John Keats “Ode on a Grecian Urn” in Aesthetic Geometry with inversion

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“Beauty is truth, truth is beauty – that is all we know on earth, and all we need to know.” So the poet said and here we will interpret his words geometrically with algorithms, illustrations and theorems.

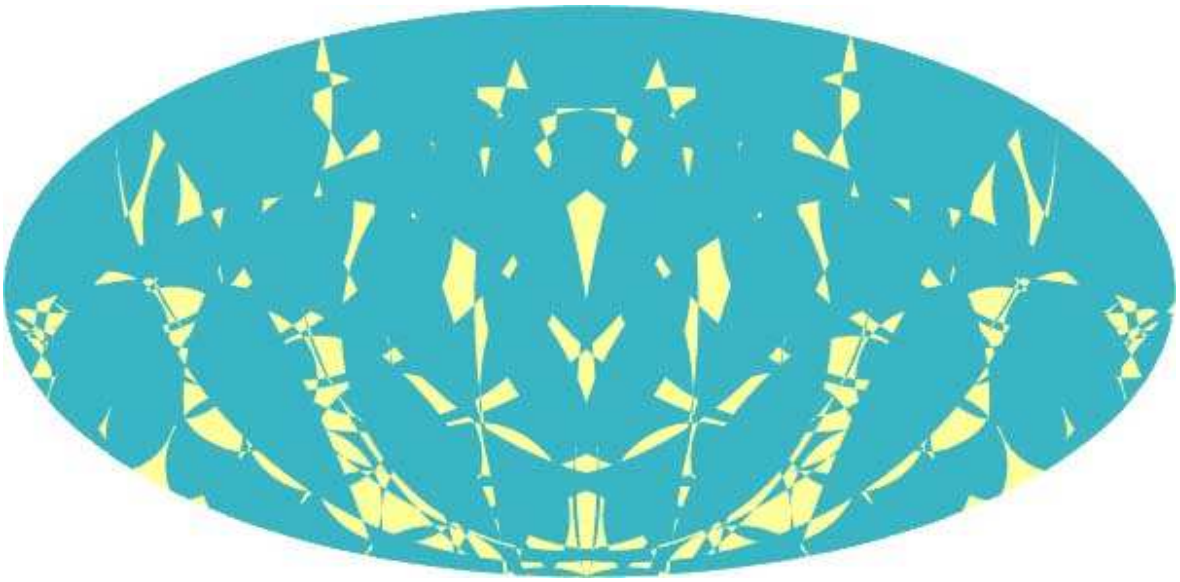
We offer your material that combines aesthetics, geometry, and topics of higher mathematics. We believe that this material can be used (and has been used) in work with children and students. What is aesthetic geometry and how we can use it for math and teaching math? It is a unified approach to geometry based on the symmetries of circles. We all know that a circle is the most symmetrical figure, but we also have symmetry about the circle, which we can define with simple and non-traditional methods that can lead to a variety of opportunities.

We'll start by introducing the aesthetic part, paintings, and video art, and then I'll explain the basics of geometry and pedagogical using.

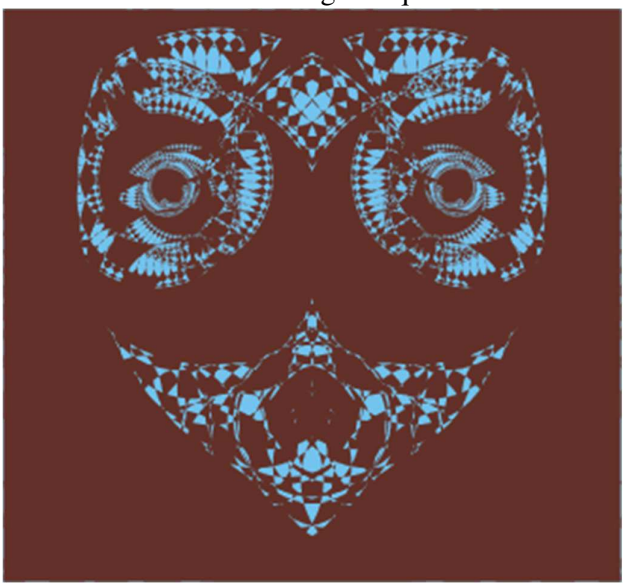
1. Paintings

All pictures in this section were made in a graphic editor CorelDraw. We used special macros that implement the geometry of the circles. We have countless images made in this way, we show the first three to explain the variety of emerging art forms, the picture 4 clarifies their geometric essence.

