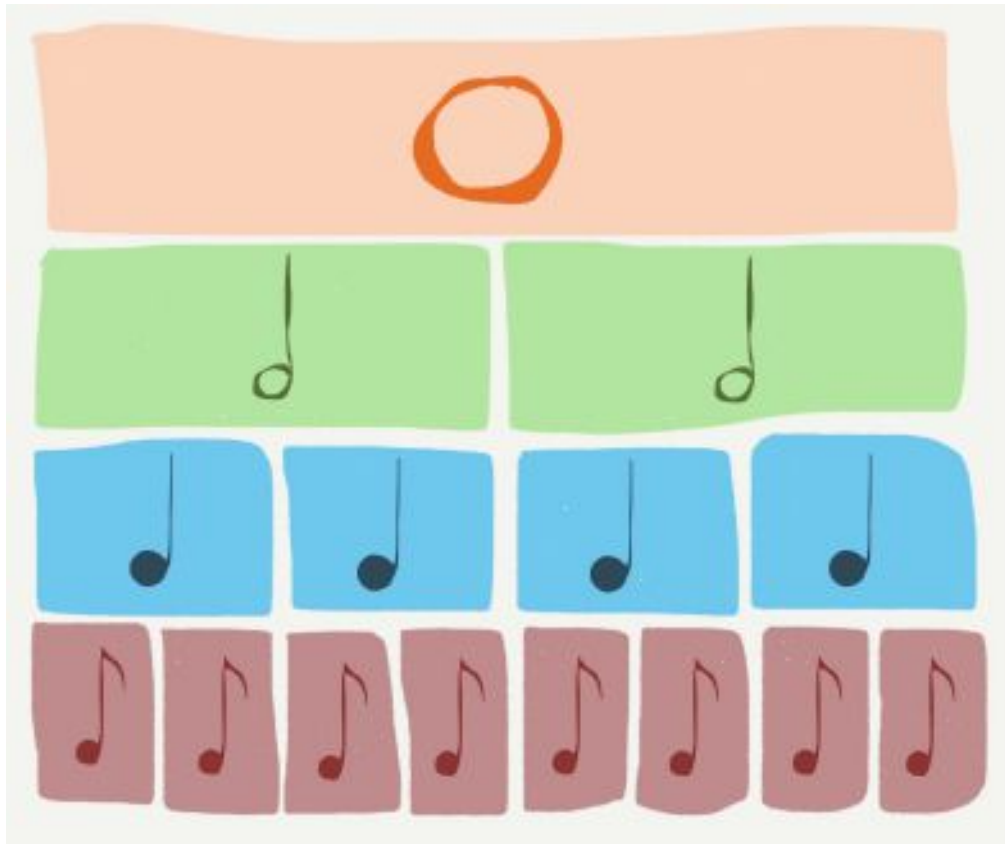
 *How else are music and maths connected? How many famous mathematicians are also musicians?*

# CALCULATING FRACTIONS WITH MUSICAL NOTES

Let's take a closer look at how our musical notes translate to fractions and how to use them to perform simple calculations. Throughout this lesson we will be using 4/4 time but you can adapt this for other time signatures if you would like - more information under 'Time Signatures', p.7.

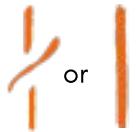
## REPRESENTING FRACTIONS AS MUSICAL NOTES

Here we have the notes we will be using along with their associated fractional values based on a musical bar being worth four "crotchet" beats (in 4/4 time) which is very common in folk & pop music (more information under 'Time Signatures' on p.7). This has also been shown using bar modelling which is another way of visualising the relative values of fractions.



### THE SEMIBREVE

This is worth four beats, and so is a whole fraction.



### THE MINIM

This is worth two beats, and so is a half fraction.



### THE CROTCHET

This is worth one beat, and so is a quarter fraction.



### THE QUAVER

This is worth half a beat, and so is an eighth fraction.



## ADDING FRACTIONS WITH MUSICAL NOTES



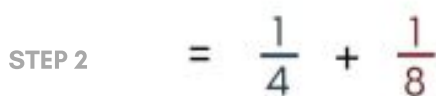
### TWO QUAVERS

Two quavers (or more) next to each other will usually be joined together by a beam in musical notation. They will last as long as a crotchet ( $1/4$ ) but will be played as two separate and equal notes ( $1/8 + 1/8 = 2/8$ ).

