Geometry of the Earth and Universe How we measure and view the world around us and decide what is the nature of reality: What does a geometric space look like, how do we know, and how do we represent it? Possibilities and real-world applications...

- diverse perspectives including local to global connections
  truth & consequences, the role of chance and probability
- ways that diverse people succeed in and impact mathematics
- what mathematics is & offers

Does the real universe have curves? Do other universes?



## Discussion Question and Ideas on Board

How could we know that the earth is a round sphere without using technology from the 20th or 21st centuries? Discuss in your group and then write at some ideas on a board.



http://gstene.files.wordpress.com/2008/08/flat\_earth.jpg

#### A View of the Earth—Once Upon a Time



Dr. Sarah 1010: Introduction to Mathematics

## Eratosthenes' (~276 BCE - ~195 BCE) Data



Creative Commons Attribution-Share Alike 3.0 Unported Todd Timberlake, remixed by lookang, version public domain earth from Tom Patterson http://weelookang.blogspot.sg/2012/06/ejs-open-source-eratosthemes-measures.html =

# Eratosthenes Thinks Big (Globally!)



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# Eratosthenes Thinks Big (Globally!)



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<u>360°</u>	circumference

http://www.freewebtown.com/gr\_math/mathimatikoi\_astr/eratosthenes\_of\_cyrene\_m.htm 🝵

*Local to Global: Multiple Perspectives* How could we know that the earth is round without using modern technology?

Geography Philosophy Physics & Astronomy Mathematics Navigation Weather

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Local to Global: Multiple Perspectives
 How could we know that the earth is round without using modern technology?

Geography Philosophy Physics & Astronomy Mathematics Navigation Weather

Still controversial? flat earth society



http://www.icis.com/blogs/asian-chemical-connections/FlatEarth.jpg http://img.dailymail.co.uk/i/pix/2008/04\_01/aprilfool60104\_468x627.jpg What does a geometric space look like, how do we know, and how do we represent it? Other possibilities and real-world applications...



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## Geometry Flat Angle Sum = ?

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### Geometry Flat Angle Sum = ?



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- Lay out a triangle with masking tape
- Pick a vertex to begin your triangle walk. Note the vertex and which way you are facing.



• Start walking along your triangle, keeping the center of your body on the boundary of the triangle.













# Walking a Euclidean Angle Sum Intrinsically

- Sweep out the last interior angle to finish your angle sum walk.
- The change in direction in your body from start to finish is the sum of the angles in this triangle.



# Folding an Angle Sum Extrinsically

- Rip a triangle from paper.
- Fold one angle to bring it down to the base by using a fold parallel to the base.
- Fold the other angles in



http://mathonthemckenzie.blogspot.com/2013/12/180.html

## Folding an Angle Sum Extrinsically

 Notice the angles fit to take up the entire space along the base and this gives us the angle sum.



http://mathonthemckenzie.blogspot.com/2013/12/180.html

What is Dimension and Parallel? Dimension: degrees of freedom of movement in space or efficient algebraic coordinates.

Example for line: 1 degree of freedom of movement along line back and forth or algebraic coordinate x in mx + b

Parallel: straight-feeling paths that never meet.



## Shape of the World & Seeing is Believing Video



PBS

The people in the video:

American Actor & Director (narrator here): **Danny Glover** British Artist and Mapmaker: **Nigel Holmes** American Art Historian: **Sam Edgerton** 

# Projective Geometry: Artists and Mathematicians

Dimension: degrees of freedom of movement in space or efficient algebraic coordinates.

Parallel: straight-feeling paths that never meet.



2D Representation of 3D Space

Interior of Antwerp Cathedral, by Pieter Neefs the Elder, 1651 http://collection.imamuseum.org/artwork/71818/ = > =

# Projective Geometry: Artists and Mathematicians



Marc Frantz's Mathematics and Art https://math.iupui.edu/m290

$$x' = \frac{dx}{z+d}$$
  $y' = \frac{dy}{z+d}$ 

where *d* is the distance from the viewer's eye at (0, 0, -d)If d = 3 and we want to paint the point (2, 4, 5), we paint at:

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$$x' = \frac{3 \times 2}{5 + 3}$$
  $y' = \frac{3 \times 4}{5 + 3}$ 

## Julian Beever's pavement drawings



http://www.julianbeever.net/images/phocagallery/gallery/butterfly-i.jpg

I decided to get into 3D after seeing the effect of tiles being removed from the street, and later trying to recreate the sense of depth in a drawing. Once I realised you could make things go down, I realised you could make them appear to go up and I began experimenting. Pavement Picasso by Sarah Loat

## Julian Beever's pavement drawings



julianbeever.net/images/phocagallery/gallery/thumbs/phoca\_thumb\_l\_globewrongview-i.jpg

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Image adapted from *Perspective and Projective Geometry* by Annalisa Crannell, Marc Frantz, and Fumiko Futamura, ISBN: 9780691196565

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#### Where is North?



https://www.reddit.com/r/Maps/comments/5cogwi/antarctica\_the\_confusing\_continent/

#### Stand up and point in the direction of North.

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https://mathequalslove.blogspot.com/p/free-classroom-posters.html
https://www.leaderinme.org/blog/the-power-of-a-growth-mindset/

.30 Exams+ .05 Effective Class Engagement + .50 Effective ASULearn Engagement + .15 Final Project

# Exam Corrections For 1 Exam

- original exam and revisions of one exam toward the end of the semester
- write on exam or separate sheet of paper to correct it
- use resources and get help from me
- Making mistakes is integral to the learning process as long as you review and understand any misconceptions, and I want to encourage and reward this.
- revised exam grade replaces the original. I want you to solidify the material and I am here to help!

