BRITISH COUNCIL

Science in schools: **Anamorphic Art**

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This unit provides opportunities for your students to learn about anamorphosis and discover how artists have used this technique in the past and continue to do so today. In doing so, they can examine links between Mathematics and Art and enhance their understanding of geometry and perspective.

Preparation needed

You will need:

- Examples of anamorphic pictures
- Worksheets
- Plain and squared paper
- Pencil, ruler, eraser, internet access

You will need to:

- Source examples of anamorphic pictures
- Photocopy the worksheets

Age range: 12-16

Science: Biology

Curriculum Links: Mathematics, Art and design

Objectives:

- To provide opportunities for students to learn about perspective and anamorphic pictures
- To use mathematics to transform a simple shape so that it needs to be viewed correctly from a particular angle and height
- To learn, revise or consolidate geometrical ideas, data handling and graphs

Skills and attributes: Critical thinking, communicating, collaborating

Learning Focus: Geometry and perspective, data tables, graph drawing, mathematical and art vocabulary

Language Functions: Naming, asking and answering questions, discussing

Vocabulary

- Anamorphic art, anamorphosis, straight lines, parallel lines, square grid, transformed grid, trapezium, shallow angle, similar triangles, perspective, vanishing point, 2-dimensions, 3-dimensions.

Background Information

Anamorphosis is a form of perspective that was developed during the Renaissance and is a technique that can be used to transform images. Your pupils are likely to be familiar with modern examples of this in the form of the advertising logos that are used on many sports pitches. These are created as flat images on the field of play, but appear to 'stand up' when viewed from a high camera position.

Anamorphosis is also used to distort an image so that it only appears in its natural form under certain conditions, such as when viewed from an angle or reflected in a curved mirror. A famous example of this technique can be seen in Hans Holbein's painting *The Ambassadors,* which can be seen in the National Gallery in London. In the foreground of the painting, Holbein has cleverly painted a distorted image of a skull. This can only be seen clearly when viewed from a point to the right of the picture.

Activities and teaching notes

Introduction

Show your students some different examples of anamorphosis including logos on a sports pitch that 'appear' to be standing up and a copy of the painting *The Ambassadors* by Hans Holbein the Younger painted in 1533 which can be found on **Worksheet 1**.

Activity 1

Ask your students to examine the painting closely and discuss the questions on the sheet in small groups before reporting their thoughts and ideas back to the rest of the class.

Worksheet 1: The Ambassadors by Hans Holbein the Younger

Reproduced with kind permission of the National Gallery London

Things to think about and discuss:

- Describe what you can see in the painting to a partner.
- Who do you think the men in the portrait might be?
- When do you think it was painted? Give your reasons.
- Make a list of all the different objects in the picture? Why do you think the artist has included these particular items?
- Examine the curious object in the foreground? What do you think it is and why has the artist included it in the painting?
- What title would you give this painting?

There are a number of mathematical and scientific objects in the painting including books – one of which is a half-open book of arithmetic, two globes – terrestrial and celestial, a pair of dividers, sundials and a quadrant as well as musical instruments – a lute and flutes. These objects infer that the men in the portrait, Jean de Dinteville - the French Ambassador on the left and his friend Georges de Selves on the right are well travelled, educated and interested in music.

Explain that the interesting object at the bottom of the painting is a human skull. Holbein has used the technique of anamorphosis to distort it, so it can only be seen clearly when viewed from the correct angle, looking down from the right-hand side. Discuss why the painter might have chosen to use this particular image and technique in the portrait.

You could also show examples of other anamorphic paintings such as William Scrots' picture of Edward VI, which is in The National Portrait Gallery in London. When seen from the front it appears as a strange elongated face with a very pointy nose but when seen from the right hand side it is in correct perspective. Discuss why the artist might have painted Prince Edward's portrait in this way?

It is thought that the technique was designed to display the skill of the painter and impress the viewer but might also have been produced as an amusing plaything for the young Prince who was only nine when it was painted.

King Edward V1 attributed to William Scrotts 1536. Reproduced with kind permission of The National Portrait Gallery, London

Activity 2: Create an anamorphic picture

To draw an anamorphic view of a picture, explain that firstly you need to cover the picture with a grid of squares and then develop suitable mathematical equations to allow the picture to be transformed into the distorted form.

Suppose that our picture is divided into a square grid with coordinates x and y. as shown in figure 1.

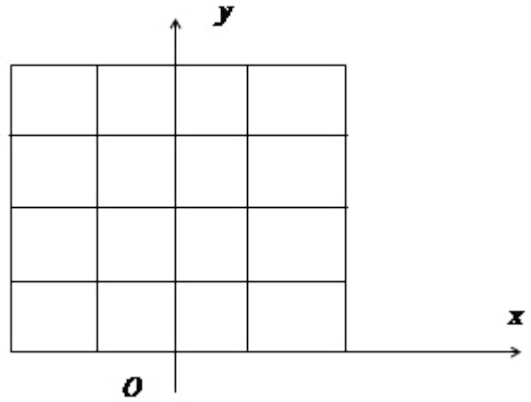


Figure 1. Picture area with square grid.