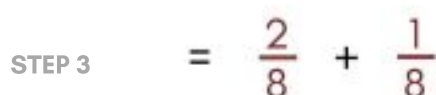


### DOTTED NOTES

A dot is often added to notes to make them last longer. To find the value of a dotted note we must add the value of the note (without a dot) and the value of the note that is half its length. In this example of a dotted crotchet, we need to add a crotchet and a quaver (Step 1).



We then substitute in the fractional values of these notes to begin the calculation (Step 2). We can only add fractions with common denominators so if they do not match we need to find an equivalent fraction so that we can proceed (Step 3, changing  $1/4$  to  $2/8$ )



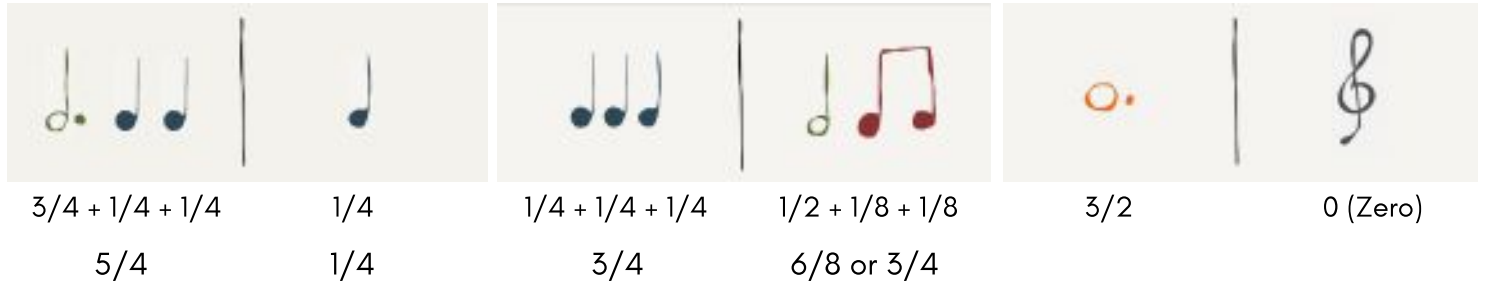
Then we simply add the numerators while the denominator stays the same (Step 3), and we're done!

# MUSICAL DOMINOES

Dominoes is a tile-based game that was developed in Italy in the 18th century with links dating back to 12th century China. There are usually 28 tiles in a set and traditionally featuring the numbers 0 to 6.

Each domino has two segments. For our dominoes we have adapted the traditional game to include musical notes to practice thinking about fractions and even possibly make a musical rhythm at the same time!

The dominoes feature combinations of  $1/8$  (quavers) to  $3/2$  (dotted semibreves) along with a picture of a treble clef serving in place of 0. Most will have unique fractions in each half but some will have the same fraction on each side (as shown in the second example).



The aim of the game is to make chains linking dominoes featuring the same fraction, as shown in the example in the image below. Full instructions of how this can be played cooperatively or competitively overleaf. Learners may find it useful to play on a sheet of A3 paper so they can write down the fraction values of all their dominoes. This reinforces the learning that has taken place as well as helping them see where they may place new dominoes without needing to work out the values of placed tiles repeatedly.

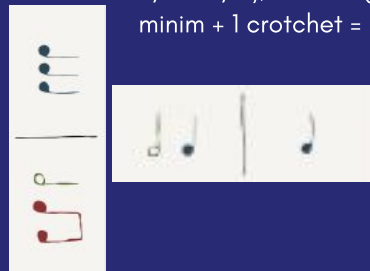
## STEP 1

The first player places the first tile!



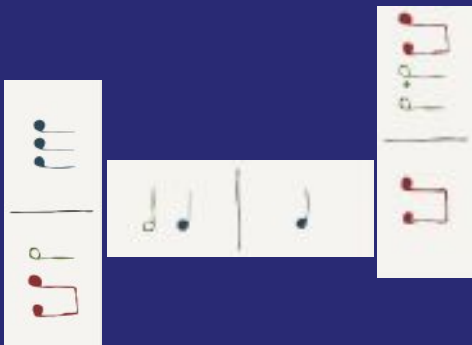
## STEP 2

The next player places a tile to match one end of the first tile. Here, both ends of the new tile have equal value ( $3$  crotchets =  $3/4$  and  $1$  minim +  $2$  quavers =  $6/8 = 3/4$ ), matching the left end of the first tile ( $1$  minim +  $1$  crotchet =  $3/4$ ).