Picture 1 “Orchestra in the air”

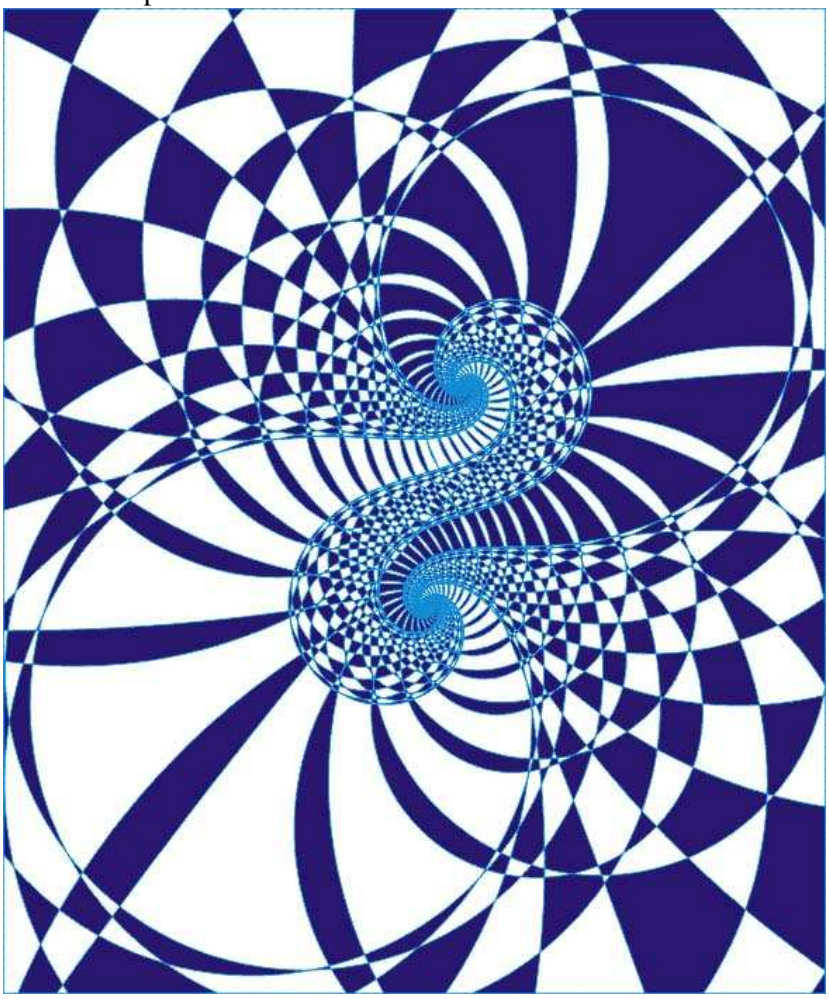


Picture 2 “The face of the grotesque”



Picture 3 “The bird of Galactic”

Picture 4 “spiral”

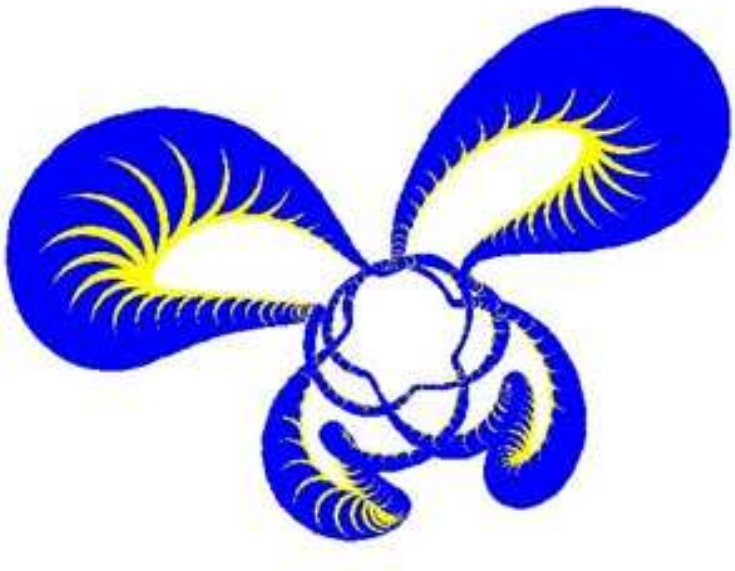


This unusual two-centred baroque spiral is obtained by the composition of inversions. From the parts of such spirals, the first three drawings are created. From a mathematical point of view, this spiral is an excellent introduction to group theory and illustrates the concept of a limit.

