EDUCATIONAL SCENARIOS FOR VISUALLY DISABLED PEOPLE

Neda Chehlarova

The created 3D printing models are suitable for use in a real environment by people with people with visual disabilities, cognitive difficulties and other groups. Educational resources are freely accessible. The developed scenarios for working with the 3D models can be used in class and STEM centers with specific target groups.

GOALS

Formation of knowledge and skills for solving tasks for counting squares and triangles in figures and spatial bodies, using 3D printed models. Development of criticality and flexibility of thinking, of the ability to carry out research.

METHODOLOGICAL NOTES

We recommend allowing sufficient time for independent work before assistance is provided.

Some of the proposed tasks can be solved orally. When a correct answer is obtained, it is useful to have a dialogue related to the student's way of solving, indicating other ways of solving, pointing to rationality, and recording intermediate results.

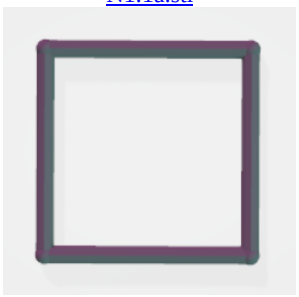
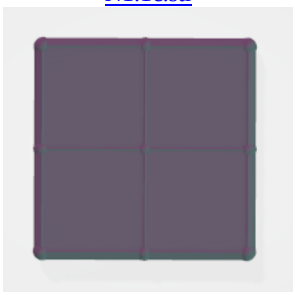
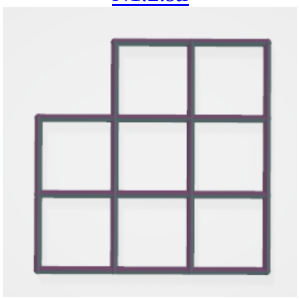
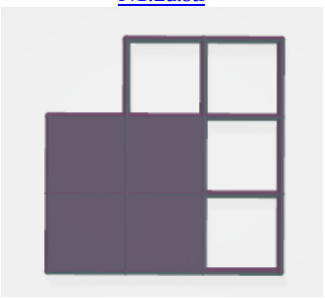
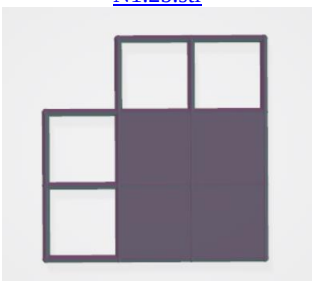
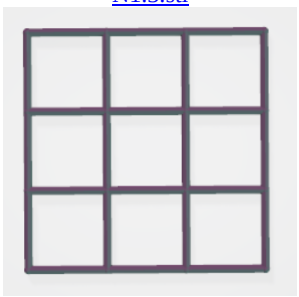
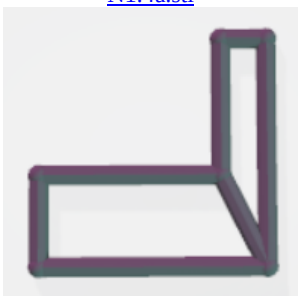
Finally, two main approaches to their solution can be distinguished when considered in the proposed sequence:

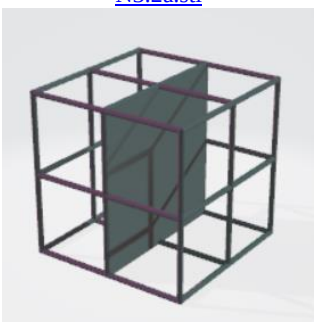
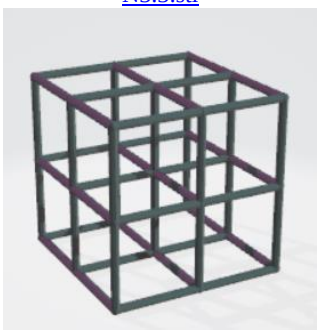
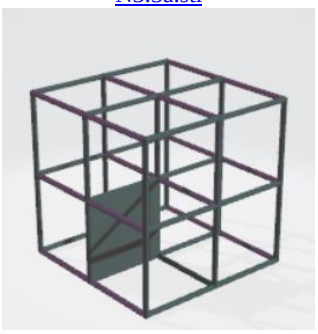
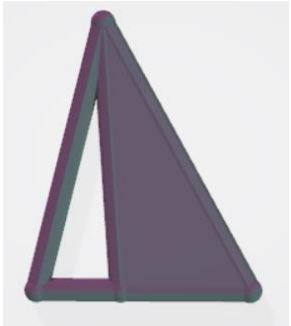
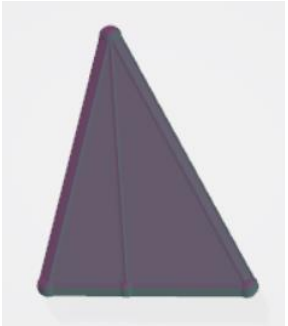
- use of already obtained results from previous tasks;
- distinguish between different species from census figures and census by species.

