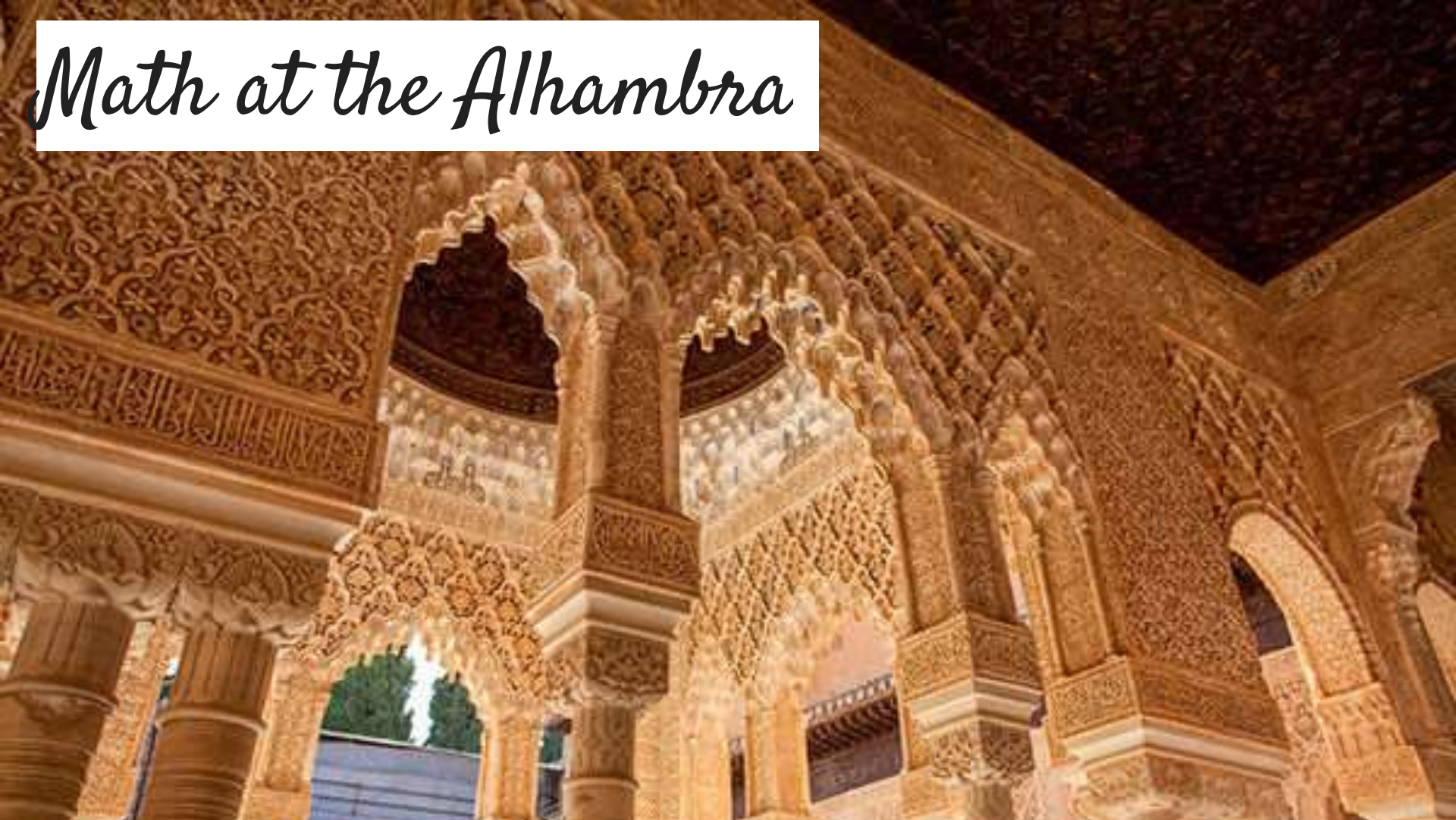


# *Math at the Alhambra*



# *The Alhambra*

Has anyone ever visited the Alhambra?

