Good practices

Template for collecting the best practices of using Poly-Universe for Teacher training purposes / courses

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Description of the problem / exercise:

Wallpaper groups with Poly-Universe, and the colors of Portuguese tiles

With Poly-Universe, you can not only lay out friezes and rosettes, but also display the symmetry groups (crystal groups) of the plane, the so-called cyclic surface divisions. What is cyclic surface division?

We are looking for the answer to the question: how many ways can a plane be covered by congruent shapes without gaps and overlaps, so that certain transformations (shifts, reflections, rotations) bring the whole pattern into itself, while the adjacent domains are superimposed on each other? The answer to this question is 17, there are 17 crystal groups in the Euclidean plane.

Some of these are presented using the square Poly-Universe tiles, and the coloring follows the colors of traditional Portuguese tiles.

The easiest way to get the 10 square patterns below is to use Inkscape. You can draw a basic element very precisely, then use the Edit, Clone, Create Tiled Clones menu to get the patterns corresponding to the different symmetry groups.

It is worth studying the works of Dutch painter M. C. Escher, who covered the plane with animals and fairytale creatures corresponding to all 17 symmetry groups.
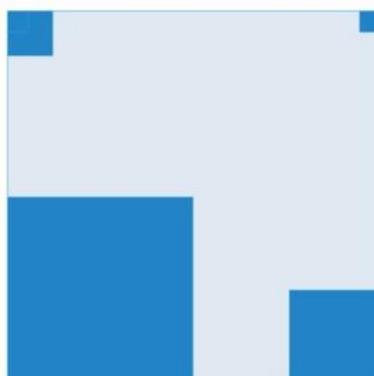
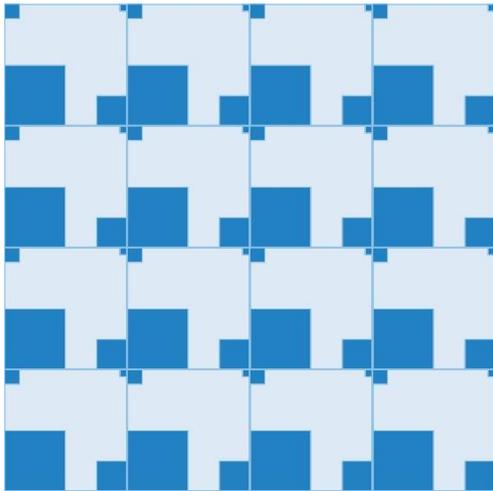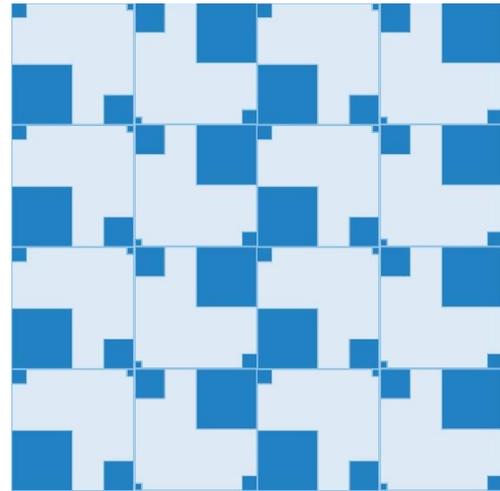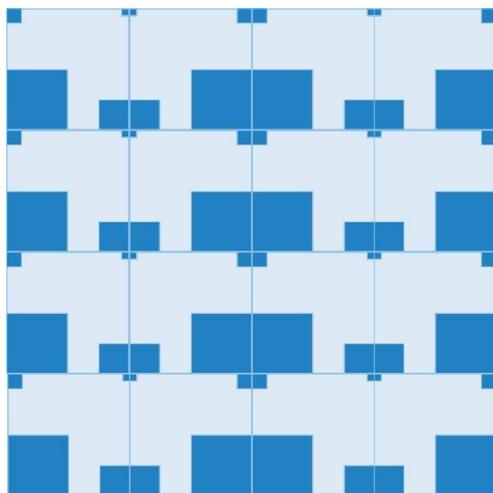https://mcescher.com/gallery/symmetry/

