# Girls' Angle

# Girls’ Angle is

- ✓ a comprehensive approach to math education for girls
- ✓ a support community for women and girls who study, use or create mathematics
- ✓ in the process of incorporating as a nonprofit

# Girls’ Angle believes that

- ✓ math is best learned by interacting with people who love math, understand it deeply and enjoy explaining it well
- ✓ there remains gender bias against women who desire to study and create math
- ✓ girls have no intrinsic disadvantages to doing math well
- ✓ the field of math would benefit by a large influx of capable women mathematicians

# Primary Mission

To foster and nurture girls' interest in mathematics and empower them to be able to tackle any field no matter the level of mathematical sophistication.

## Secondary Missions

To be an example of quality mathematics instruction.

To help eradicate gender bias in the field of mathematics.

To be a support community for all women and girls engaged in the study, use and creation of mathematics.

We are new, less than a year old, and at the start of a long journey. Currently, we meet weekly in Cambridge and have 9 girls attending.

Ultimately, we want to be a place where all women and girls at every stage in mathematics, from those just beginning to explore shapes and numbers all the way through high school, college, graduate school, postdoctoral positions, tenure track, to professional mathematicians, have another home.

Current leadership includes: Lauren Williams, Eli Grigsby, Grace Lyo, Elissa Ozanne, Connie Chow, Lauren McGough, Kathy Paur, Yaim Cooper, Beth O'Sullivan.

To realize this dream, **we need your help!**

Girls’ Angle uses a four-component strategy:

1. Mentors.
2. The Girls’ Angle support network.
3. The Girls’ Angle Bulletin.
4. Community outreach.

# Mentors, the heart and soul of Girls' Angle

Women who understand math deeply and enjoy explaining math to others.

Ultimately, we want to pay mentors salaries that are highly competitive with industry. Right now, the salaries for high school, college and graduate student mentors are generous, but the salaries for postdocs and beyond are not yet where we hope to get them.

Past and present mentors:

Precocious high schooler Lauren McGough…
Harvard undergrads Hana Kitasei, Hilary Finucane and Alison Miller…
MIT undergrad Beth Schaffer…
Harvard graduate student Cammie Smith Barnes…
and Professor Wehrheim came to mentor ten days ago!

# Girls' Angle Support Network

Women professionals who use math in their work and are interested in showing the girls how and for what they use math. We want girls to know that many women today use mathematics to make important and interesting contributions to society.

Women in the support network who have visited the club include:

Sarit Smolikov, biology of worms, Harvard Medical School
Elissa Ozanne, decision models in breast cancer, Harvard Medical School and MGH
Karen Willcox, aircraft design, MIT Aeronautics and Astronautics
Tamara Awerbuch, population dynamics, Harvard School of Public Health
Kimberly Pearson, statistics, Harvard School of Public Health
Dina Sonenshein, baking chocolate chip cookies, Upstairs at the Square
Tanya Khovanova, number sequences, independent mathematician
Leia Stirling, angular momentum, MIT Aeronautics and Astronautics

# The Girls' Angle Bulletin

The Bulletin is a bimonthly magazine covering topics related to mathematics. Also, instruction that is better suited to the printed word is placed in the Bulletin. A typical issue will have an interview, several articles, and the *It Figures* comic strip.

In the three issues so far, we've had contributions from:

Yaim Cooper, graduate student at Berkeley
Lauren McGough, Quincy High
Lauren Williams, Benjamin Pierce assistant professor at Harvard
Grace Lyo, Moore Instructor at MIT
Eli Grigsby, NSF postdoc at Columbia

…and all the girls who are members of Girls' Angle.