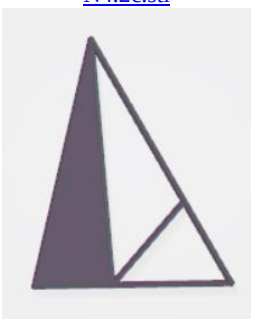
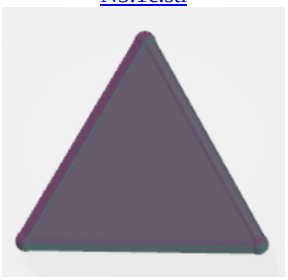
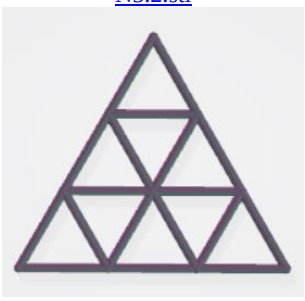
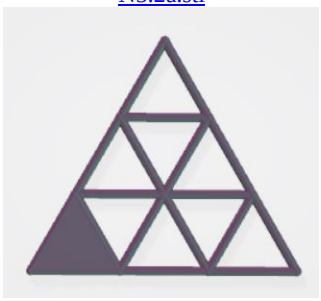
At the end of each of the topics, students can be directed to compose an analogous task.

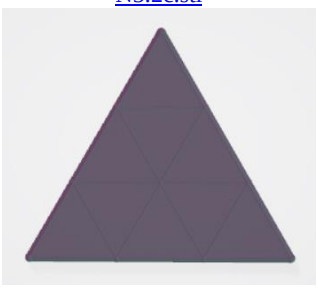
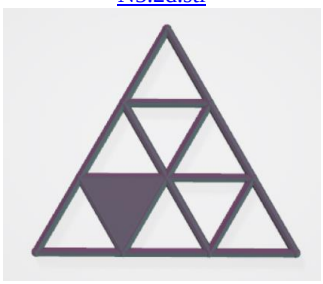
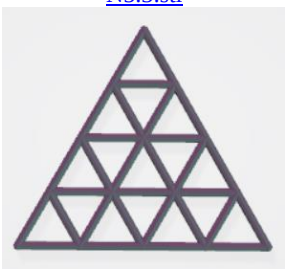
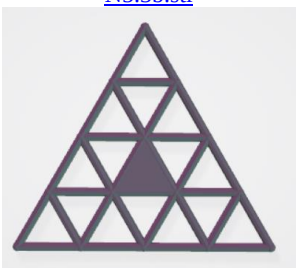
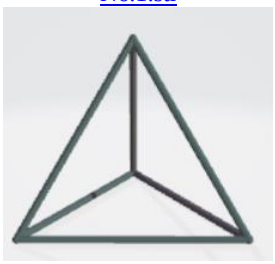
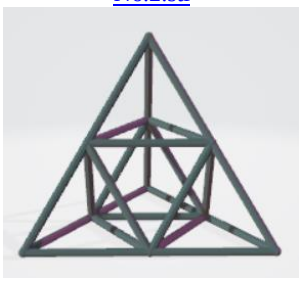
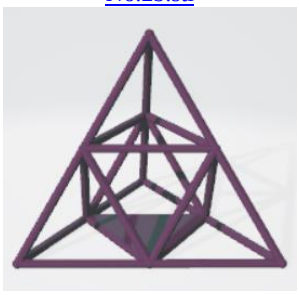
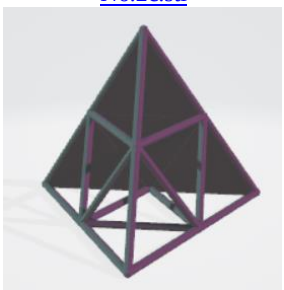
Each of the tasks can be used independently.

FILES FOR 3D PRINTING

N1.1.stl  3D model 1.1 https://cabinet.bg/storage/N1.1.stl	N1.1a.stl  3D model 1.1a https://cabinet.bg/storage/N1.1a.stl	N1.1b.stl  3D model 1.1b https://cabinet.bg/storage/N1.1b.stl
N1.1c.stl  3D model 1.1c https://cabinet.bg/storage/N1.1c.stl	N1.2.stl  3D model 1.2 https://cabinet.bg/storage/N1.2.stl	N1.2a.stl  3D model 1.2a https://cabinet.bg/storage/N1.2a.stl
N1.2b.stl  3D model 1.2b https://cabinet.bg/storage/N1.2b.stl	N1.3.stl  3D model 1.3 https://cabinet.bg/storage/N1.3.stl	N1.4a.stl  3D model 1.4a https://cabinet.bg/storage/N1.4a.stl
N1.4b.stl  3D model 1.4b https://cabinet.bg/storage/N1.4b.stl	N1.4c.stl  3D model 1.4c https://cabinet.bg/storage/N1.4c.stl	N2.1a.stl  3D model 2.1a https://cabinet.bg/storage/N2.1a.stl

N3.1.stl  3D model 2.1a https://cabinet.bg/storage/N3.1.stl	N3.2.stl  3D model 3.2. https://cabinet.bg/storage/N3.2.stl	N3.2a.stl  3D model 3.2a https://cabinet.bg/storage/N3.2a.stl
N3.3.stl  3D model 3.3 https://cabinet.bg/storage/N3.3.stl	N3.3a.stl  3D model 3.3a https://cabinet.bg/storage/N3.3a.stl	N4.1.stl  3D model 4.1 https://cabinet.bg/storage/N4.1.stl
N4.1a.stl  3D model 4.1a https://cabinet.bg/storage/N4.1a.stl	N4.1b.stl  3D model 4.1b https://cabinet.bg/storage/N4.1b.stl	N4.1c.stl  3D model 4.1c https://cabinet.bg/storage/N4.1c.stl
N4.1d.stl  3D model 4.1d https://cabinet.bg/storage/N4.1d.stl	N4. 1e.stl  3D model 4.1e https://cabinet.bg/storage/N4.1e.stl	N4.2.stl  3D model 4.2 https://cabinet.bg/storage/N4.2.stl

