MATHS WEEK SCOTLAND
PRIMARY TEACHERS PACK

DANCING REEL SYMMETRIES

CONNECTING CREATIVITY & MATHS BY INVESTIGATING SYMMETRY IN DANCE.

LEARNING INTENTIONS:
Pupils are learning to:
1. Link creativity, dance and maths
2. Understand and explain the symmetries of a square
3. Identify different symmetries
4. Create their own dance based on symmetries

NO MATHS OR DANCE SPECIALISM REQUIRED
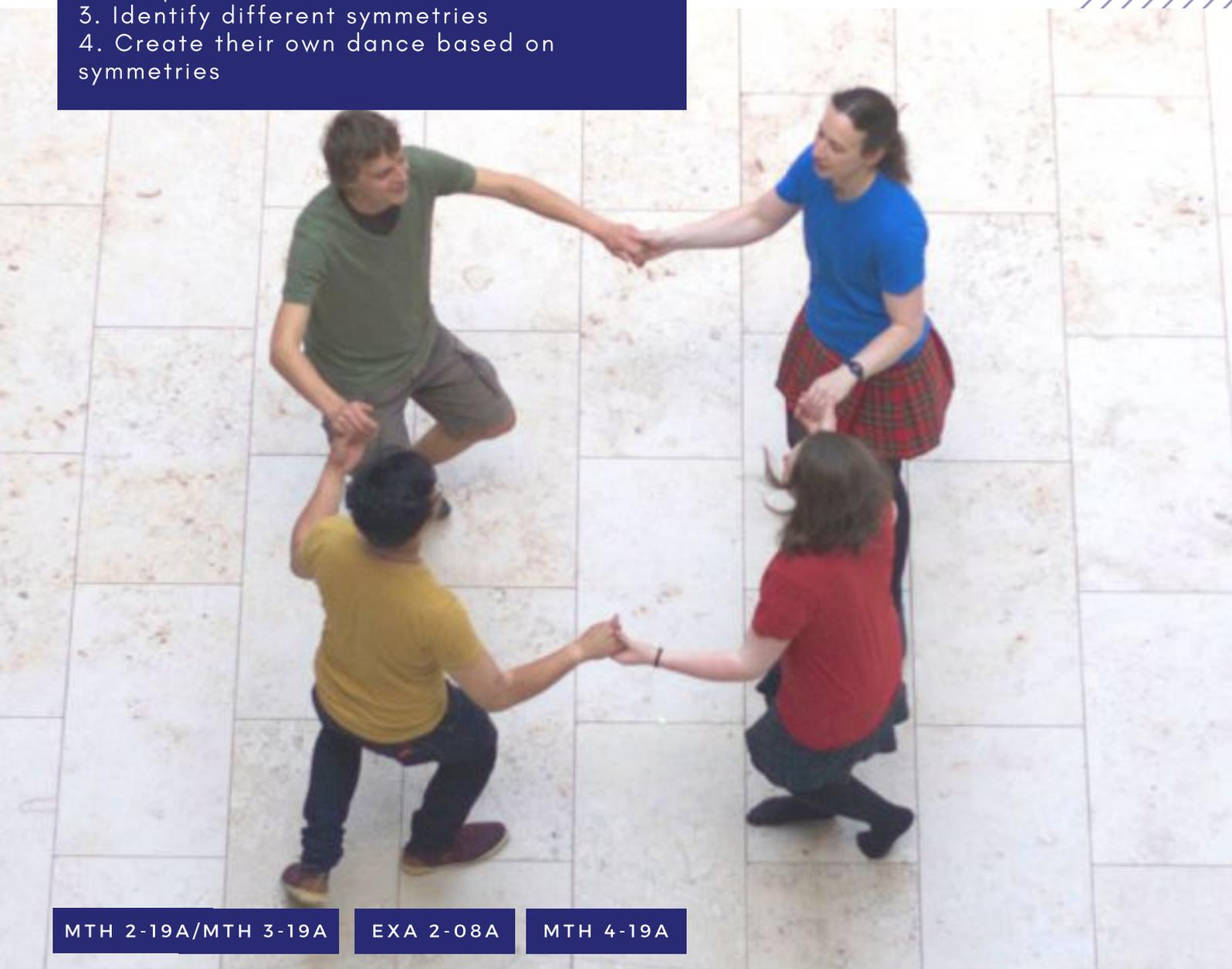
MTH 2-19A/MTH 3-19A   EXA 2-08A   MTH 4-19A