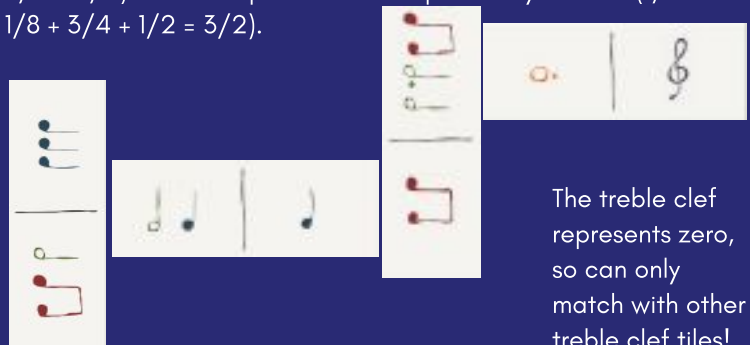
## STEP 3

The next player places a domino whose one end ( $2$  quavers =  $2/8 = 1/4$ ) matches the open end of the first tile ( $1$  crotchet =  $1/4$ ).



## STEP 4

The next player matches a dotted semibreve ( $4/4 + 2/4 = 6/4 = 3/2$ ) with the open end of the previously laid tile ( $1/8 + 1/8 + 3/4 + 1/2 = 3/2$ ).



The treble clef represents zero, so can only match with other treble clef tiles!

To print the dominoes for your own game, head to the link at the back of this pack to find a single-side PDF you can print in A4 or A3 with the musical dominoes on to cut out. You can laminate this for more durable dominoes that can be reused. There is also an empty sheet of dominoes for students to make their own.

## DOMINOES EXPLANATION

We recommend starting off by playing the dominoes game as a cooperative game in groups of three or four learners. Once they are comfortable with the concept, the groups can compete to see who can make the most (correct!) connections within a set time.

We also recommend handing out a blank sheet of A3 paper to each group – the learners can place the domino tiles directly on this & write down their working out beside each tile. (See image on p.4)

## COOPERATIVE VERSION

Instructions per group of 3 - 4 students. If doing under a fixed time, 10-15 minutes

1. Turn all the dominoes face down and shuffle them on the table with paper underneath as a board. Divide them equally between the players with everyone's dominoes being visible to the others.
2. The youngest player goes first by placing a domino with any value on the paper.
3. The next player lays down a domino whose mathematical value on one end matches either end of the domino already in place.
4. The players take turns to add a matching domino to the open ends of those already placed.
5. The group is encouraged to work together to find matching dominoes as well as write their working out to show that the fractions they have selected are indeed equivalent.
6. If at any point a player can't go, the group moves on to the next player who can.
7. At the end of the given time, the learners (or another group) should count how many correct connections they have. A competitive element can be included here by comparing the final scores of all groups in the class.

For tiles with both ends showing the same value you can lay these at a right angle to the rest of the chain to show that both ends are the same.

## TRADITIONAL COMPETITIVE VERSION

Instructions per group of 2 - 4 students. Each game may take up to 10 minutes.

1. Turn all the dominoes face down and shuffle them on the table. Deal seven tiles to each player which they keep hidden. Any remaining tiles should stay face down in the centre – if during the course of the game a player can't go, they will draw a domino from this pile.
2. The player who drew the highest double domino (i.e. with identical ends) begins by playing any domino from their hand.
3. The next player lays down a domino whose value on one end matches either end of the domino already in place.
4. The players take turns to add a matching domino to the open ends of those already placed.
5. If a player can't go they must pick a tile from the pile but do not get to play it. If at any point no one can play, the player with the most dominoes remaining can start a new 'board'.
6. The winner is the player who gets rid of all their dominoes first!

If students are feeling adventurous, they could try and play the rhythms of their dominoes outputs, or even make their own dominoes set involving the same notes, or include rests or even semiquavers!



## EXERCISES

To accompany this lesson plan and support learners, we have created several exercises and worksheets. These include:

- A worksheet focused on recapping the values of the musical notes, with some work on equivalent fractions and calculating the value of dotted notes through adding fractions.
- Exercises adding in missing bar lines as shown below by grouping notes together.