N4.2a.stl  3D model 4.2a https://cabinet.bg/storage/N4.2a.stl	N4.2b.stl  3D model 4.2b https://cabinet.bg/storage/N4.2b.stl	N4.2c.stl  3D model 4.2c https://cabinet.bg/storage/N4.2c.stl
N4.2d.stl  3D model 4.2d https://cabinet.bg/storage/N4.2d.stl	N4.2e.stl  3D model 4.2e https://cabinet.bg/storage/N4.2e.stl	N5.1.stl  3D model 5.1 https://cabinet.bg/storage/N5.1.stl
N5.1a.stl  3D model 5.1a https://cabinet.bg/storage/N5.1a.stl	N5.1b.stl  3D model 5.1b https://cabinet.bg/storage/N5.1b.stl	N5.1c.stl  3D model 5.1c https://cabinet.bg/storage/N5.1c.stl
N5.1d.stl  3D model 5.1d https://cabinet.bg/storage/N5.1d.stl	N5.2.stl  3D model 5.2 https://cabinet.bg/storage/N5.2.stl	N5.2a.stl  3D model 5.2a https://cabinet.bg/storage/N5.2a.stl

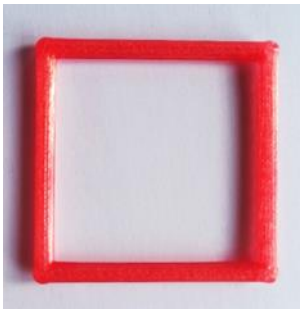
N5.2b.stl  3D model 5.2b https://cabinet.bg/storage/N5.2b.stl	N5.2c.stl  3D model 5.2c https://cabinet.bg/storage/N5.2c.stl	N5.2d.stl  3D model 5.2d https://cabinet.bg/storage/N5.2d.stl
N5.3.stl  3D model 5.3 https://cabinet.bg/storage/N5.3.stl	N5.3a.stl  3D model 5.3a https://cabinet.bg/storage/N5.3a.stl	N5.3b.stl  3D model 5.3b https://cabinet.bg/storage/N5.3b.stl
N6.1.stl  3D model 6.1 https://cabinet.bg/storage/N6.1.stl	N6.1a.stl  3D model 6.1a https://cabinet.bg/storage/N6.1a.stl	N6.2.stl  3D model 6.2 https://cabinet.bg/storage/N6.2.stl
N6.2a.stl  3D model 6.2a https://cabinet.bg/storage/N6.2a.stl	N6.2b.stl  3D model 6.2b https://cabinet.bg/storage/N6.2b.stl	N6.2c.stl  3D model 6.2c https://cabinet.bg/storage/N6.2c.stl

1. COUNTING SQUARES IN PLANE FIGURES

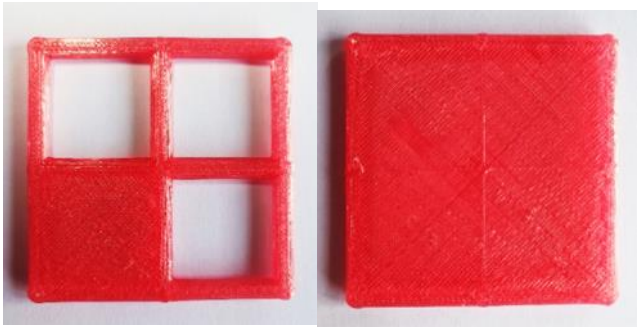
Task 1.1. Count the squares in the figure.

Help:

- If necessary, the description of the square shape is recalled by providing a 3D printed model of the square.



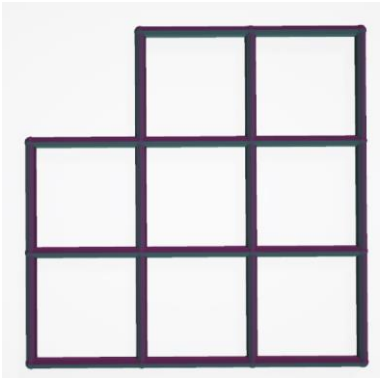
- In case of an incomplete answer, the models with filled concrete squares are used and the number of squares of the type 1×1 and the number of squares of the type 2×2 are commented on, specifying which is the unit segment.



- It is important that students orientate themselves to rational counting and aim for an appropriate arrangement of intermediate results. In this case, it is appropriate to separate 4 squares of the type 1×1 and one square of the type 2×2.