Can you describe it to me?

What about the Alhambra seems to make it special and interesting?

Why do you think people continue to be so interested in the Alhambra today?

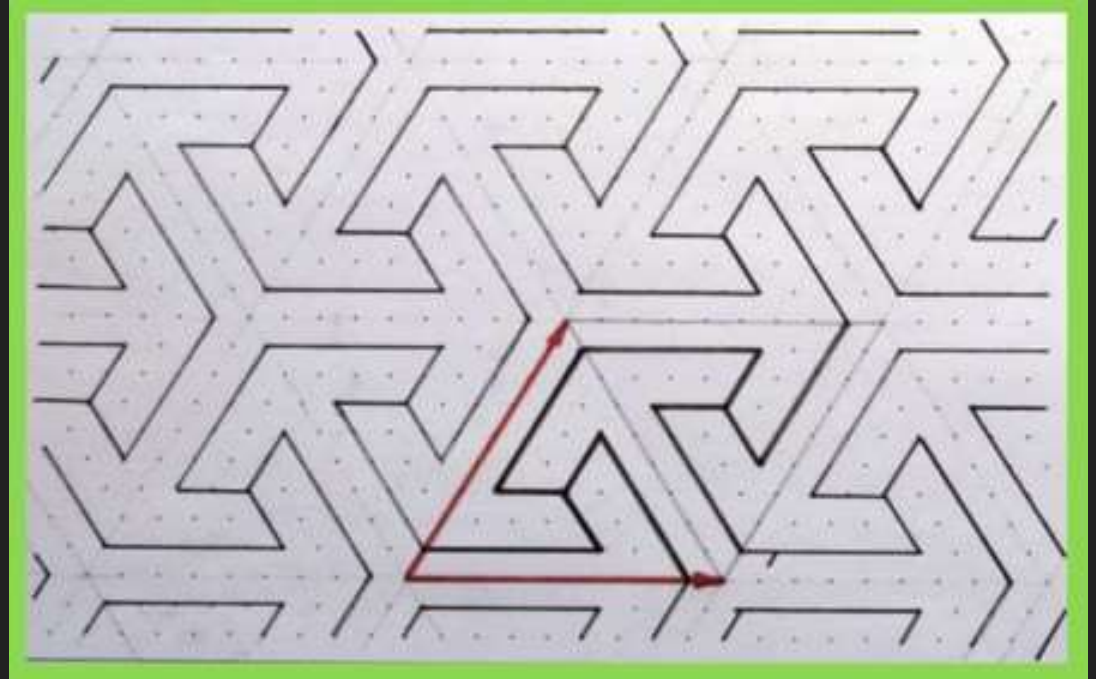
Does anyone have any ideas on what the relationship between the Alhambra and math could be? Is there a relationship between math and the Alhambra?

[https://www.youtube.com/watch?v=SwB7oCY\\_9LA](https://www.youtube.com/watch?v=SwB7oCY_9LA)

<https://edu.glogster.com/glog/geometry-of-the-alhambra/1v0k71m9lkx>

## *The Use of Trigonometry*

Islamic scholars used trigonometry most often to calculate distance for travel, however, they also used trigonometry to create the spectacular designs that decorate the Alhambra.





