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Good practices
MATH_105BC_EN

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Description of the problem / exercise: **Combinations of a net**

The following task belongs to the topic of geometry-solid geometry, different cases of a net of a solid object. Used sets: square, triangle.

The next shape is a net of a solid object body, using 1 square and 4 triangles.

The next shape is a net of a pyramid, in the creation of which we can choose the base square. The base colors of the opposite triangular faces of the pyramid are the same. The base colors of adjacent triangular faces are different. The colors of the corner fields are not important for the connections.

How many different shapes (pyramids) can we create if we consider only the base color of the base square and triangular faces?

It is clear that if we swap two opposite triangles, it does not count as a new case-way (because only the base color of the triangles matter, and it does not change). Similarly, rotating the shape at an angle of 90 °, 180 °, or 270 ° also does not count as a new case-way.

Each case can be tabulated:

Base color of the base square	Triangle pairs	Number of ways
Yellow	2Y+2R, 2Y+2G, 2Y+2B, 2R+2G, 2R+2B, 2G+2B	6
Red	2Y+2R, 2Y+2G, 2Y+2B, 2R+2G, 2R+2B, 2G+2B	6
Green	2Y+2R, 2Y+2G, 2Y+2B, 2R+2G, 2R+2B, 2G+2B	6
Blue	2Y+2R, 2Y+2G, 2Y+2B, 2R+2G, 2R+2B, 2G+2B	6

For a given base square, we can create 6 different pyramid nets. If the base square can also be replaced, a total of 24 different pyramid nets can be made. The result can also be determined by calculation. You can choose from 4 colors for the base color of the base square.

For the four triangles, the 2–2 pairs of triangles can be selected in a $\binom{4}{2}$ way due to the 4 base colors.

This is a total of $4 \cdot \binom{4}{2} = 4 \cdot 6 = 24$ different shapes.

- *Why this exercise is good:* Develops problem solving, logical thinking, inductive thinking, combinatorial thinking, spatial vision.
- *Level of teacher training:* Primary school upper grade, secondary school
- *School subject(s):* Mathematics