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GOSTEAM Hands-on Activity Template *(Classroom-Formal)*

Title:

mirror anamorphosis

Short Description (Max 500 words):

Learning about optics (f.e. law of reflection) and image space with the help of anamorphic art and its connection to art history. When you place a cylindrical mirror onto an anamorphed painting the "real" picture reveals.

Keywords (Up to 5):

optic, mirror, anamorphosis, painting, art

Information about the Implementation

Age and language of the students: 9-12 12-15 15-18 18+

Language: German Age: ☐ ☐ ■ ☐

Number of Lessons – Duration (per lesson):

Number of Lessons: 2,5 Duration per Lesson: 2 H

Subjects:

For which subject(s) the activity is usable, is it an interdisciplinary activity?

Science ☐

Physics ■ Chemistry ☐ Biology ☐ Geosciences ☐ Environmental ☐ Other ☐

Technology ☐

Engineering ☐

Arts ■

Mathematics ☐

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Information about the Scenario

Curriculum and country:

Link of the current activity to the curriculum:

Country: Austria | Class: AHS | Grade: 10 to 12

Topic: anamorphic painting, optical illusion, art history

Objectives (Max 100 words):

Description of the learning objectives

spatial awareness, optical illusion, creating an anamorphic painting, spatial relations

Materials (Max 100 words):

Which resources and materials (software, hardware) are needed?

convex mirror, paper, pencil, worksheet, examples, ruler, compass

Spatial concepts, skills and abilities:

Which spatial concepts and skills are covered by the activity?

Spatial concepts:

Primitives: Identity/Name ☐ Location ■ Space/Time ☐

Simple: Distance ■ Direction ■ Connectivity ☐ Movement ☐

Boundary ☐ Shape/Area ■ Adjacency ☐

Difficult: Overlay ☐ Buffer ☐ Topology ☐ Coordinate ☐

Map ■ Scale ☐ Shortest Path ■ Navigation ☐

Surface ■ Slope/Gradient ☐ Aspect ☐ Contour ☐

Complex: Interpolation ☐ Map Projection ■ Spatial Dependency ☐

Other:

Spatial skills:

- ☐ Map literacy
- ☐ Navigation/orientation
- ☐ Estimating distances and directions
- ☐ Recognizing and understanding patterns/Understand and identify models of spatial organization
- ☐ Select an ideal location based on the given spatial features
- ☐ Visualization
- ■ Understand and identify spatial correlations/ dependencies
- ☐ Categorize spatial entities/ geographic features and identify hierarchies
- ☐ Compare spatial entities and draw analogies among them
- ☐ Identify/determine connections/relations
- ☐ Understanding scale in space and time
- ☐ Delineation of spatial regions/ zones based on given features/ properties

Short Description

Navigation/orientation: Finding one's way in unfamiliar environments, interpreting and giving walking and driving directions.
Estimating distances and directions: Measure paths, weighted distances, angles.
Map literacy: Using, interpreting/understanding, learning from, and communicating acquired spatial knowledge from maps, comprehension of geographic features represented as points, lines, or polygons.
Recognizing and understanding patterns/Understand and identify models of spatial organization. Delineation of spatial regions/zones based on given features/properties: Regionalization processes, pattern recognition and clustering identification in the 2d and/or the 3d world.
Select an ideal location based on the given spatial features: Single or multi-criteria siting and optimal areas identification.
Visualization: Visualizing spatial entities from written/oral verbal descriptions, from their 2d or graphical representations or through mental transformations; such as axis rotation or perspective taking.
Understand and identify spatial correlations/ dependencies: The ability to realize, identify and explain patterns, clusters and relevant spatial dependencies.
Categorize spatial entities/geographic features and identify hierarchies: Identify the hierarchical form of data and gradients between spatial entities.
Compare spatial entities and draw analogies among them: Calculate and compare different geometric objects' shapes, area and, boundaries.
Identify/determine connections/relations: The ability to identify links and common characteristics among spatial entities and between humans and spatial entities.
Understanding scale in space and time: The understanding of changes/transitions through space and time for different spatio-temporal scales.

Geospatial concepts and spatial abilities documentation (see Section 3.2):
http://www.gosteam.eu/wp-content/uploads/2021/05/GOSTEAM_IO1_A1_final.pdf

Description of the activity in detail

Classroom activities

Illustrative example

This activity starts with an example of real anamorphosis. The students receive an illustration and a curved mirror to test and experience the optical illusions themselves beforehand. Afterwards a brief discussion about optics will take place.

Excursion into Optics

With the law of reflection - or more precise Snell's Law - we know that when light reflects off a surface, it bounces off at the same angle it entered. [1]
Plain Mirrors create distortion-free images with a scale of 1:1, whereas spherical mirrors produce distorted images. This distortion is directly inherited from the curvature of the mirror itself, as a result pieces of the image are sent off in different directions.[2] As a reverse conclusion a distorted object will be portraited corrected on the surface of the mirror.
With the help of this fact anamorphic pictures can be created. So if drawn correctly on a cylindrical grid, a hidden illusion can be created, which only will be revealed using a cylindrical mirror.[3]

Art History Input

Since prehistoric times art plays with the spatial perception of the viewer. At its peak in renaissance dozen artists used a variety of methods to portray perspective in different ways. One of the most famous artworks is "The Ambassadors ", by Hans Holbein painted in 1533. Therefor this artwork must be analysed during this activity and the famous anamorphic skull will be discussed. This the connection between theory, physics, art history and real world of the students. This artwork offers a wide frame for interpretation and can be used to learn how to analyse artworks correctly.

Artistic and practical working phase

To start off easy, the students get a printed worksheet with a distorted drawing grid and a square grid on it. Both grids must have the same number of squares, which are labelled in the same way, so that later on the reference art can be transferred. Alternatively, the students can also draw their own grids with the help of a compass and a ruler. If so, concentric circles have to be drawn around the mirror, radial lines going outwards from the centre for the distorted grid and straight squares for the second grid have to be be added. Exact measurements depend on the scale of the mirror.
The main task now is to draw the reference art onto the straight grid and to transfer this drawing on the distorted grid. In this procedure the "grid transfer method" will be used, this means transferring the original artwork a distorted way in the corresponding squares. Always check the process in between by putting the mirror in the centre. After finishing the sketch, it will be outlined with a marker.[4]

Online activities

This activity can be held online in almost exactly the same way, but a cylindrical mirror must be provided by the teacher. A pre-shot video, which shows how to draw an illusion, or an online live broadcast are needed. A graphic software, like "https://www.anamorphosis.com/" can also be used to distort images online.

Sustainable contact:

Name & email Rauscher Jessica

References (if any):

1 Demtröder Wolfgang, Experimentalphysik2, 6.Auflage (Berlin 2013) S. 265ff

2 Demtröder Wolfgang, Experimentalphysik2, 6.Auflage (Berlin 2013) S. 233ff

3 https://www.instructables.com/Cylindrical-Mirror-Art/

4 https://www.instructables.com/Cylindrical-Mirror-Art/

Assessment (if any):