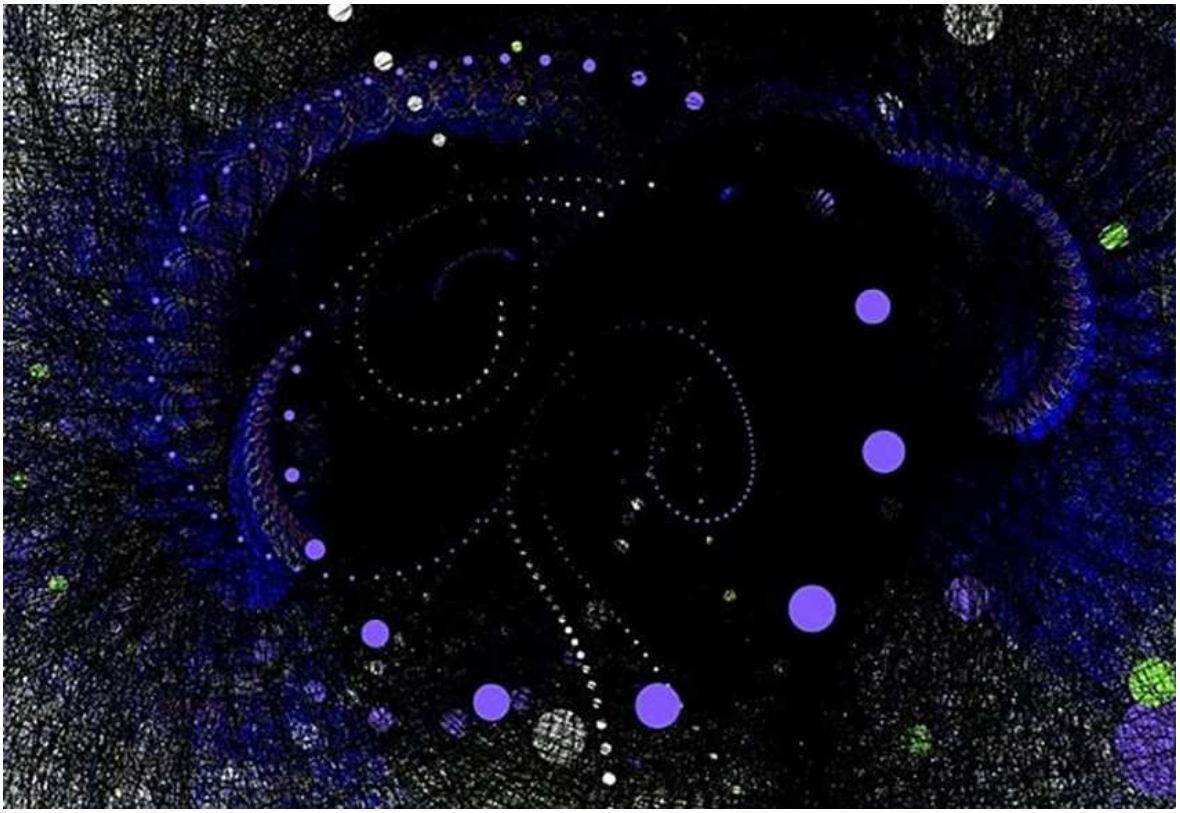
2. Video-art.

These are visual and endless visual sentences. The laws of inversion create an environment, each change of which is harmonious. In this environment we put objects, and they move without repeating and without ending, keeping harmony, time and rhythm is part of this harmony. We can modify pictures by changing colors and moving objects. It is similar to the movement in a force field. It’s an example of the intersection of aesthetic geometry with physics, which we can use to model moving planets in the Solar System. Here we give examples from freeze frames. You can download a program for viewing video art by reference in the last section.