It is fine to ignore the positioning of the different notes on the staff and simply look at their values but they are presented as different notes here so that they may be played back to create real music should a learner wish to attempt them either in MuseScore (see below) or on an instrument.

## CREATING MUSIC IN CLASS

To facilitate the music creation portion of the lesson plan we have written exercises which feature short pieces of music with some notes or even whole bars of music missing! The learners need to work out what fraction of the bar is missing and choose the notes they want to use to fill in the gaps themselves such as in the example below



This can be continued, you could even consider giving learners completely blank sheet music and letting them create a piece from scratch. This can also be achieved using technology described below to enable the learners to hear their creations as they are going along.

## PLAYING BACK THE MUSIC

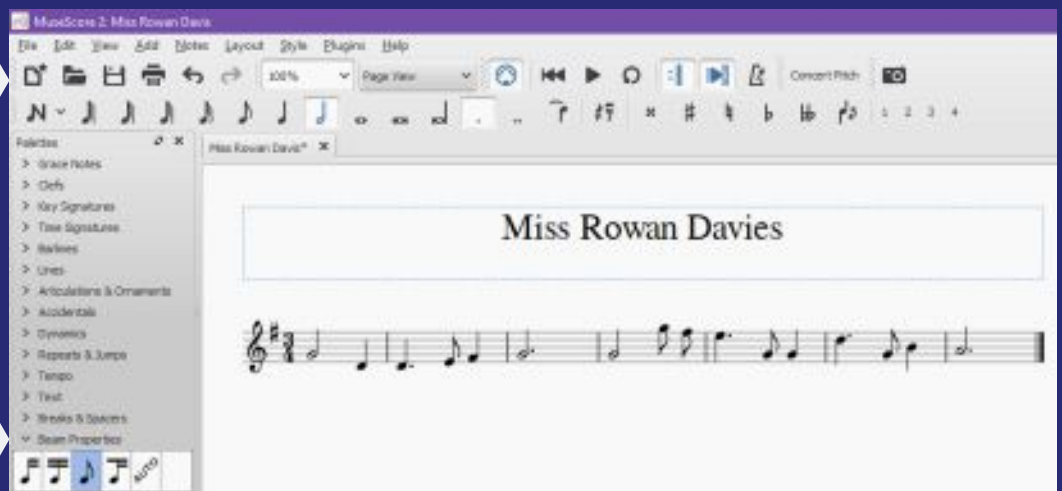
There is a piece of free downloadable software called MuseScore that can be used for writing and playing back music but other programs you may have such as Sibelius would work just as well.

In MuseScore there are simple drag & drop tools or you can also type the letters corresponding to the notes you wish to put in. You can press play & hear the music played back to you. This could be done on a smartboard or individually for a bigger project.

Alternatively it might be fun to have a musical teacher or senior musical student(s) play the pieces live for the class on their instrument of choice, if they feel comfortable!

Click here to choose the note value you want

Double click the highlighted button to remove automatic beaming



# MUSIC THEORY EXTENSION IDEAS

## TIME SIGNATURES

Although many Scottish traditional pieces of music (called reels) are in 4/4, giving all fractions a denominator in powers of two, this is not always the case. There are in fact many different time signatures used in music all over the world.

In time signatures the number on top tells you how many beats there are in a bar and the number on the bottom tells you which note has the value of one beat.

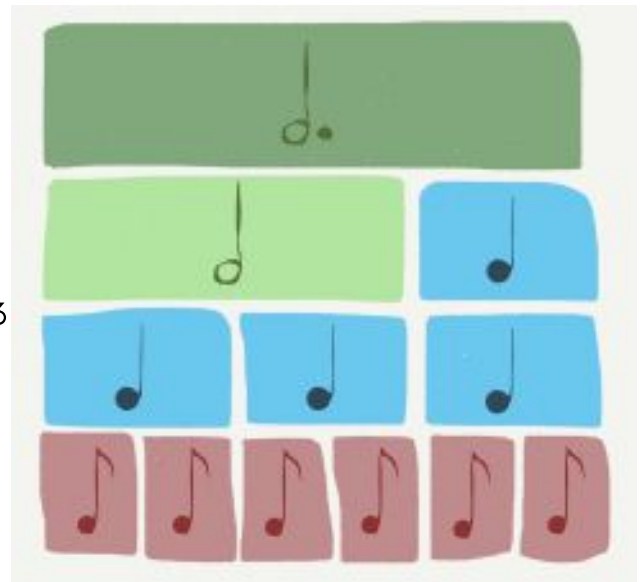
In 4/4 then there are four beats in a bar and one beat is one crochet. In 6/8, there are six beats in a bar and each beat is one quaver so there must be the equivalent of 6 quavers in every bar. A dotted crochet, with the value of  $\frac{1}{4} + \frac{1}{8} = \frac{3}{8}$ , would then take up half the available time of one bar in this time signature.



