

## Hong Kong Space Museum (East Wing)

### Introduction

"This dome has got to be a hemisphere!" my friend protested the other day. "No! It's actually egg-shaped," I said, showing her the photo on the right. Criss-crossed with fine lines on its surface, the "Pineapple Bun" in Tsim Sha Tsui has overlooked Victoria Harbour for three decades. The building was the avant-garde in the city when it opened in 1980, but the maths behind this bizarre piece of architecture has been obscure.

### Description

The most defining feature of the East Wing is its **curious egg shape**, and in fact, this building has a hemispherical "egg yoke" called the [Stanley Ho Space Theatre](#)

[http://www.lcsd.gov.hk/CE/Museum/Space/Museum/VirtualTour/e\\_virtualtour.htm](http://www.lcsd.gov.hk/CE/Museum/Space/Museum/VirtualTour/e_virtualtour.htm). What an enormous egg - well, half a big egg!

This "egg" in Hong Kong caught the attention of locals and tourists, and investigation into the egg shape posed some questions:

- How can the egg shape be represented mathematically?
- What properties do egg-shaped structures have, with relation to this building?

And finally, as in analyzing any piece of architecture,

- why is the building represented by this shape?

Let's begin with the parent of the egg shape: the oval.

### The oval

Though the term "oval" is not defined mathematically, ovals in general include many smooth, single-loop curves which resemble ellipses, including the egg curve. You can construct an oval in many different ways, though one common way is to use a string and three nails forming an isosceles triangle:

[1][3]



[http://www.mathsinthecity.com/sites/www.mathsinthecity.com/files/CIMG1512\\_2.JPG](http://www.mathsinthecity.com/sites/www.mathsinthecity.com/files/CIMG1512_2.JPG)



Hong Kong Space Museum, 10 Salisbury Road, Kowloon, Hong Kong.

**Viewpoint:** From the east. The photo was taken near the YMCA.

**Author:** ChloeJennifer

**Concepts:**

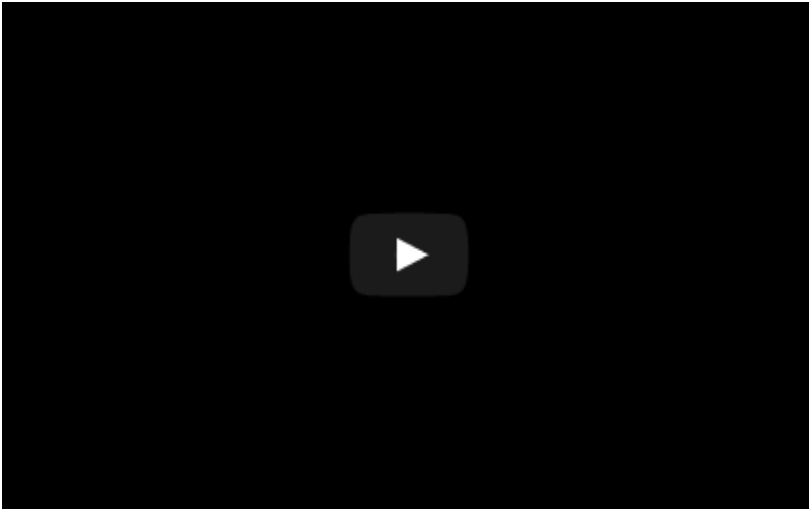


**Themes:**

**Last updated:** 05/06/2011 - 08:58

**Access information**

**Wheelchair/buggy accessible:**  
Yes



The oval has a long history in architecture. The earliest oval-form architecture was found in Asia Minor in about 4,000 B.C., and oval structures were found in Gothic and Renaissance architecture. [2]

## The egg

The egg shape is an oval with only one axis of symmetry, but egg curves can be described by various equations.