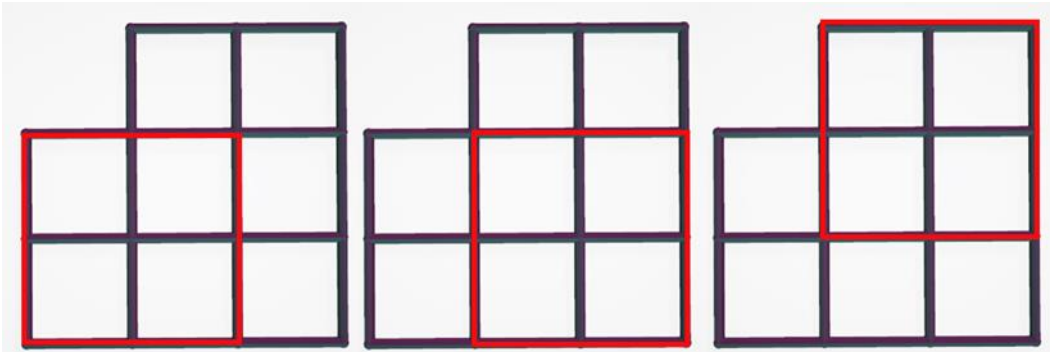
Amswer: 5.

Task 1.2. Count the squares in the figure.



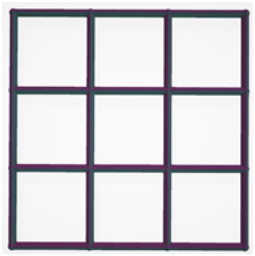
Help:

- Students should be directed to an analogous activity, as in solving the previous problem. They usually count the "small" 8 squares with ease.
- Students have to find 8 squares type 1x1 and 3 squares 2x2. Below are shown the three 2×2 squares.



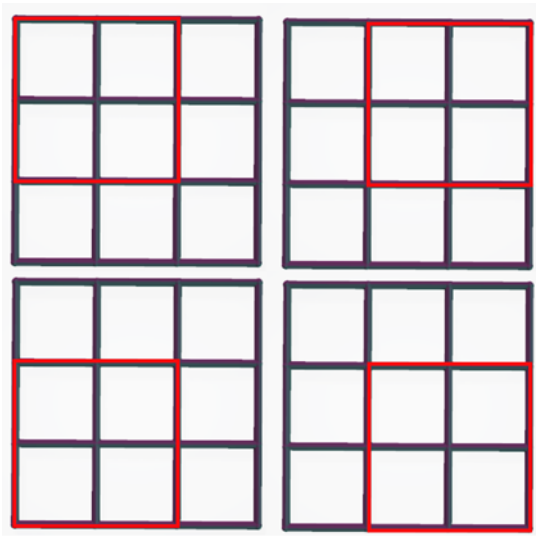
Answer: 11.

Task 1.3. Count the squares in the figure.



Help:

- Students should be directed to an analogous activity, as in solving the previous problem. They have to find 9 squares of the type 1x1, 4 squares of the type 2x2 and one square of the type 3x3. Shown below are the four 2×2 squares.



Answer: 14.

Task 1.4. Count the squares in the figure.

a) б) c)

Answer: a) 0; b) 0; c) 0.

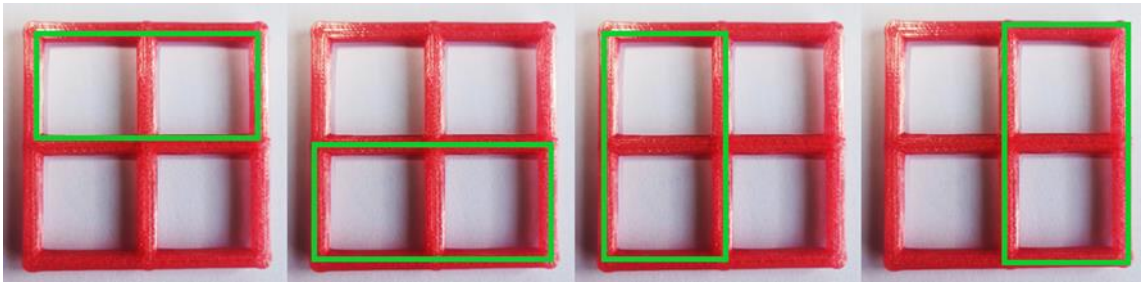
2. COUNTING RECTANGLES IN PLANE FIGURES

Task 2.1. Count the rectangles in the figure.

Help:

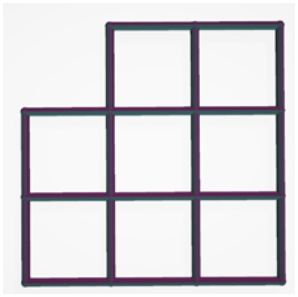
- If necessary, to recall that squares are rectangles, i.e. the result of Task 1.1 can be used and continue counting rectangles that are not squares.
- In case of an incomplete answer, the model with a filled rectangle of the type 2×1 is used.

- Often students end up with two such rectangles, they need to be helped to find the four rectangles of the type 2×1.



Answer: 9.