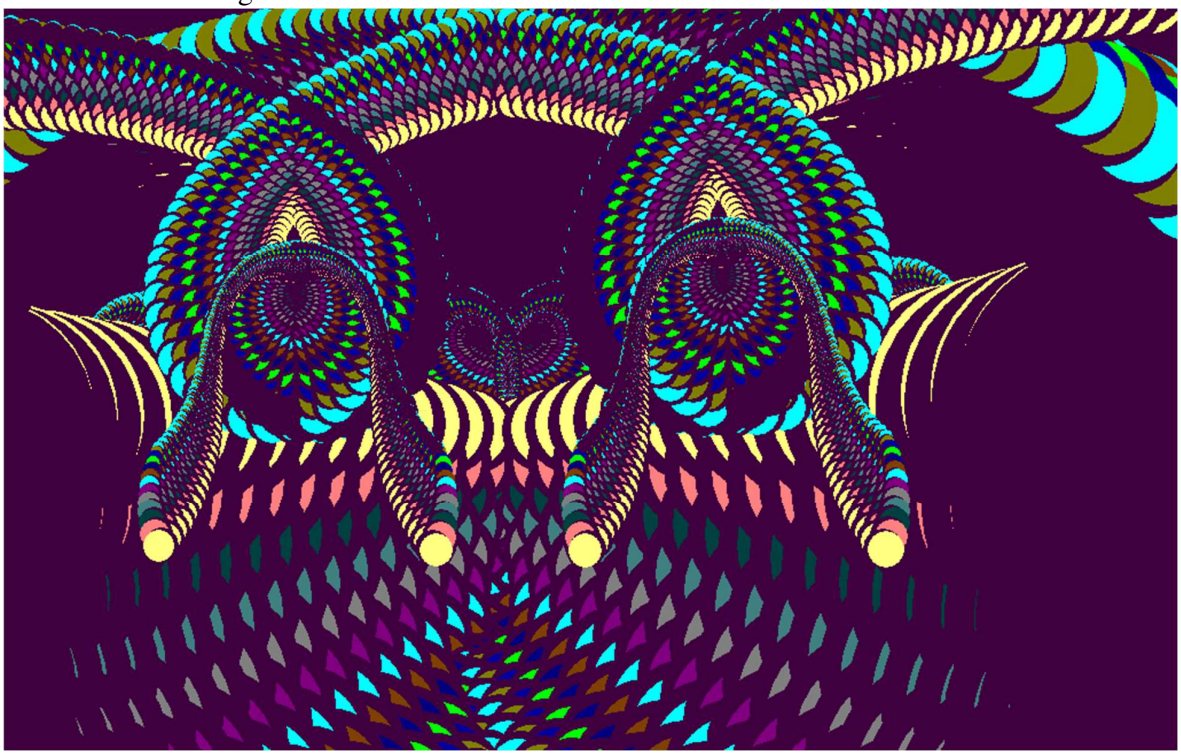
Picture 5 “Flying knot”



Picture 6 “Cosmos”



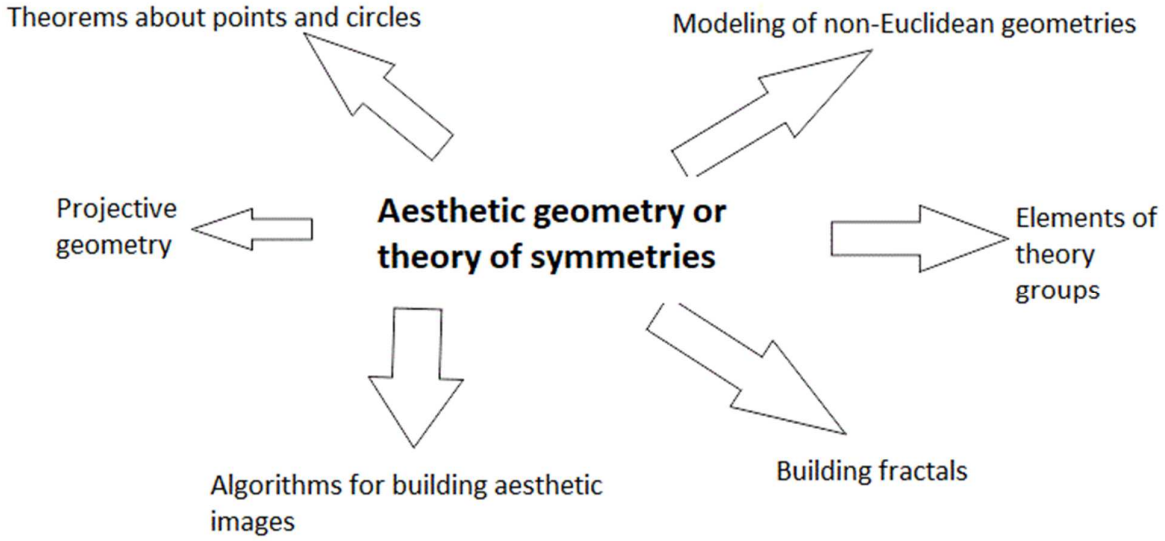
Picture 7 “Mourning”



3. Math

Here we show topics of mathematics that are convenient to study with inversion, or, as we say, with "Aesthetic Geometry".