Here is a simple egg equation:

$$\frac{x^2}{a^2} + \frac{y^2}{b^2} t(x) = 1$$

It differs slightly from the equation of an ellipse,  $\frac{x^2}{a^2} + \frac{y^2}{b^2} = 1$ , except that we multiply the term in  $y^2$  by a suitable function  $t(x)$ , such that the curve resembles an egg. [3]

Below is the egg represented by  $\frac{x^2}{4^2} + \frac{y^2}{3^2} \frac{1}{1+0.1x} = 1$ . [4]

**Visiting times:** Weekdays (except Tue): 1300-2100; weekends and public holidays: 1000-2100; closed at 1700 on Christmas Eve and Lunar New Year's Eve; closed on Tue (except public holidays) and the first two days of the Lunar New Year

**Cost:** Exhibition Halls: HKD 10 (standard). OMNIMAX Show / Sky Show: HKD 24 (front stalls), HKD 32 (stalls)

**Access notes:**

[Details on admission fees](#)

[http://www.lcsd.gov.hk/CE/Museum/Space/Museum/GeneralInfo/e\\_generalinfo\\_fee.htm](http://www.lcsd.gov.hk/CE/Museum/Space/Museum/GeneralInfo/e_generalinfo_fee.htm)

## External links

- [Hong Kong Space Museum Official Website](#)  
<<http://hk.space.museum/>>
- [Hong Kong Space Museum - Hong Kong Tourism Board](#)  
<<http://www.discoverhongkong.com/eng/attractions/museum-hongkong-space.html>>

## Attributions

[1] The video "Drawing an Oval with a String and Three Nails" is distributed by the [Wolfram Demonstrations Project](#)

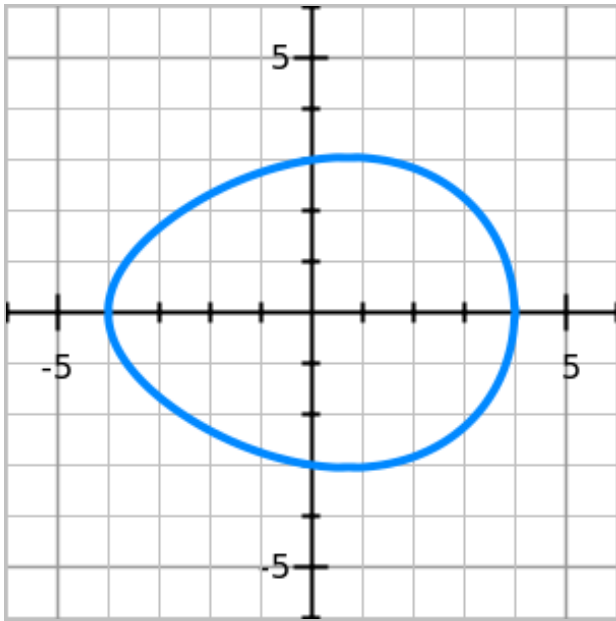
<<http://www.wolfram.com/legal/terms/wolfram-demonstrations-project.html>> under the Creative Commons Attribution - Noncommercial - Share Alike 3.0 Unported License.

[2] Huerta, Santiago. *Oval Domes: History, Geometry and Mechanics*. Nexus Network Journal Vol. 9, No. 2: Architecture and Mathematics (2007).

[3] Köller, Jürgen. [Ovals and Egg Curves](#)  
<<http://www.mathematische-basteleien.de/eggcurves.htm>>

[4] Produced with [GraphSketch \(Parametric\)](#)  
<<http://graphsketch.com/parametric.php>>

[5] Yamamoto, Nobuo. [Equation of Egg Shaped Curves](#) <<http://www16.ocn.ne.jp/~akiko->



[y/Egg/index\\_egg\\_E.html>](#)

[6] Wikipedia: [Non-Euclidean geometry](#)  
<[http://en.wikipedia.org/wiki/Non-Euclidean\\_geometry](http://en.wikipedia.org/wiki/Non-Euclidean_geometry)>

Search this site:

Search

There is a website which expounds on [complicated egg curves](#)

<[http://www16.ocn.ne.jp/~akiko-y/index\\_E.html#egg](http://www16.ocn.ne.jp/~akiko-y/index_E.html#egg)>, such as

$$(x^2 + y^2)^2 = ax^3 + (a - b)xy^2 \quad \text{where } a \geq b \geq 0.$$

For this equation, the best approximation of the egg shape is when  $b = 0.7a$ .