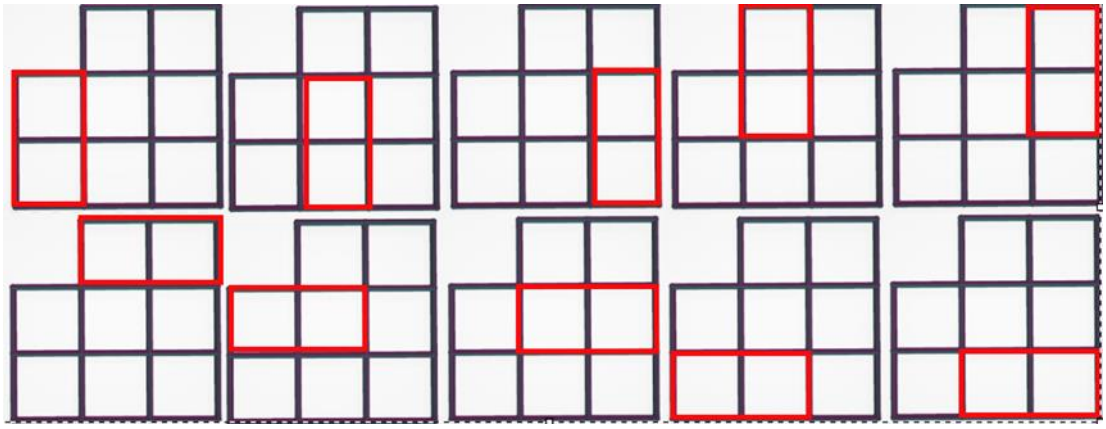
Task 2.2. Count the rectangles in the figure.



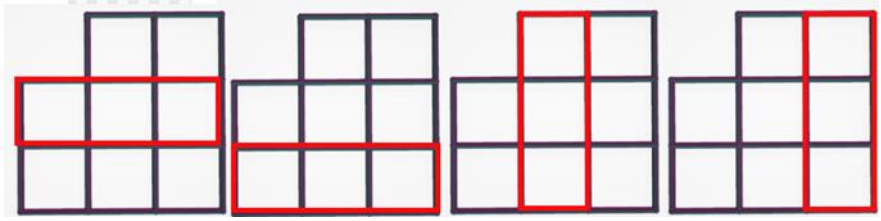
Help:

- The result of Task 1.2 can be used and continue counting rectangles that are not squares.

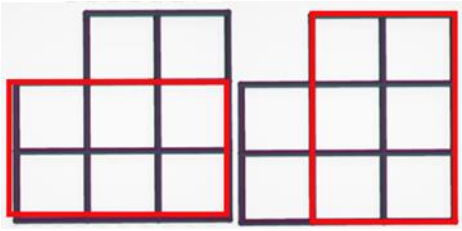
There are 10 rectangles of the type 2.



4 rectangles of the type 3×1



2 rectangles of the type 3×2



Answer: 27.

Task 2.3. Make up a rectangle counting problem.

3. COUNTING OF SQUARES IN A SPATIAL SOLID

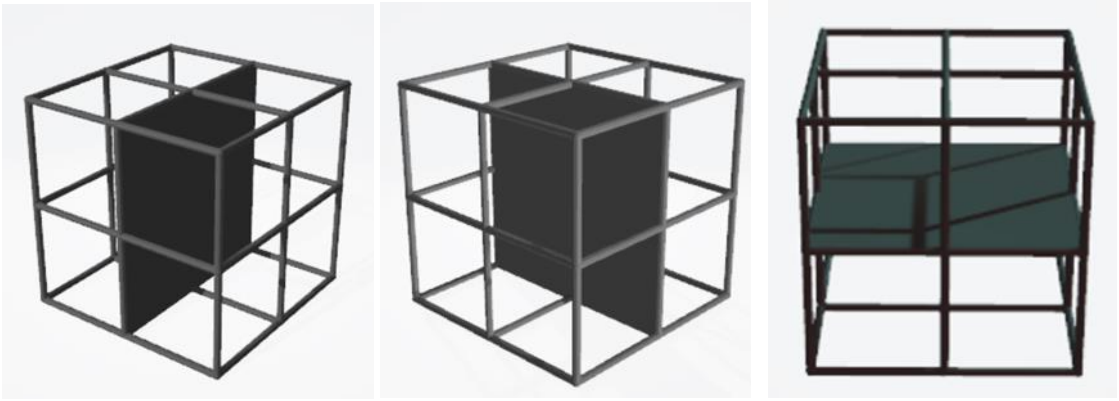
Task 3.1. Count the squares in the cube.

Answer: 6.

Task 3.2. Count the squares in the solid.

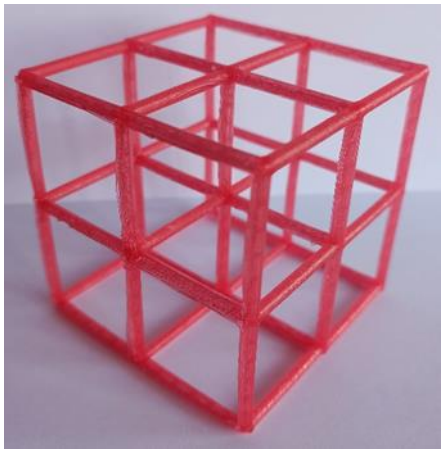
Help:

- The result of Task 2.1 can be used. (and get 6×5=30) and continue counting the rectangles that are not on the "outer" parts, ie. on the walls of the big cube.
- In case of an incomplete answer, models like the images below are used.