Firstly we draw an anamorphic grid which when viewed from a distance d away from O and height h above the paper is as shown in figure 2.

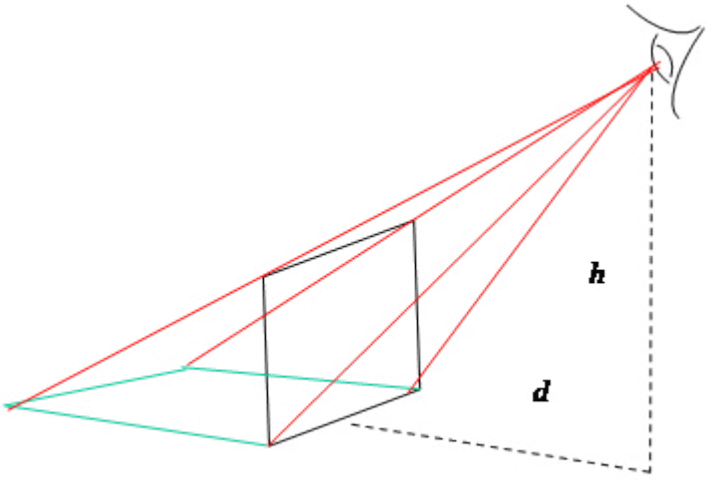


Figure 2. View from distance d and height h.

In figure 3 we see how the point A in the picture is transformed to the point B.

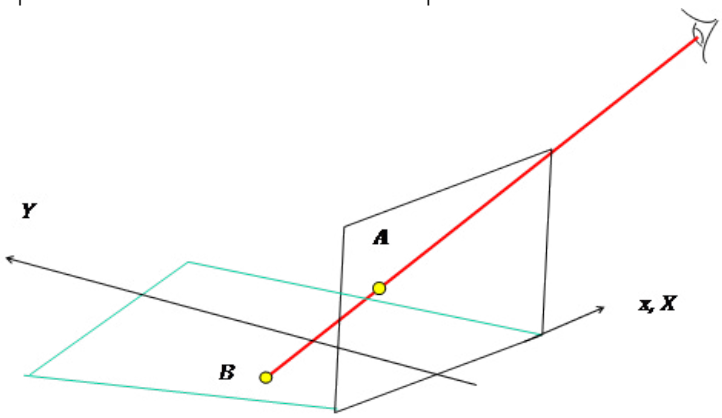


Figure 3. The point A is transformed to the point B.

The transformed grid has coordinates X and Y as shown in figure 4.

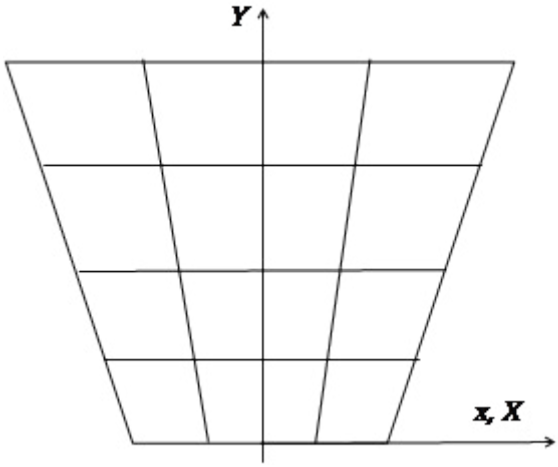


Figure 4. Transformed grid from figure 6.

To find the relationships between (X, Y) and (x, y) we consider the views in figures 5 and 6.

Build an anamorphic grid: A simple square

Ask your students to work in pairs using the activity sheet below to complete a simple square. The data tables are partially completed to help them understand the transformation. It may be helpful to pair learners with strong mathematical skills to work with students who may find this activity more challenging.

To build the anamorphic grid

We have a square of side 2cm as shown in figure 1.

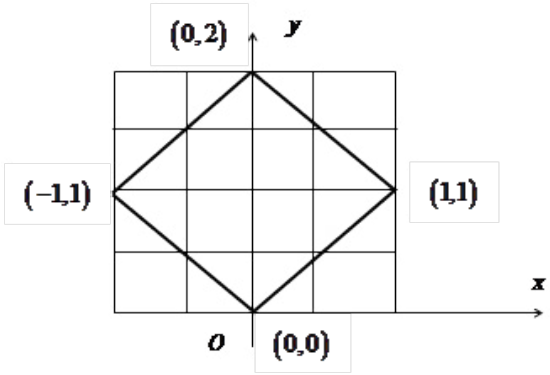


Figure 1. Square of side 2cm.