# Girls' Angle Bulletin

October 2007 • Volume 1 • Number 1

*To Foster and Nurture Girls' Interest in Mathematics*

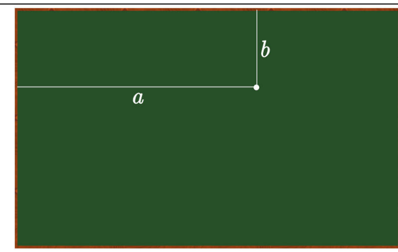

## Inside:

# Coordinate Systems

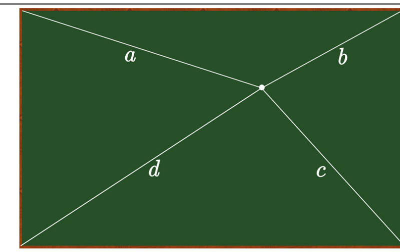
Coordinate systems are a way to systematically label points on some geometric object using numbers. There are many ways to think about coordinate systems. They can be thought of as generalizations of the number line. Recall that a number line is a line where each point is associated with a number. The association is made in such a way that many geometric properties of points on a line are reflected in properties of numbers. For example, if $a$, $b$, and $c$ are the numbers that represent points $P$, $Q$, and $R$ on a number line, and $Q$ is between points $P$ and $R$, then $a < b < c$.

At Girls' Angle, we began by thinking of ways to identify points on the chalkboard, which can be modeled mathematically by a rectangle.

**Sylvia** had the idea of identifying points on a chalkboard by measuring the distance of the point from the left edge and from the top edge of the chalkboard. **Trisscar** suggested identifying points on a chalkboard by measuring the distance of the point from the four corners.

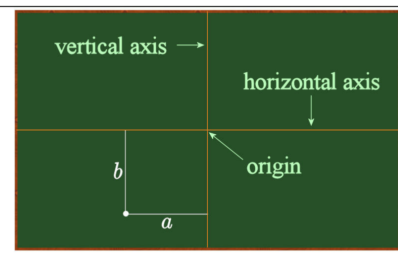



**Sylvia**'s Coordinates

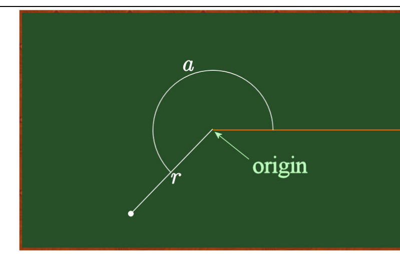



**Trisscar**'s Coordinates

We also introduced Cartesian coordinates and polar coordinates.




Cartesian Coordinates

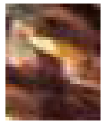



Polar Coordinates

In Cartesian coordinates, one horizontal and one vertical line are arbitrarily chosen. These special horizontal and vertical lines are called *axes* and the point where they intersect is called the *origin*. A point is indicated by measuring the shortest distances to each of these lines If the point is to the left of the vertical axis, then the coordinate labeled $a$ in the figure is taken to be the negative of the distance. If the point is to the right of the vertical axis, then $a$ is taken to be the distance. Similarly, $b$ is taken to be the distance, or the negative of the distance, to the horizontal

# An Interview with Grace Lyo

Grace Lyo is a Moore Instructor at the Massachusetts Institute of Technology. She earned her Ph.D. in mathematics from the University of California at Berkeley.



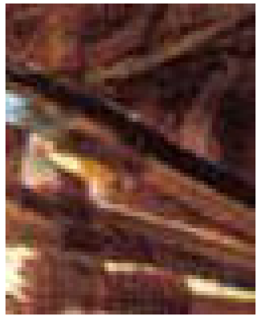
**Ken**: Hi Grace, thank you for agreeing to do this interview! My first question is: what got you interested in mathematics?

**Grace**: My interest developed gradually. When I went to college, I was thinking about majoring in physics or computer science, but eventually realized that the courses I liked best were the math/theory courses.

**Ken**: So you didn't realize your interest in math until college?

**Grace**: The way I was taught math, it didn't seem like something that one could do. It was easy for me to understand if someone said they did research in physics or biology, but if someone said they did research in math, I wouldn't have understood what they meant. What is there to research in math? In school, math seemed like just a tool to do other things, like physics or engineering. So I didn't really know what math was all about until I went to college.