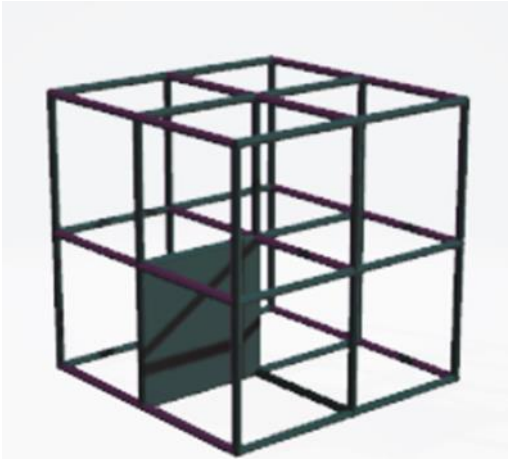
Answer: 33.

Task 3.3. Count the squares in the solid.



Help:

- The result of Task 2.1 can be used.
- After counting the figures, which are as in Task 2.1, it remains to calculate $9\times5=45$.
- 1×1 squares and 2×2 squares can be counted separately.
- Then $9\times4+9\times1=45$ should be calculated.
- Models like the images below are used where necessary.



Answer: 45.

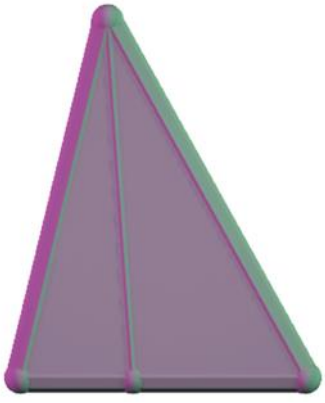
4. COUNTING TRIANGLES IN PLANE FIGURES

Task 4.1. Count the triangles in the figure.

Help:

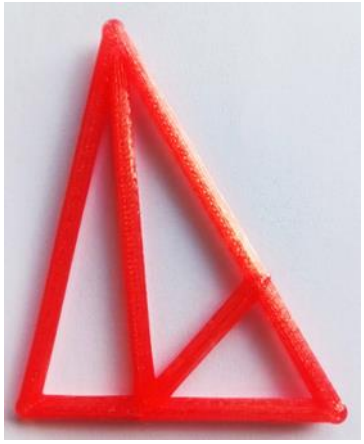
- If necessary, the description of the triangle figure is recalled, providing a 3D printed model.

- In case of an incomplete answer, the models with filled specific triangles are used.



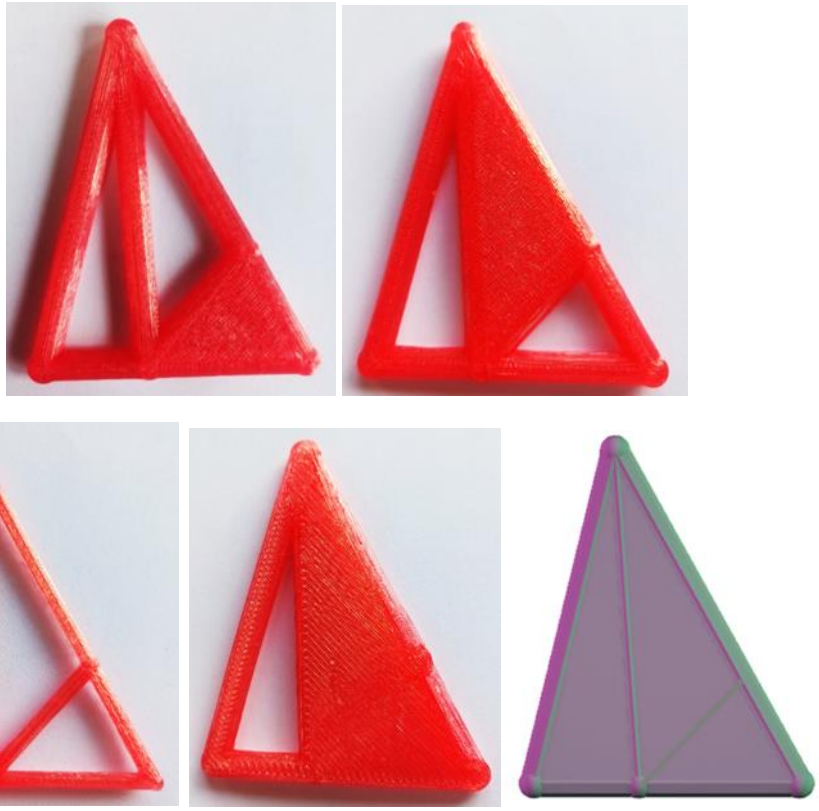
Answer: 3

Task 4.2. Count the triangles in the figure.



Help:

- Students should be directed to an analogous activity, such as when solving the previous task or to make a comparison and use the solution of Task 4.1.
- In case of an incomplete answer, the models with filled specific triangles are used. The triangle from the fourth pattern below, which is an amalgamation of two smaller triangles, is most often omitted.

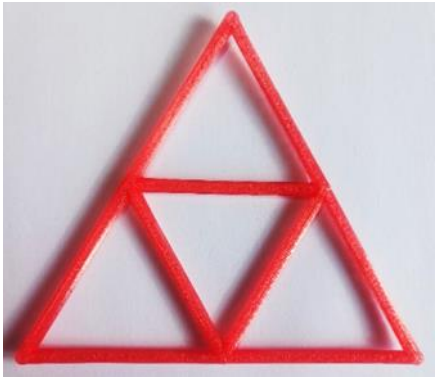


The solution of the previous Task 4.1 can also be used and add the number of triangles associated with the added segment, which is two.

Answer: 5.

