How can I use mathematics for painting?

Primary: (ages 7 – 11)	Mathematics

The aim of this activity is to discover new ways of understanding and applying mathematical knowledge through creating art work inspired by artists such as Kandinsky. Students pose challenges, generate mathematical problems, and seek or calculate suitable answers. Students empathise with artists in order to understand the choices and challenges faced when producing paintings: How will I use the space? How big shall I make it? How can I use maths to help me paint?

Time allocation	3-4 lesson periods
Subject content	Generate, understand, and solve mathematical problems and calculations (e.g. simple arithmetic, length/height measurement, proportion, ratio, geometry as appropriate to local curriculum)
Creative and critical thinking	This unit has a **creativity** and **critical thinking** focus: • Make connections between paintings and mathematics • Generate several approaches to posing and solving mathematical problems to create visual art • Reflect on chosen approach relative to alternatives
Other skills	Collaboration, Communication, Persistence/Perseverance
Key words	Kandinsky; geometry; measurement; angles; proportion; division; painting

Products and processes to assess

Students discuss paintings and generate a series of unusual ideas for how maths can help them produce an artwork inspired by their favourite painting. At the highest levels of achievement, students are open to exploring a variety of ideas and successfully embark on a series of new initiatives in order to approach the problem from alternative perspectives. They are able to see connections and express the strengths and weaknesses of various approaches in a reasoned way. They reflect thoughtfully on the value and usefulness of mathematical knowledge in solving everyday problems and they successfully overcome any doubts associated with dealing with an unknown situation to produce a meaningful creative output and pose challenges about it using their mathematical knowledge.

Teaching and Learning plan

This plan suggests potential steps for implementing the activity. Teachers can introduce as many modifications as they see fit to adapt the activity to their teaching context.

Step	Duration	Teacher and student roles	Subject content	Creativity and critical thinking
1	Lesson period 1	Teacher presents Kandinsky's paintings, showing a series of paintings, several times in order to allow students enough time to observe carefully. Teacher tells students these are by a painter called Kandinsky. (some brief facts about his life can be mentioned). Each student is asked to make a personal choice of their favourite painting and share with their team. Why have they chosen this one? How does it make them feel? Teacher explains the driving question: **How can I use mathematics to help me create drawings and paintings?** They explain that students are going to use mathematics (e.g. measurement, proportion, division, geometry etc.) to help them create a painting, inspired by one of the paintings they have seen. Students engage in small group discussion in order to agree on which of their favourite paintings they will work with as a team. The teacher may decide to challenge students to select the painting for which mathematics will be most helpful (e.g. ones which have several figures to measure and place etc.). The teacher can support by suggesting additional criteria and methods of decision (e.g. voting, process of elimination, etc.) as appropriate. Students are asked to write down the reasons they have chosen their particular painting. As appropriate to teaching context, they could also be asked to note down one or two first ideas for how they might use maths to help them create a similar painting. Teacher facilitates a discussion (or asks students to write) on what has been learnt.	Looking at how mathematics can help to solve problems in the real world Listening respectfully to others whilst using mathematical and other reasoning to support their personal choices Recalling existing maths knowledge and applying it in a new way	Feeling, empathising, observing, and describing relevant information about paintings and possible connections to mathematics Considering and reviewing several perspectives to select a group painting which can be reproduced or imitated with the help of mathematics
2	Lesson period 2	Teacher begins the session by showing students all the paintings again as a useful reminder and asks students to start articulating what they remember doing in the previous session. Teacher reminds students they must use mathematics to plan their painting and that they should record and label their calculations on paper throughout the process. Teacher encourages students to think creatively to come up with as many ideas as		Generating, exploring, and playing with unusual or novel

		possible about how mathematics can help them and may also propose a number of strategies to support students to see further applications of maths to painting as relevant. For example:		ideas for how mathematics can help them with their task
		1. Measuring the paper and the original painting and creating grids to guide their painting. Students can also be encouraged to give coordinates to their grid if relevant. 2. Identifying and specifying the shapes of the figures they will portray. These do not necessarily need to coincide with those chosen by the artist, they are free to choose those they prefer. 3. Are there any repeating patterns in the painting? Or would they like to create some repeating patterns? 4. How are they going to distribute the space: Are all figures going to be the same size and shape? If some are bigger how much bigger? How much space should each take up? 5. Considering the size of the figures and the arrangement of the space. Where are they are going to draw each figure? Do they have enough space? How many figures can they fit in? 6. Deciding what materials they need and why 7. Defining what each team member will do and setting timeframes. Throughout this process teacher supports students to identify the challenges they have on the basis of the painting chosen (e.g. we need to fit in x number of figures etc.), how to deal with these challenges, and how to make any calculations that may help them Students can be encouraged to write down the questions that have helped them to deal with the challenges before starting to create their paintings/drawings. At the end of the session, the teacher can ask students either in writing or verbally to reflect on what has been learnt today.	Using division to work out how to create a given number of equal grids on their paper Creating and using coordinates Identifying the properties of geometric figures, classifying them, and reviewing how to draw them Measuring space available and distributing it between figures, possibly of different sizes Comparing and planning height and length of figures and using simple multiples such as half/twice as big etc. The teacher may introduce or review ideas such as ratio, proportion, using angles etc. depending on curriculum, level, and paintings chosen.	Making new connections to pose relevant mathematical problems and envisioning how to solve them in a meaningful way Reflecting on steps taken to pose and solve a maths problem
3	Lesson periods 3 and 4	Students finish their paintings/drawings and may be asked to present them to the rest of the class, explaining how they were created, what challenges they encountered and how mathematics helped them. As appropriate to the context and areas of subject knowledge the teacher wishes to reinforce, they can then lead discussions, set group challenges, or ask for individual written work on areas such as the following: Think of some interesting or unusual ways your painting could be changed or re-imagined. What would make it more beautiful, interesting or different and why? Use	Communicating how they used mathematics to solve real-life problems Generating and articulating mathematical problems	Explaining and justifying approach and reflecting on steps taken to pose and solve the problems Imagining different possibilities for the paintings and generating