Maths Week Scotland

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SYMMETRY LESSON PLAN

SUCCESS CRITERIA

By the end of the lesson, pupils can:
- Identify and explain the symmetries of a square
- Work as a team to solve problems
- Co-ordinate ideas with other team members to create a dance

RESOURCES

- ☐ Classroom space
- ☐ Square templates with a letter in each corner (and different shapes for extension tasks)
- ☐ Projector, laptop, video & music online*
- ☐ Different coloured wristbands or material

INTRODUCTION

5 mins

Introduce that we're **linking mathematics and creativity** (specifically dance) using symmetry.

Review two key considerations about symmetry:
Does the move keep the shape/structure the same?
Does it preserve **connectedness**?

💬 *Connectedness in symmetry is the idea that adjacent corners must always be adjacent after the move is applied. A good way of explaining this is as a 'hand holding analogy'. If B is holding hands with A and C at the beginning then it has to always be holding their hands; the same goes for all the other corners.*

FIND THE SYMMETRIES

10 mins

Split the class into groups of 4 and give each member of the group a different coloured wristband which matches the 4 coloured corners of a mini square template.

Each group has to work out how many symmetries their square template has and write them down.
Ask each group to explain all the symmetries they have found.

💡 *The groups can work out the symmetries as a competitive activity with the fastest group getting a prize.*

EXPLANATION

5 mins

Recap all the symmetries with the class using the powerpoint provided. Make a special effort to point out the identity symmetry and then the different types of symmetries there are (rotations and reflections).

💡 *The pupils can demonstrate the symmetries they have found using their square template or hold hands in their groups and demonstrate them themselves!*

SYMMETRY OF DANCE

15 mins

Explain that we will be watching a video of a symmetric dance and the challenge is to identify what kind of symmetry is happening at the end of every move.

Watch the video together (see link at backpage)
It begins at normal speed and then goes into slow motion to make it easier to identify the symmetries.

💬 *As an extra challenge can you work out what kind of reflection/rotation is happening? If it is a reflection, is it diagonal, horizontal or vertical? It it's a rotation, what is the angle of the rotation?*

DANCE CREATION

20 mins

In groups of 4 learners will now write their own symmetric dance! It should include a minimum of 6 different steps and everyone should try to be back in their original positions at the end.

Write down your moves as you go!
Perform the dances to the rest of the class.

💡 *Think about rotating a square both clockwise and anti-clockwise. What is the angle of each rotation?*

PLENARY

5 mins

Recap what we've covered about symmetries and also how we could take this further to understand more.
Revise connection of maths to creativity, and link to **real life uses of symmetry**!

💡 *Learners can do the same process with different shapes- triangle, pentagon, octagons etc.. After trying several regular shapes, a mathematical pattern may develop in regards to number of sides (n) and number of symmetries (= 2n)*

Bold text explained further in resource   💬 Discussion Ideas   💡 Differentiation &/or Extension Ideas

HOW ARE SYMMETRY, DANCE & CREATIVITY CONNECTED?

Symmetries are everywhere and dances get creative with, and subvert, symmetries to ensure people end up in the same place, or purposely change order so everyone takes turns as the "first couple". Mathematically, symmetries are different arrangements of a shape which keeps the same structure – e.g with dancing, this means dancers always stay next to the same people no matter where in the dance they are (i.e. A is always next to B & D below). There are many types of symmetries but we'll focus on rotational and reflective ones.