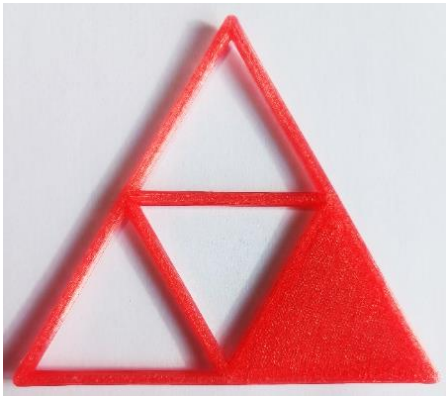
5. COUNTING OF EQUILATERAL TRIANGLES IN PLANE FIGURES

Task 5.1. Count the triangles in the figure.



Help:

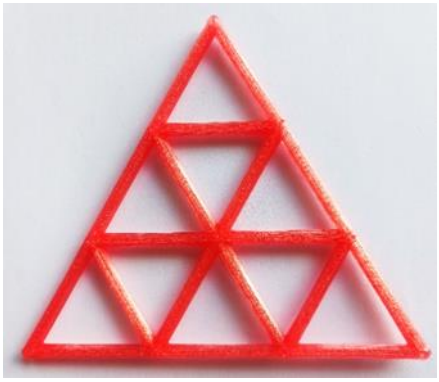
- In case of an incomplete answer, models with filled concrete triangles are used.



- It is appropriate to discuss that all triangles are equilateral and to refer to a systematic description of triangles. One way of describing it is: 4 equilateral triangles of side length 1 and one equilateral triangle of side length 2.

Answer: 5.

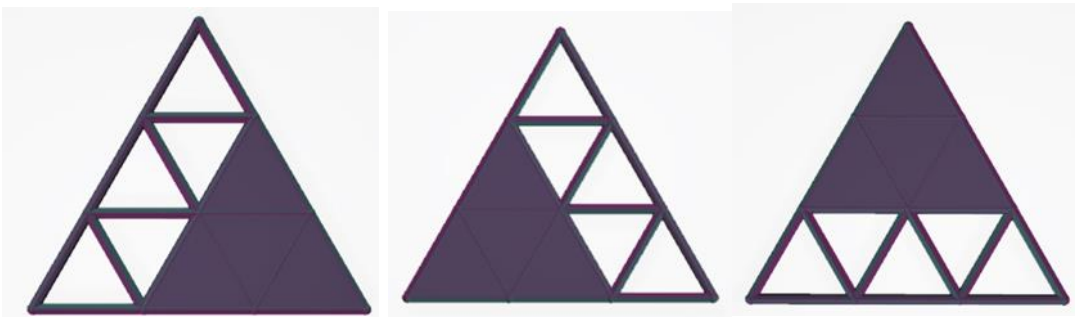
Task 5.2. Count the triangles in the figure.



Help:

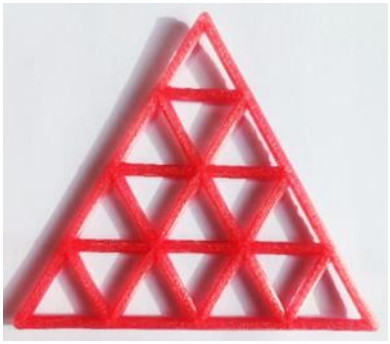
- Students should be directed to an analogous activity, as in solving the previous task.
- If necessary, the different sized triangles can be discussed first, then the counting done.

- In case of an incomplete answer, models with filled concrete triangles are used, or auxiliary models cut from cardboard are prepared.
- In this case, there are 9 equilateral triangles of side length 1, three equilateral triangles of side length 2, and one equilateral triangle of side length 3.



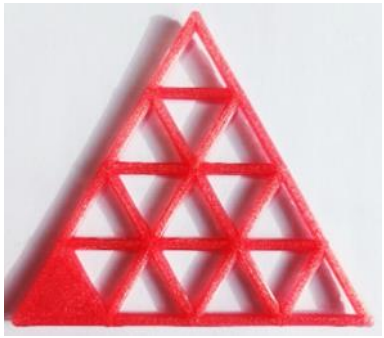
Answer: 13.

Task 5.3. Count the triangles in the figure.

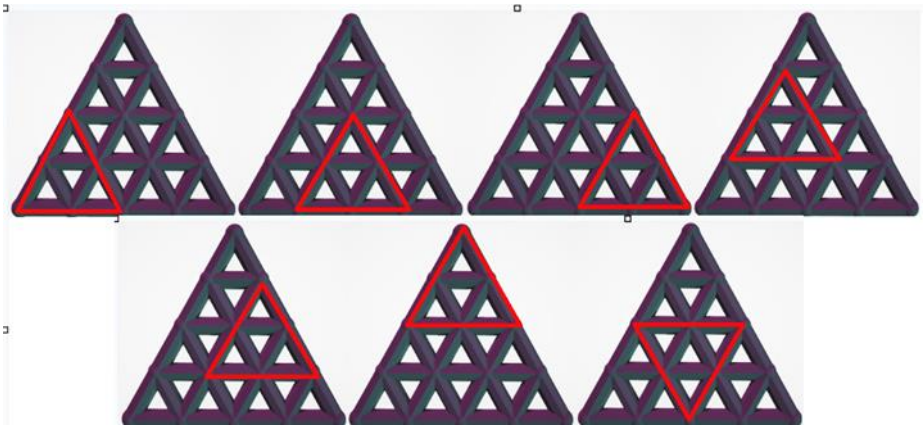


Help:

- Students should be directed to an analogous activity, as in solving the previous task.
- If necessary, the different sized triangles can be discussed first, then the counting done.
- In case of an incomplete answer, models with filled concrete triangles are used, or auxiliary models cut from cardboard are prepared.