## *Why did the Muslims only use patterns?*



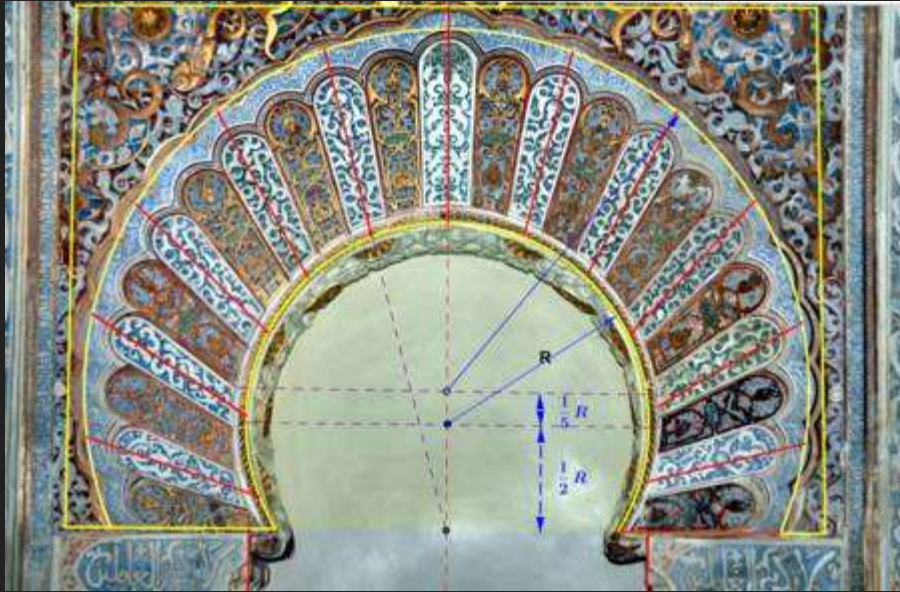
In the Islamic faith, the depiction of animals and people is forbidden as Muslims believe that such depictions can lead to idolatry. Therefore, complex and intricate tile patterns were instead used to adorn the palace.

## *An Enduring Interest*

Both mathematicians and artists throughout the centuries have been intrigued by these repetitive designs that are meant to symbolize the uniqueness of God. The repetitive mosaic image is also meant to represent infinity, denoting the notion that God is everywhere.



# *Math and Art Combined*



Both a knowledge of geometry and the laws of trigonometry are needed to create the tiles that make up the patterns and designs of the palace. The Alhambra is a well-known example of the important relationship between math and art.



# *The Royal Alcazar in Seville*

Just as at the Alhambra, the Royal Alcazar in Seville is an important historical example of these Islamic designs and patterns that utilize geometry and trigonometry to create the amazing symmetry we see all throughout the structure.

The Alcazar is in a Mudéjar style, meaning that it was built in an Islamic decorative style by Moors who remained in the Iberian Peninsula following the Christian reconquest of Seville.





## *Differences Between the Alcazar and the Alhambra*

In the Alcazar, there are various Christian and Spanish images, denoting that the art is Mudéjar rather than Islamic. The Islamic faith forbids the use of images and depictions in artwork.



# The Mosaics of the Alhambra

The mosaics in the Alhambra demonstrate the 4 types of rigid motion in symmetry.

1. *Translation* -- Slide the pattern for some distance along a straight line.
2. *Rotation* -- Leave one point in the same place, and rotate the pattern through some angle about that point.
3. *Reflection* -- Flip the pattern over. A reflection leaves some line in the same place. Everything on either side of that line is reflected through the line to the opposite side, as if in a mirror.
4. *Glide Reflection* -- This is just translation along some line, followed by a reflection through that line.