Picture 8



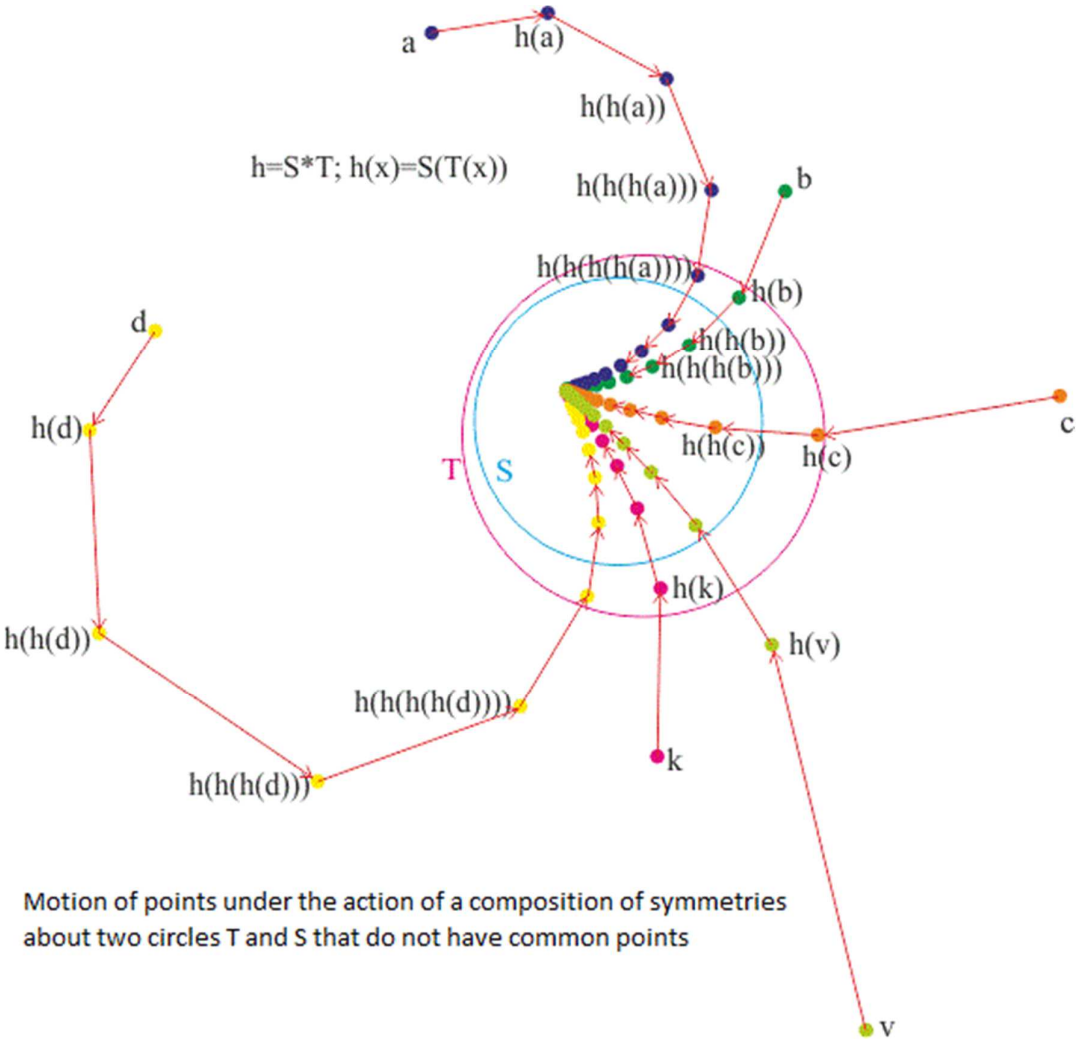
http://bogemnyipeterburg.net/revolt/matem/teachpictures/index.html

It is close to Friedrich Bachman’s book “*Building Geometry From the Mirror Concept*”. Symmetry considered there is symmetry about straight line, we consider symmetry about circles and it creates new amazing possibilities.