In 3/4 time, there are three crotchet beats per bar, which means that each crotchet or its equivalent value forms one third of the bar.

In 3/4 time, there are three crotchet beats per bar, which means that each crotchet or its equivalent value forms one third of the bar. Looking at it in this way, in each bar one crochet =  $\frac{1}{3}$  of the time, one minim =  $\frac{2}{3}$  of the time, and one semibreve equals  $\frac{4}{3}$  making it's value too large to fit into one bar.

Here is an example of some music in 3/4 time. The same kinds of exercises we used for 4/4 time could then be used to explore calculations with thirds or any other time fractions you can think of!



Finally we have a short section of the carol 'We Three Kings of Orient Are'. This is in 3/8 which means that one quaver forms  $\frac{1}{3}$  of each bar and there are 3 quavers or notes of equivalent value in every bar. Using more complicated time signatures like these may help challenge learners further



## RESTS

One area we have not gone into that may be worth exploring as an extension task is that of rests. There are 4 main types of rest and they each correspond to the note values we've seen throughout of quaver, crotchet, minim and semibreve. Learners might like to use these to add some more style to their compositions! Here are all the rests in increasing order for reference.



## HOW TO USE THIS RESOURCE

In this guide you'll find an interdisciplinary lesson plan incorporating music with mathematics to explore the topic of fractions. Appropriate for Third and Second Level (S3s - P6s) with suggestions for differentiation & covers Experiences and Outcomes within the Curriculum for Excellence for mathematics (Shape, Position & Movement) and expressive arts.

**MTH 3-07b:** By applying my knowledge of equivalent fractions and common multiples, I can add and subtract commonly used fractions.

**MTH 3-07c:** Having used practical, pictorial and written methods to develop my understanding, I can convert between whole or mixed numbers and fractions.

**EXA 2-16a:** I can sing and play music from a range of styles and cultures, showing skill and using performance directions, and/or musical notation.

**EXA 2-17a:** I can use my voice, musical instruments and music technology to experiment with sounds, pitch, melody, rhythm, timbre and dynamics.

This is designed as a full **60 minute session** but can be adapted to fit within a much longer time period with the further extensions. To adapt for a **25 minute session** discussing fractions and music you could focus on only explaining the musical notes and then the musical fractions games.

Accompanying free resources available online include:

**Videos** discussing fractions and music in different contexts

**Fractions Dominoes** print-outs for the games along with a plain version for students to make their own

**Poster** of musical notes bar modelling in 4/4 time and **presentation** with the lesson slides and artwork

**Exercise Worksheets** to practice adding the notes/fractions appropriately

## FURTHER LINKS

**Maths Week Scotland** - for more maths activities and resources: [mathsweek.scot](http://mathsweek.scot)

**Music for Ceilidh Dances** - recorded from the band & recommendations: [scienceceilidh.com/music](http://scienceceilidh.com/music)

**Learn More About Music Theory** - [bit.ly/fractionmusical1](http://bit.ly/fractionmusical1)

**Online Game on Maths and Time Signatures** - [bit.ly/fractionmusical2](http://bit.ly/fractionmusical2)

**"Cultivating Creativity in the Mathematics Classroom"**: [bit.ly/fractionmusical3](http://bit.ly/fractionmusical3)

**Imaginary** - Open Maths website and resources including sound of mathematics: [imaginary.org](http://imaginary.org)



Science Ceilidh is an award-winning education organisation exploring STEM, creativity, arts, research and health & wellbeing across Scotland. Our school programme focuses on interdisciplinary learning, raising science and cultural capital, linking schools with research and breaking STEM stereotypes.

### Acknowledgements:

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