Figure: Base tile

Figure 1: p1

Figure 2: p2

Figure 3: pm
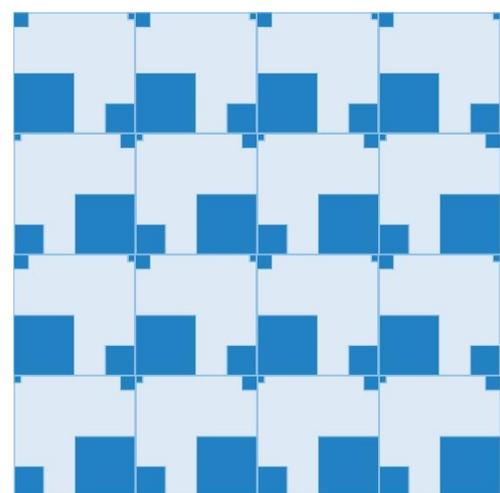
Figure 4: pg
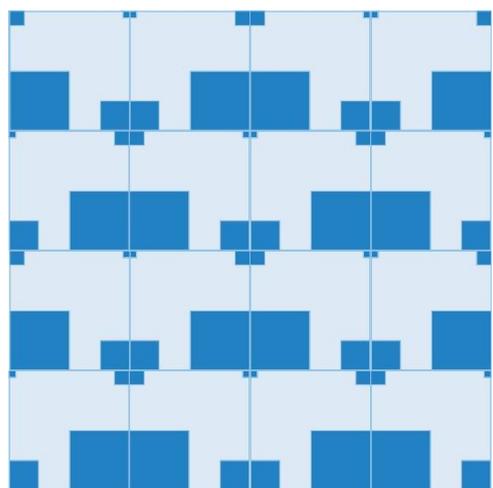
Figure 5: cm
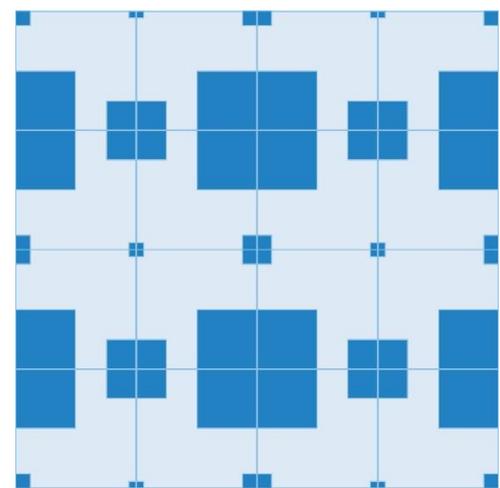
Figure 6: pmm
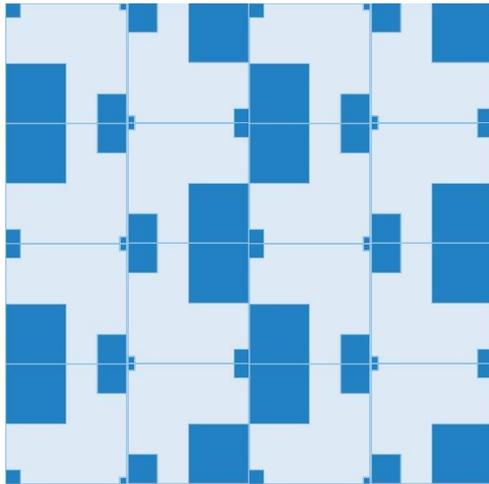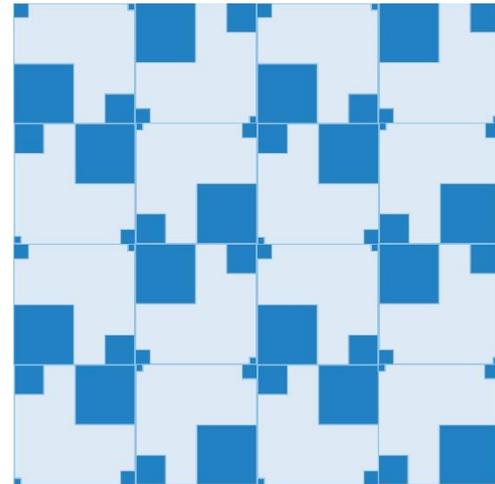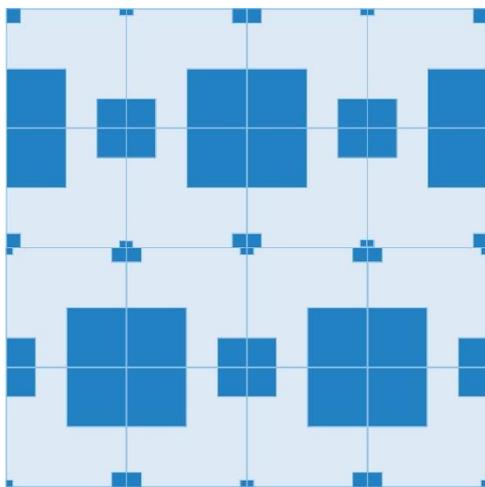
Figure 7: pmg

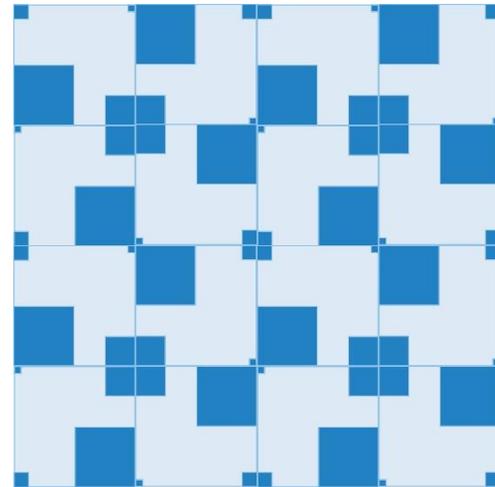**Figure 8**: pgg

Figure 9: cmm

Figure 10: p4

- Why this exercise is good: Symmetry is one of the ordering principles of nature. Symmetry, asymmetry, and dissymmetry (minor damage to symmetry) are all present in the body structure of plants, animals, and humans. Although, symmetry is still felt to be dominant. We can also discover symmetry in the laws of physics, in the crystal structure of materials. Symmetrical objects give us a sense of harmony, of order, and therefore symmetry is reflected in human creations, in our everyday objects, and artworks. We can have a real interdisciplinary (STEAM) session if we look for examples of wallpaper groups in nature, in different sciences, in art, in our everyday life.
- Which level is recommended: Primary, secondary school
- School subject(s): Mathematics, arts, IT
- Comments: Can be done in GeoGebra, or in various graphics editors