**Ken**: What in college awakened you to mathematics?



**Grace**: When I took algebra, mathematics became really exciting. For the first time, math wasn't just a collection of facts that one had to learn. Instead, it was an arena where you could experiment and create. For instance, you can ask yourself, "what would happen if I set five equal to two?" In high school and before, such questions weren't allowed. But in real math, this is a perfectly valid question, and it leads you to create a number system where three equals zero. (Incidentally, in my research, I usually work with number systems like this, in which some prime [number] gets set equal to zero.) I found it exciting to learn that math is about building up structures from axioms and that you can change those axioms around and get different structures.

**Ken**: You make mathematics sound like a very creative endeavor!

**Grace**: It is! In school, math often seems like something where there is a definitive answer. But really, mathematical facts do not represent the end of something, but the beginning of something. There is a lot to explore and that's what makes math interesting. There is so much that is unknown—it's not like math homework where you know that there's an answer and that the problem is designed so that one can find that answer in a reasonable amount of time. In math, you don't always even know if there is an answer, or, if there is, how hard it will be to find.

Actually, this makes me think of something that I wish I had known much earlier. Maybe it might help the girls at Girls' Angle to know

# Introduction to Manifolds

**by Elisenda Grigsby**

Not all mathematics involves numbers. "What on Earth is math without numbers?" you may ask. Well, remember that mathematics is just a systematic way of tackling abstract questions–so mathematical techniques can be brought to bear on almost any question of interest.

For example, if we had been alive 2,500 years ago, we would probably have been very interested in the following question:

What is the general shape of the surface of the Earth? Is it a plane? Is it a disk that you would fall off if you sailed too far?

These days, you can find a toy globe in any hobby shop, and we have all seen satellite images of the Earth from space. We know the Earth is round–its surface is a sphere. Two and a half centuries ago, however, you can probably imagine how difficult it would have been to figure something like that out. The Earth is big, and without the aid of airplanes and spaceships, we are confined to a small section of it. When our distant ancestors looked at the surface of the Earth–the ground beneath their feet–it looked pretty flat, albeit with some hills and mountains thrown in.

When we speak of the "general" or "overall" shape of the Earth, we are ignoring hills, mountains, canyons and other bumpy findings. If you wish, think of the Earth as covered entirely by a perfectly calm ocean. In fact, even when this is done, the surface is not really a sphere! The Earth bulges at the equator and is more like an ellipsoid. However, to a mathematician who works in topology, a topologist, a sphere and an ellipsoid are considered equivalent. One can be deformed into the other without having to damage the surfaces by cutting them; one just has to stretch and bend a bit.

