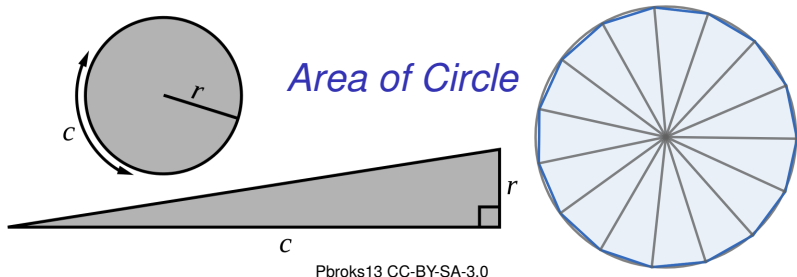# Measurements

How were circumference, area and volume formulas obtained via axiomatic and other perspectives and before coordinate geometry, metrics, and calculus II and analytic geometry?

- Eratosthenes and circumference of earth
- Archimedes and others' polygonal method for circumference and π
- Archimedes' proof of area of circle by exhaustion
- Archimedes' proof of surface area of a sphere
- Archimedes and volume of a sphere (Cavalieri's principle)
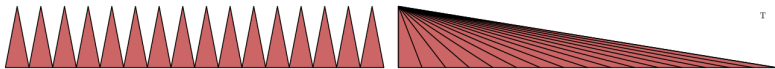- area of a triangle on the sphere and the sum of the angles

"Pi what squared? Long John, you should be able to get this."

https://www.newyorker.com/online/blogs/cartoonists/pi-what-squared.jpg

Area of Circle

Pbroks13 CC-BY-SA-3.0

If $C > T$, where area circle $= C$ and area triangle $= T$ then inscribe a polygon inside the circle with area P so that $T < P < C$. Dissect the polygon into triangles. The height will be less than the radius and the sum of the widths (perimeter) will be less than the circumference because it is inside. Hence $P < T$, which is a contradiction to $T < P$.
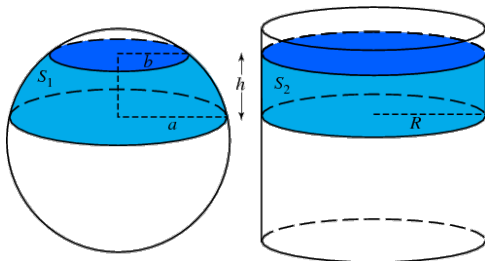

http://www.ams.org/publicoutreach/feature-column/fc-2012-02

Dr. Sarah   Math 3610: Introduction to Geometry

Surface Area of Sphere

area of a sphere is 4 times the area of a great circle of the sphere $= 4\pi r^2$

https://www.youtube.com/watch?v=FB-acn7d0zU

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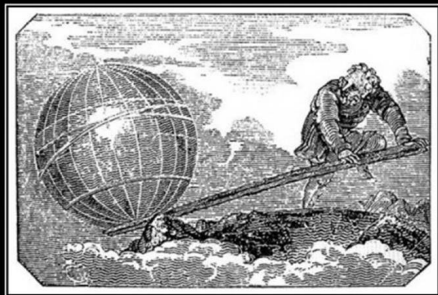
http://mathworld.wolfram.com/ArchimedesHat-BoxTheorem.html

If a polygon is inscribed in a circle and revolved about an axis, forming a solid of revolution inside a sphere, then the surface area < surface area of sphere. Conversely for a circumscribed polygon.

Volume of a Sphere

http://www.cs.appstate.edu/~sjg/class/3610/
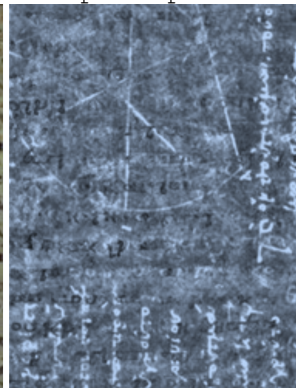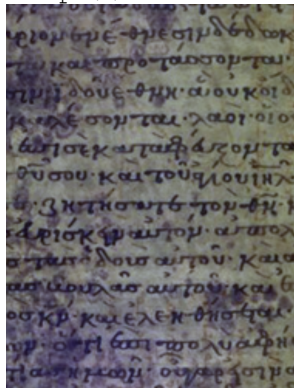ArchCav.html

Certain things first became clear to me by a mechanical method, although they had to be demonstrated by geometry afterwards because their investigation by the said method did not furnish an actual demonstration.
[*The Method* in *The Works of Archimedes* translated by Heath]

http://www.archimedespalimpsest.org/

Area of a Spherical Triangle and the Sum of the Angles

http://cs.appstate.edu/~sjg/class/3610/
beachball.pdf