- In this case, there are 16 equilateral triangles of side length 1, 7 equilateral triangles of side length 2, 3 equilateral triangles of side length 3, and one equilateral triangle of side length 4



Answer: 27.

6. COUNTING OF EQUILATERAL TRIANGLES IN SPATIAL BODIES

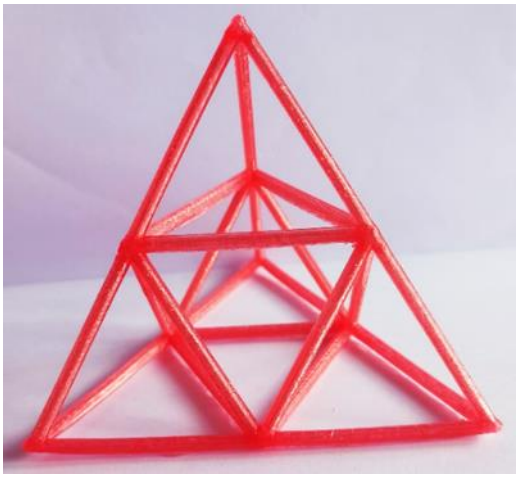
Task 6.1. Count the triangles in the composition.

Help:

- In case of an incomplete answer, models with filled concrete triangles are used, or auxiliary models cut from cardboard are prepared.

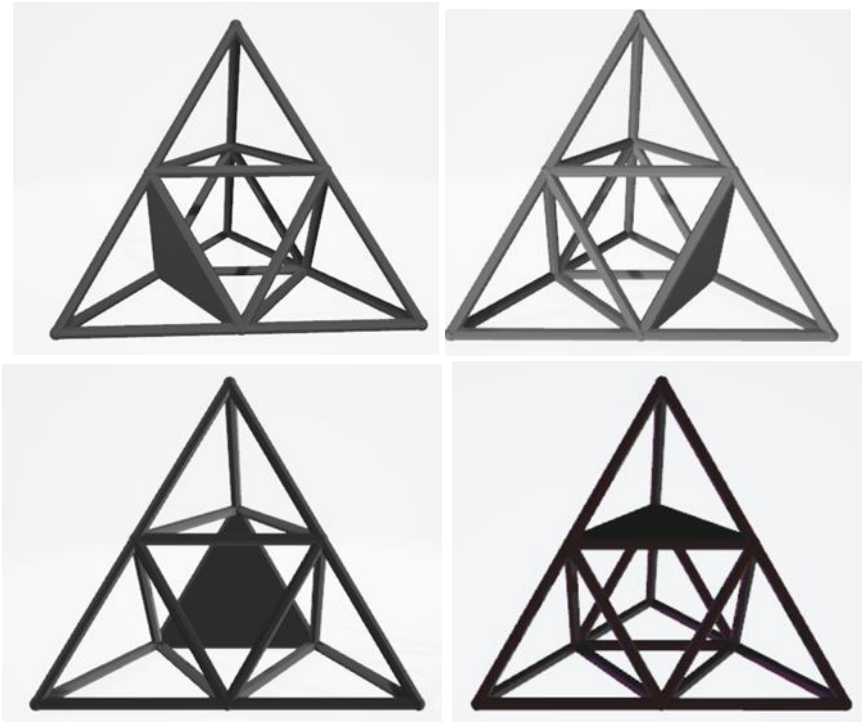
Answer: 4.

Task 6.2. Count the triangles in the composition.

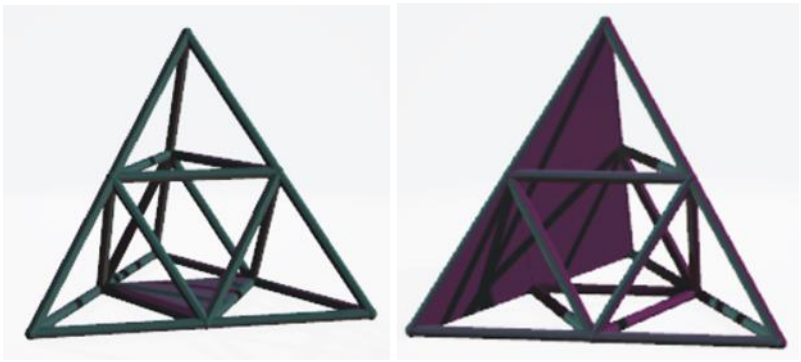


Help:

- It is appropriate for students to focus on rational calculus using the answer to Task 5.1. They must consider that each of the walls of the solid represents the figure from problem 5.1. To the 4×5=20 triangles (5 triangles on the four sides of the large tetrahedron) must be added the four "inner" triangles.



- Another option is to discuss the different size triangles and then do the counting.



- In case of an incomplete answer, models with filled concrete triangles are used, or auxiliary models cut from cardboard are prepared.

Answer: 24.