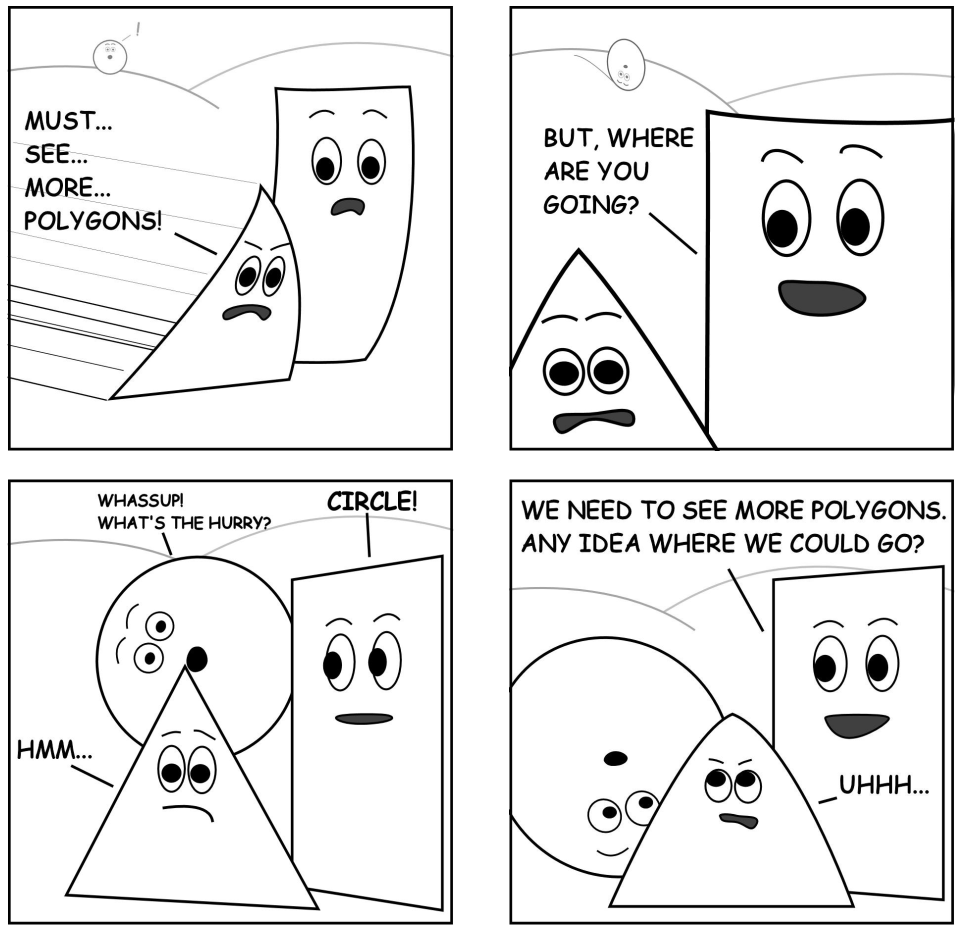
Conceptualizing the surface of the Earth as a sphere helped us build the global transportation and communication systems that we enjoy today. Study of the sphere and similar objects led mathematicians to define a category of geometric objects known as manifolds. The sphere is an example of a manifold, more specifically, a 2-dimensional manifold. It is a manifold because it looks "locally flat". In other words, around any point of the sphere, there is a small neighborhood around that point that looks like a neighborhood of the origin in the Cartesian plane (see the previous issue of this Bulletin). It is 2-dimensional because any coordinate system used to map positions on the Earth's surface requires two numbers (for example: latitude and longitude).

Let me pause for just a moment to clear up a point that can be very confusing the first time you encounter a manifold: why is a sphere considered to be 2-dimensional? Isn't it sitting inside of a 3-dimensional space?

The best way to approach this question is to think of a sphere as a completely abstract object. In other words, imagine what would happen if someone were to squash you absolutely flat, so you looked like a paper doll. Then imagine that someone were to stick you onto the sphere so that you could only move north, south, east or west, but no longer up or down off of it.

# It Figures!

by CKFan



# Community Outreach

Not yet implemented…

We hope to find people and organizations willing to commission the girls of Girls' Angle to solve a math problem and use the girls' work.

For example, an ice skating rink manager might ask the girls to figure out how many times around the rink is equivalent to a mile.  In a brochure put out by the rink, it would say, "Did you know that ten laps is equivalent to a mile?  This fact courtesy of Girls' Angle, a math club for girls."

# How you can help

You can help us by:

Mentoring at the club…
Visiting the club as a member of the support network…
Participating in an interview for the Bulletin…
Writing an article for the Bulletin…
Helping to edit articles for the Bulletin…
Spreading the word…
Giving us a much needed donation (tax deductible)…
Helping to raise money…
Lending your particular expertise (e.g. real estate broker? lawyer?)…

Want to help? Have Questions? Need More details? Suggestions?

Please send email to girlsangle@gmail.com!

# THANK YOU

for listening!

girlsangle@gmail.com

(website coming soon)

Girls' Angle