Translation Symmetry  
along a Horizontal Line



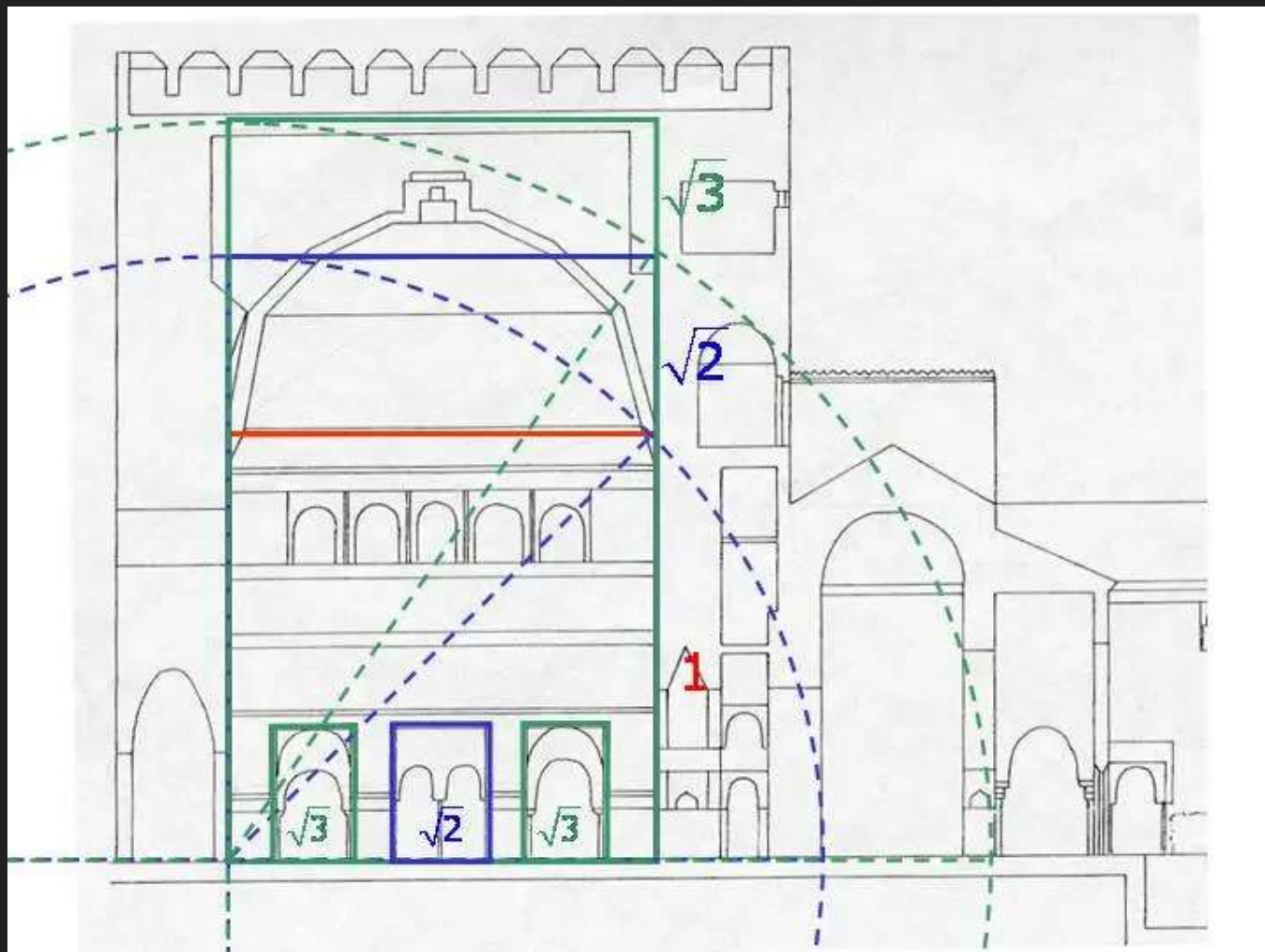
Reflection Symmetry  
about a Vertical Line



Rotation Symmetry  
of 60 degrees



Glide Reflection Symmetry  
along a Horizontal Line



# Vocabulary

**Trigonometry:** The branch of mathematics dealing with the relations of the sides and angles of triangles and with the relevant functions of any angles.

**Mosaic:** A picture or pattern produced by arranging together small pieces of stone, tile, glass, etc.

**Pattern:** A repeated decorative design.

**Geometry:** The branch of mathematics concerned with the properties and relations of points, lines, surfaces, solids, and higher dimensional analogues.

**Symmetry:** The quality of being made up of exactly similar parts facing each other or around an axis.