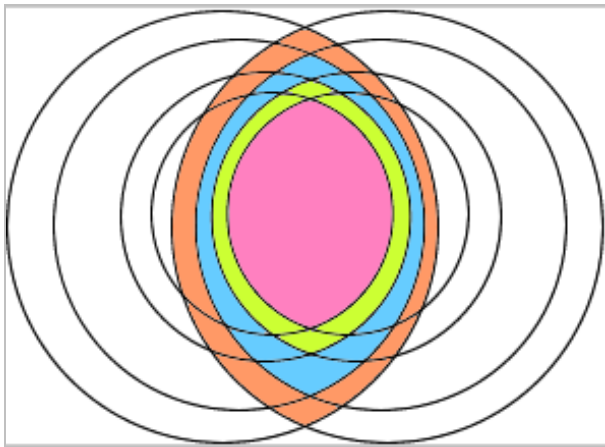
[5]

[This article](#) <[http://books.google.com.hk/books?id=PF-TZ75D9e8C&pg=PA290&lpg=PA290&dq=egg+math+geometry&source=bl&ots=IXSCiZZN0B&sig=GXxQxTuqVT7Y5eJu9e4fCjY4ccg&hl=zh-TW&ei=EdK4TYPMFo66vQPCppyiAw&sa=X&oi=book\\_result&ct=result&resnum=1&ved=0CBoQ6AEwADqe#v=onepage&q&f=true](http://books.google.com.hk/books?id=PF-TZ75D9e8C&pg=PA290&lpg=PA290&dq=egg+math+geometry&source=bl&ots=IXSCiZZN0B&sig=GXxQxTuqVT7Y5eJu9e4fCjY4ccg&hl=zh-TW&ei=EdK4TYPMFo66vQPCppyiAw&sa=X&oi=book_result&ct=result&resnum=1&ved=0CBoQ6AEwADqe#v=onepage&q&f=true)> illustrates various ways of constructing an egg figure.

## A must-mention property of the building: the elliptical geometry

The [grid pattern](#)

<<http://www.flickr.com/photos/travelhaha/4820604270/sizes//in/photostream/>> on the building is not made up of straight lines, but of interlocking [lenses](#) <<http://mathworld.wolfram.com/Lens.html>>. Why is that?



*Here the pink lens is on top of the green lens, which is in turn on top of the blue and orange lenses. A suitable arrangement of arcs can form the grid pattern on the East Wing of the Hong Kong Space Museum.*

Designing patterns on the three-dimensional surface of the East Wing requires knowledge in [elliptic geometry](http://en.wikipedia.org/wiki/Elliptic_geometry) , a type of non-Euclidean geometry. Parallel lines on non-Euclidean surfaces violate [Euclid's fifth postulate](http://en.wikipedia.org/wiki/Parallel_postulate) .<sup>[6]</sup>

*If a line segment intersects two straight lines forming two interior angles on the same side that sum to less than two right angles, then the two lines, if extended indefinitely, meet on that side on which the angles sum to less than two right angles.*

Therefore, when the "perpendicular" grid lines intersect at the top of the building, they form [lenses](http://mathworld.wolfram.com/Lens.html) , giving the East Wing the appearance of a ["pineapple bun"](http://en.wikipedia.org/wiki/Pineapple_bun) , a southern Chinese pastry with a crust like a pineapple.

## Conclusion: why the mathematics?

"But then," asked my friend, "why the egg shape? What has the universe got to do with the egg shape?"

In fact, a ["cosmic egg"](http://en.wikipedia.org/wiki/Cosmic_egg) was found in creation stories across various civilizations, including the traditional Chinese myth of [Pangu](http://en.wikipedia.org/wiki/Pangu) , a giant who broke apart a cosmic egg to form the earth and the sky. Most locals in Hong Kong have learnt the Pangu story in school. Perhaps, this "egg of a Space Museum" is but a cosmic legend revived.

---

## Comments