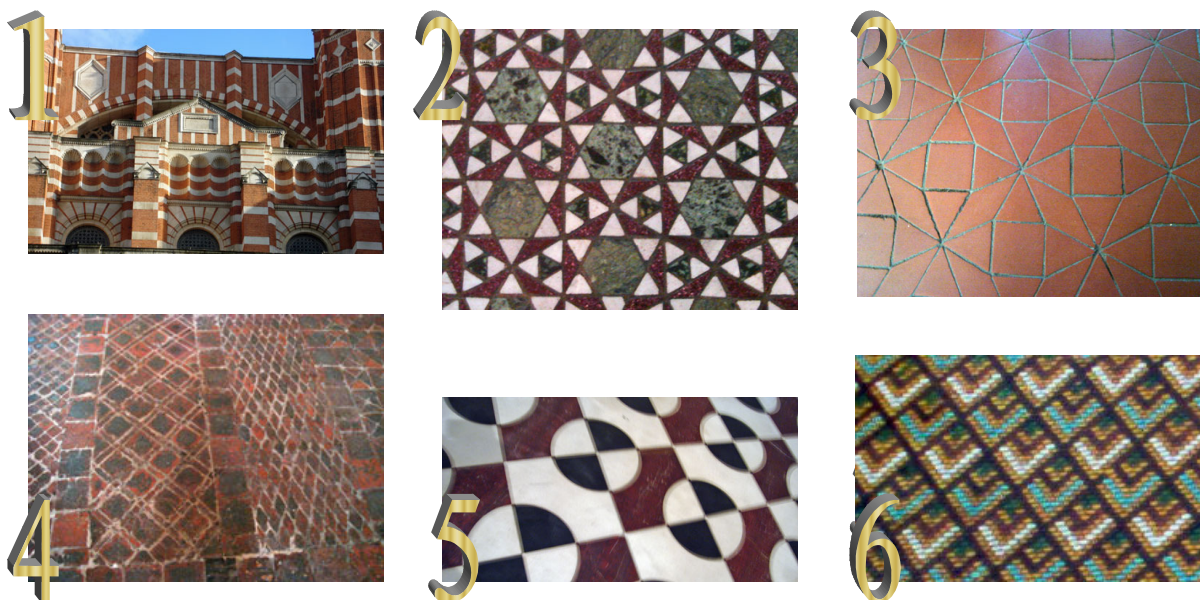


MATHS OF CHURCHES, MOSQUES, SYNAGOGUES AND TEMPLES:

Tilings

Tiling patterns are a major feature of places of worship. Look at these images, and come up with a list of properties which define what a tiling is.

This should include: small tiles which cover a surface in a symmetric pattern of some kind without overlapping or leaving gaps. Examples are floor, wall and roof tiles, brickwork, etc.



1. Analysing tilings

A generating set is a minimum set of tiles from which the entire tiling pattern can be produced. For this we take into account shape and size, but not colour.

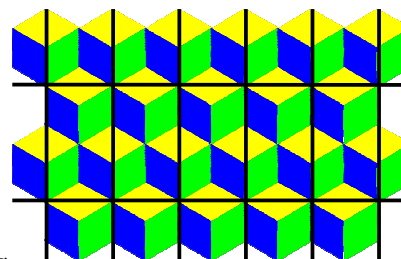
- In tilings 2, 3, and 5 how many tiles are there in the generating sets?
- What shape are they?

Tiling 2: 3 (equilateral triangle, isosceles triangle, hexagon)

Tiling 3: 3 (isosceles triangle, rhombus, square)

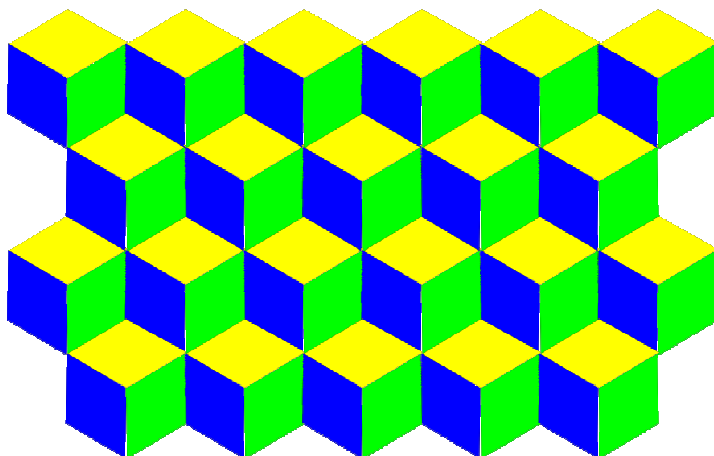
Tiling 5: 2 (quarter circle, square minus two quarter circles)

Many tilings are *periodic*. A tiling is periodic if we can construct a *lattice*, or grid, on it. For this we do take colour into account. Each cell of the lattice should be exactly the same as all the other cells. The tiling on the right has a rectangular lattice superimposed on it.



The pattern in a single cell is called the *fundamental domain* of the tiling. The complete tiling can be re-created by copying this and pasting it in the lattice cells.

- This is not the only way we could superimpose a lattice on this tiling? Draw a different lattice on this copy of the tiling, and sketch your fundamental domain beside it.



Any grid composed of two sets of parallel regularly spaced axes forms a lattice. The fundamental domain should be the basic cell unit, and this should be a rectangle or a rhombus. Note that a hexagon wouldn't do, because it doesn't tessellate the plane without leaving gaps.

2. Create your own tiling

You could start with a set of generating tiles, with a fundamental domain or with a lattice. You may find it helps to sketch your ideas first. You could draw your tiling on square or isometric paper, or cut out tiles and stick them onto the paper, or use software if it is available.

However you decide to start, follow these rules:

- Choose 1, 2, or 3 generating tiles in simple geometric shapes - equilateral triangle, isosceles triangle, square, rectangle, rhombus, parallelogram, hexagon, octagon. (Remember you can use the same shape in different colours).
- The tiles should fit exactly into the fundamental domain, without leaving any spaces and without overlapping. Think about the angles in your tiles - do all the angles meeting at a point add up to 360° ?
- The lattice should be made up of two sets of regularly spaced, parallel lines, and the fundamental domain should exactly fit a cell in the lattice. Each cell should contain the same fundamental domain.

During the VC this afternoon, you will be asked to display your work. You should be able to identify the generating tiles, the fundamental domain and the lattice, and mention any problems you encountered in creating your tiling and how you solved them.