

Good practices MATH_112BC_EN

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Description of the problem / exercise: **Poly-Universe and symmetry, plane isometries**

The classification of the four plane isometries by direction preserving property and the existence of fixed points can be seen in Table below.

| | There is a fixed point | No fixed point |
|------------------------------|------------------------|------------------|
| Preserves direction (motion) | Rotation | Translation |
| Reverses direction | Reflection | Glide reflection |

Symmetries in the PUSE methodology book

When studying symmetries in this essay we imply forms but ignore the colours. More precisely, if we say that, for instance, two figures can be mapped onto each other by translation, then after translation, the same forms but not necessarily the same colours will cover each other.

In section A of the geometry chapter in the book some tasks directly ask about isometry. In 110_A the task is to colour the reflected image of triangle, square, circle elements; in 102_A they build shapes that remind them of rotation (Figure 1). It is well worth observing the ratio of symmetric and non-symmetric shapes created by children during tasks allowing for free play and the flow of creation.

Task 505_AB is the following: 'Work in pairs: both of you should construct a shape of 3-4 elements that your partner cannot see. Then show it to each other for a few seconds and cover them. After that draw the shape your partner constructed for you from memory. Check each other's solution if you are ready. If you succeed, continue the game by constructing the given shapes using the elements of your own sets.'

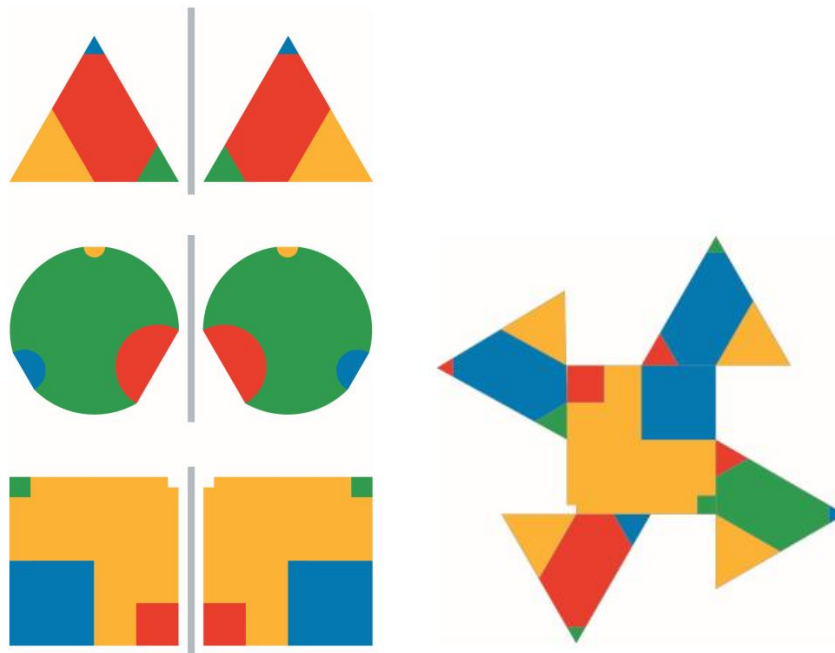


Figure 1: Figures for task sheets 110_A and 102_A.

It is useful to ask about the symmetries of the constructed shapes. The teacher methodology sheets provide some of the most interesting symmetry constructions (Figure 2).

Apart from the top right picture, each construction seems to have reflection symmetry. Having a closer look at them, though, we notice that only the top left construction has perfect reflection symmetry, the other two just almost. What is the reason for this imperfect symmetry? The axis of symmetry is not where two shapes meet (as with the top left figure) but it crosses the figure – and none of the Poly-University elements is mirror symmetric.

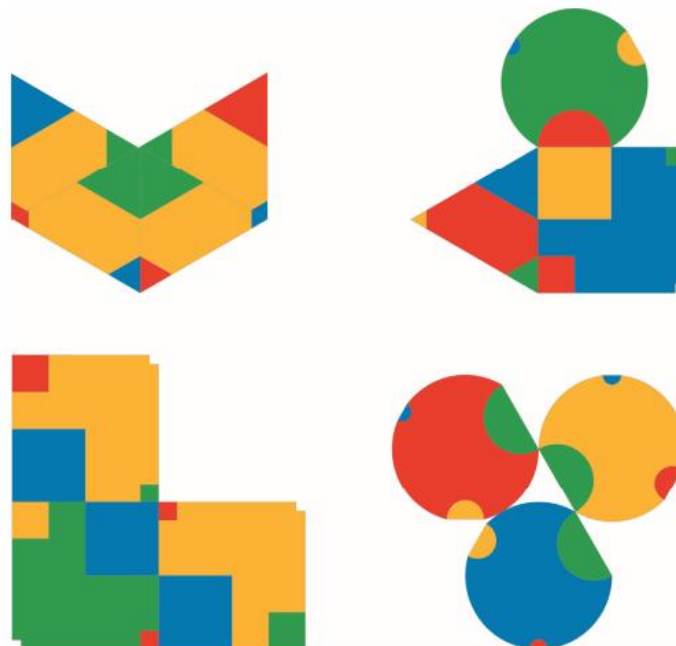


Figure 2: Figures for task sheet 505_AB

- *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 symmetry in nature, in different sciences, in art, in our everyday life.
- *Which level is recommended:* Upper primary school, secondary school
- *School subject(s):* Mathematics, IT, arts
- *Comments:* All references to the worksheet are to Saxon Szász, J. & Stettner, E. (eds.) (2019)