TYPES OF SYMMETRY

ROTATIONS

1.
0° rotation (identity)
OR
360° rotation (identity)

2.
90° rotation

3.
180° rotation

4.
270° rotation
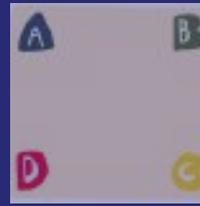
360° rotation (same as 0°)

Rotational symmetry means that an image can be turned around a central point a number of times and it will stay the same shape.

The number of times it can be rotated is also called the 'order of rotational symmetry'.
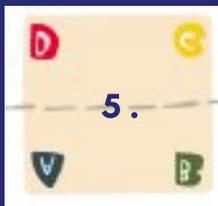
REFLECTIONS

5.
horizontal

6.
vertical

7.
diagonal

8.
diagonal

Reflective symmetry means that one half of the image is a mirror image of the other.

This is also called line symmetry.

IDENTITY

In symmetry we also use the **identity** to refer to the symmetry when nothing is done to the image.

Every image then has this symmetry at least, even if it has no others!

MUSIC FOR THE DANCE

Ceilidh music is made up of traditional Scottish reels and jigs. You can also use most pop music as it usually fits the 8 beat structure, which pupils may enjoy! It's usually a bit slower than ceilidh music so you can either dance at a relaxed pace, or speed up the music (use the speed setting at 1.25 or 1.5 x on YouTube). We have included links to traditional & less traditional music to get you started!

RESEARCH: GROUP THEORY, BIOLOGY AND THE RUBIK'S CUBE!

Symmetry belongs to an area of maths called group theory. This is widely used in many areas of science and even in music! In science it is heavily used in theoretical physics and in chemistry, where molecules that have mirror symmetry can have very different properties, despite having the same elements in them. Humans and animals also find symmetry an attractive feature. Biologists believe this is because symmetry suggests good genes as only a strong animal could keep a symmetrical appearance when going through environmental stressors such as competition for food.

The most famous example of group theory might be the Rubik's cube. This popular toy was invented by a Hungarian mathematician to help his students learn group theory. There are around 43 quintillion (that's 43,000,000,000,000,000,000!) symmetries of a Rubik's cube compared to 8 for a 2D square!

HOW TO USE THIS RESOURCE

In this guide you'll find an interdisciplinary lesson plan incorporating dancing with mathematics to explore the topic of symmetry. Appropriate for Second & Third Level (P6 – S3s) with suggestions for differentiation & covers Experiences and Outcomes within the Curriculum for Excellence for mathematics (Shape, Position & Movement) and expressive arts.

MTH 2-19a/MTH 3-19a: *I can illustrate the lines of symmetry for a range of 2D shapes and apply my understanding to create and complete symmetrical pictures and patterns.*
EXA 2-08a: *I can explore and choose movements to create and present dance, developing my skills and techniques.*
MTH 4-19a: *Having investigated patterns in the environment, I can use appropriate mathematical vocabulary to discuss the rotational properties of shapes, pictures and patterns and can apply my understanding when completing or creating designs.*

This is designed as a full **60 minute session** but can be adapted to fit within a shorter or longer time period. To adapt for a **25 minute session** discussing symmetry and dance creation you could watch the accompanying explanation video together as a class and then begin creating your own dances.

Accompanying free resources available online include:
Video explaining symmetries of the square and our symmetric dance
Symmetry Square tool available to download and print
Powerpoint showing all the symmetries of the square
Music which can be used to accompany the dance

FURTHER LINKS

Maths Week Scotland – for more maths activities and resources: mathsweek.scot

Music for Ceilidh Dances – recorded from the band & recommendations: scienceceilidh.com/music

Lesson Explanation Video – Caity and Lewis from Science Ceilidh explaining the lesson on youtube! – bit.ly/dancingreel1

Dance Video – only the dance video in regular and slow motion on youtube: bit.ly/dancingreel2

Article on the symmetry found in biology – www.teachervision.com/symmetry-nature

"**Cultivating Creativity in the Mathematics Classroom**": https://nrich.maths.org/5784

Science Ceilidh is an award winning education organisation exploring science, traditional arts, creativity 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.

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