	your ideas to: - create a challenge for another group to change your painting using 2 calculations - create a challenge for another group to change your painting involving multiplication - create a challenge for another group to change your painting involving adding and multiplication - create a challenge about any of the paintings (e.g. Work out how to make this painting twice as big) - If time is available, students can be asked to work on the challenges set by others but the main point of this exercise is that students identify and articulate mathematical problems and link them to aesthetic effects. The activity can be concluded with further reflection on and assessment of what has been learnt about how mathematics can help you draw and paint and how this could be used in the future.	Any area the teacher wishes to reinforce. E.g. measurement, multiplication, division, proportion etc.	ideas to pose relevant maths problems in a personally novel way Reflecting on steps and approaches taken and applications in the future

Resources and examples for inspiration

Web and print
- ➢ A selection of Kadinsky (or Miró or similar) paintings to show students
- ➢ Some basic facts about Kadinsky's life can be found in the appendix

Other
- ➢ A projector is needed to show the paintings to the students.
- ➢ A3 paper or card to enable the students to create their drawings, one per team.

Opportunities to adapt, extend, and enrich
- ➢ Further activities on geometry at primary level can be found here https://nrich.maths.org/12338
- ➢ This could be part of a broader unit on the use of mathematics in the art world. Students could be asked, for example, to calculate perimeters and angles of geometric shapes in existing or created artwork. See the activity *Geometrical architecture and artwork* in this series for more ideas
- ➢ Links could be made to literacy by asking students to write stories about the paintings or, for example, plays in which the characters are mathematical concepts (such as addition, multiplication etc) and work together or compete against each other to create a beautiful painting

Creativity and critical thinking rubric for mathematics	• Mapping of the different steps of the lesson plan against the OECD rubric to identify the creative and/or critical thinking skills the different parts of the lesson aim to develop				

	CREATIVITY Coming up with new ideas and solutions	Steps	CRITICAL THINKING Questioning and evaluating ideas and solutions	Steps
INQUIRING	Make connections to other maths concepts or to ideas from other disciplines	1-3	Identify and question assumptions and generally accepted ways to pose or solve a maths problem	
IMAGINING	Generate and play with several approaches to pose or solve a maths problem	2-3	Consider several perspectives on approaching a maths problem	1-3
DOING	Pose and envision how to solve meaningfully a maths problem in a personally novel way	2-3	Explain both strengths and limitations of different ways of posing or solving a math problem based on logical and possibly other criteria	3
REFLECTING	Reflect on steps taken to pose and solve a maths problem	1-3	Reflect on the chosen maths approach and solution relative to possible alternatives	1-3

Some facts about Kandinsky

- ❖ He was born in Moscow on 16 December 1866. He studied painting and drawing in Odessa and law and economics at the University of Moscow.
- ❖ At the age of 30 he moved to Munich to begin his career as a painter.
- ❖ One interesting question is how did he come up with the titles for his works?
- ❖ The initial works, completely abstract within the realm of modern art, made no reference to objects in the physical universe and were inspired by the world of music from which the titles are taken.
- ❖ In 1911, along with Franz Marc and other German expressionists he formed the group Der Blaue Reiter (the blue jockey, a name that stems from Kandinsky's penchant for blue and Marc's fondness of horses).
- ❖ Interesting fact: one day, a painting caught his eye owing to its colour... he did not know who the artist was, he just stared at the colours, the shapes... he then realised it was one of his but it had been hung upside down.
- ❖ He was also a teacher at Moscow Academy of Fine Arts from 1918 to 1921, and at the Bauhaus in Dessau, Germany, from 1922 to 1933.
- ❖ He died on 13 December 1944 in Neuilly-sur-Seine in the outskirts of Paris at the age of 78.