4. Pedagogical

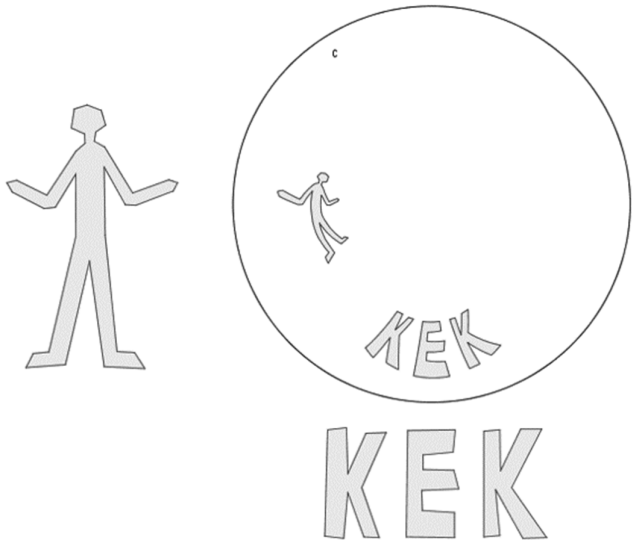
This example illustrates three math concepts: limit, action group on set, and composition of transformations. We can replace points by circles and create the beauty necklace, it turns a math lesson into an aesthetic lesson.

Picture 9



Motion of points under the action of a composition of symmetries about two circles T and S that do not have common points

Picture 10



Elements of aesthetic geometry were taught in the lessons and electives at the Alferov Physics and Technology Lyceum, S-Petersburg. This is the example of students' work: when schoolchildren first learned about inversion, they drew man and named him Kek (Кек). It was a good and clever play for them. We also know about 4-year work program of school №96 "Eureka Development" in Rostov-on-Don about this subject.

5. Interdisciplinarity

In the past, we have talked and shown how aesthetic geometry turns math lessons into design or drawing lessons. Now we will talk about the amazing and fascinating connection between aesthetic geometry and biology. When we create spirals like Figure 5, we often see zoomorphic forms, for example Figure 4. If we start playing with pieces of these spirals, both anthropomorphic forms and forms reminiscent of ancient art appear. Anthropomorphic forms also arise during the work of video art. We cannot predict when and how they arise, but they do. This, we believe, suggests that biologists may also benefit from an introduction to aesthetic geometry. Perhaps this will shed new light on morphogenesis. Here we are talking not only about pedagogical activity, but also about research work.

As an example, we will show a drawing of Cheburashka, a character from a popular cartoon, which emerged from spirals. We think that the biological component of aesthetic geometry is noticeable in other drawings as well.

Picture 11. Cheburashka

6. References

Elected publications about Aesthetic Geometry

1. "Aesthetic Geometry or Symmetry Theory," 2014, St. Petersburg, School League, 288 pages.
2. "Mappings of Sphere and non-Euclidean geometries," Mathematical Education, Series 3, Issue 3, Moscow, 1999. pp. 158-166.
3. "Triple Symmetry of fractal kaleidoscope," Mathematical Education, series 3, issue 20, Moscow, 2016 pp. 57-110
4. «The Law of the Flower», Computer Tools in Education, No. 5, 2006, pp. 61-69.
5. Tangent of four circles (N7 / 2015) Teaching and methodological journal. "Mathematics" (First September). Moscow.
6. Computer Laboratory of Planimetric Transformations at the Lyceum of the Academic University. St. Petersburg, materials of the scientific conference "Herzen Readings - 2018", pp. 202-207
7. About the course “Aesthetic Geometry” and the role of symmetry about the circle in teaching mathematics, Vestnik SSU Ser. 1 Issue 1 (19). 2014, p. 12-2424.
8. Modelling aesthetic geometry: video art and the planetary system in 14 illustrations, «The land of knowledge» (Країна знань), Kiev №6, 2020

Internet resources

1. Artistic and popular science YouTube channel about aesthetic geometry "Revolt Pimenov and his trained newts" Tritons (children work).
2. Aesthetic Geometry Lessons Playlist
3. Playlist "learning Dodek programs"
4. Program for android "Dodeca: meditation"
5. Windows program DodecaLook
6. Aesthetic Geometry Website
7. Instagram https://www.instagram.com/tritons_life/
8. Tik-Tok https://www.tiktok.com/@sonya_merrychristmas
9. About me