We shall view the square from a distance of 15cm and a height of 5cm. i.e. *d=15* and *h=5* in our equations:

$$Y = \frac{yd}{h-y} \quad (1)$$

and

$$X = \frac{x(d+Y)}{d} \quad (2)$$

- Substitute the values in equations (1) and (2) then complete table 1.

Table 1. Data for the square in example 1.

x	−1	1	1	−1
y	0	0	2	2
Y	0	0		
X	−1			

Now draw the anamorphic view from the values in the table 1.

The transformed grid has coordinates X and Y as shown in figure 2.

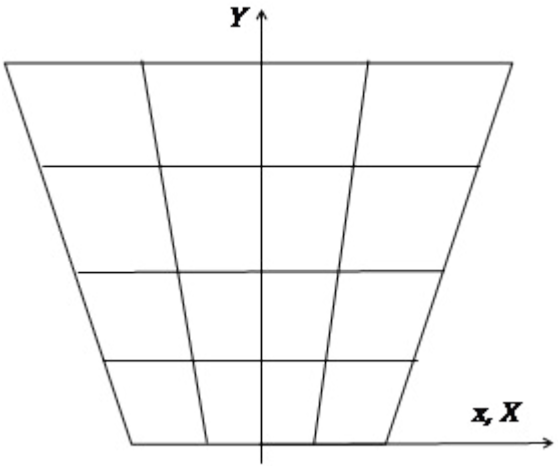
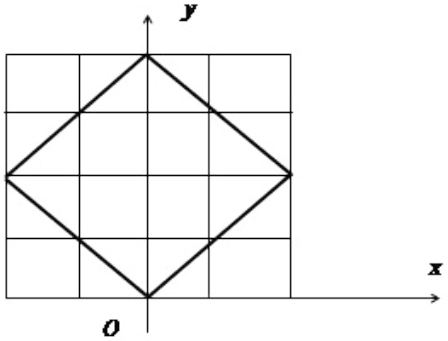


Figure 2. Transformed grid from figure 1.

To draw the anamorphic picture:

We now have the 'frame' for a picture drawn in the square. We shall transform the very simple picture of a square shown in figure 13.

Figure 3. Simple square picture.



Complete table 2 and draw, in your transformed frame, the anamorphic picture of the square.

Table 2. Data for the picture square.

x	−1	0	1	0
y	1	0	2	2
Y	3.75	0	3.75	
X	−1.25	0		

Now view the picture. Look again from a distance of 15cm and a height of 5cm. Describe what you see.

Activity 3 Build an anamorphic grid: A star

Once your pupils have mastered the square, challenge them to build the anamorphic grid to create a star.

- Build the anamorphic grid as before.
- Draw your star in the square grid.
- Complete a new data table for the star and transfer the data to the transformed grid.
- View the anamorphic picture. Check the view again from the right height and distance and describe what you see.

For hundreds of years, artists have been interested in perspective and the tricks that can be played with it.

Show your students a copy of William Hogarth's engraving *Satire on False Perspective.*

The work shows a scene with many deliberate examples of misplaced and impossible perspective effects such as the sign is attached to two buildings.

Additional activities

Your students could also:

- Try and spot as many examples of 'wrong' or impossible effects as they can in the engraving
- Work together to create a large anamorphic mural on a plain wall, using direct (two-dimensional) anamorphosis
- Carry out further research into traditional and contemporary artists such as Jonty Hurwotz who use these techniques in their artwork.

Find out more

Additional information can be found at:

- http://www.nationalgallery.org.uk/paintings/hans-holbein-the-younger-the-ambassadors This site has additional information about The Ambassadors by Hans Holbein

Watch a short informative film about The Ambassadors at:

- https://www.khanacademy.org/humanities/renaissance-reformation/northern/holbein/v/hans-holbein-the-younger-the-ambassadors-1533
- https://en.wikipedia.org/wiki/Satire_on_False_Perspective - Images and information on Satire on False Perspective by Hogarth
- https://www.royalcollection.org.uk/collection/405346/a-lady-at-the virginal-with-a-gentleman-the-music-lesson - Information on this painting and perspective by Vermeer
- http://bibliodyssey.blogspot.co.uk/2012/08/curious-perspectives.html
- Information on the portrait of Edward VI at the National Portrait Gallery can be found at: http://www.npg.org.uk/collections/search/portrait/mw02032/King-Edward-VI#description

Partner School Activities

If you are working with a partner school you could:

- Exchange examples of art and artists from different cultures and time periods who have used anamorphic techniques
- Swap photographs of completed pictures with your partner schools, along with the information of correct viewing location.
- This could be further extended as a cryptographic exchange of information, whereby the image is not included, but co-ordinates to be plotted on the grid and then joined up with the viewing location information