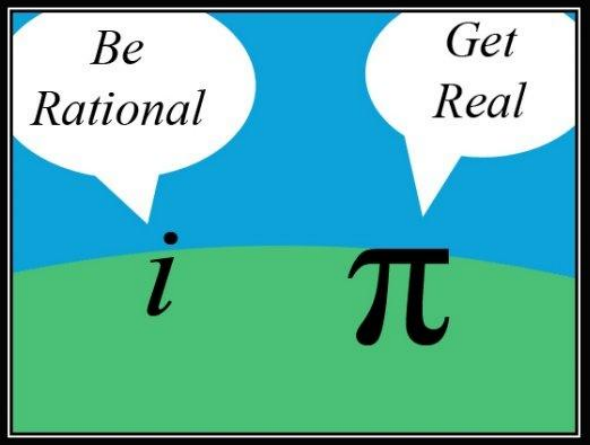
Richard Seitz
Helena High School
Helena, Montana

ottoseitz@hotmail.com



high-interest problem solving, and explorations

Fridays, My Days
4 Great Math Tasks

Initial Observations

"If I couldn't explore new ideas, get excited about crazy connections of mathematics to life, teach fun applications, and solve problems; I would have never chose to be a mathematics teacher."

Math Life Skills:

1. **Mental Agility**
2. **Problem Solving.**
3. **Real World Experiences**
4. **Technology**

Goals of this Talk

- Examine high interest ideas & **explorations.**
- Have **participants share** ideas.
- Suggest math **software** students should learn.

Program Description

- In the age of CCSSM we are challenged to get students involved in high-interest problem solving, and explorations. We will share several high school problems that challenge students to engage in mathematics and create models. Strategies for fitting high-interest topics into the curriculum will be discussed. Explore tipis, tornadoes, and transformations.
- Several mathematics projects will be presented. Tipis - Modeling with polyhedron with connections from Geometry to Algebra to Calculus. Transformations of Points in Space - How transformations connect basic ideas of points, segments, lines, to systems of equations, parametric & polar representations, & vectors Modeling - Strategies for building students ability to model and explain their reasoning in mathematical terms.

Friday Projects – Based on Real Life

- What is the mathematics involved in making a Tipi?
- What do we know (or need to learn) about Tipis?
- How could we teach someone about Tipis and the mathematics of Tipis?

The Tipi https://sway.com/JyzTr56gtfOWpN_J

Activity

A strong part of western American culture is the Plains Indian Tipi. This structure could be as simple as a 3 pole structure (a tetrahedron shape) but usually was much more elaborate, with 12 or more poles giving the structures a cone shaped appearance.

Your task will be to create an engineering design and a **scale model of a life-sized tipi**. Provide specifications, and describe the processes you used to come up with the measurements. The life-sized tipi you will be modeling is a 12-pole tipi with a height of 18 feet to the cross pole, and has a perimeter of 48 feet (4 feet between poles).

Friday Topics based on Big Topics

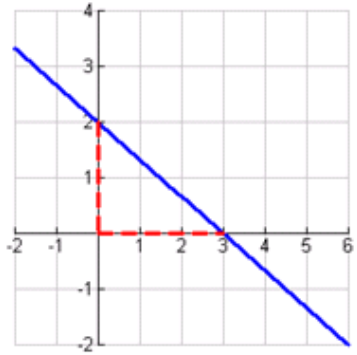
- What are the big ideas for Math?
- What are some of the basic concepts?
- What are some of the skills needed to work with those concepts?
- What advanced ideas strengthen conceptual thinking?
- What applications are connected to this skill?

Linearity

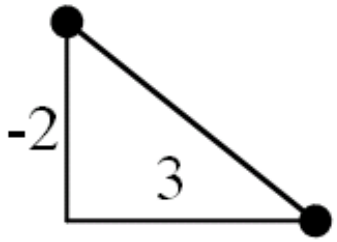
- When should students master lines?
- What does it mean to master linearity?
- Where do lines show up in mathematics?
- What do we teach about lines?

Graphic Organizer for Linearity

Linear Equation – Graphic Organizer

Standard Form	Slope Intercept Form	Graph
$2x + 3y = 6$	$y = -\frac{2}{3}x + 2$	

Graphic Organizer - continued

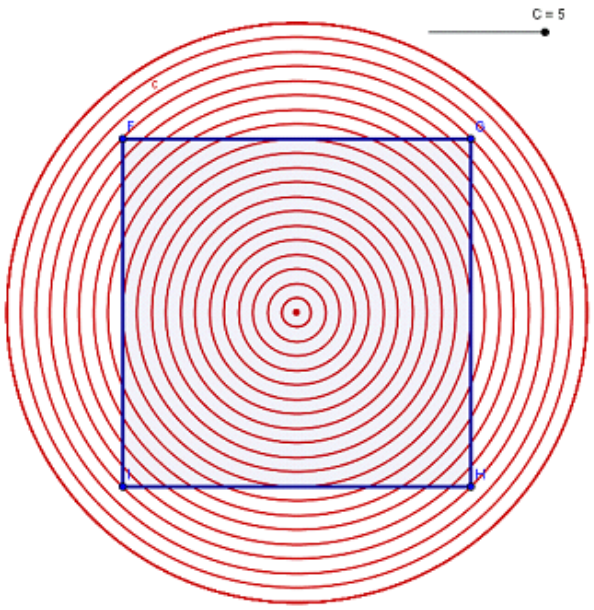
Table	Slope & Point	Intercepts
x | y -3 | 4 0 | 2 1 | $1\frac{1}{3}$ 3 | 0	$m = -\frac{2}{3}$ (6. -2)  	y–intercept 2 (0, 2) x-intercept 3 (3, 0)

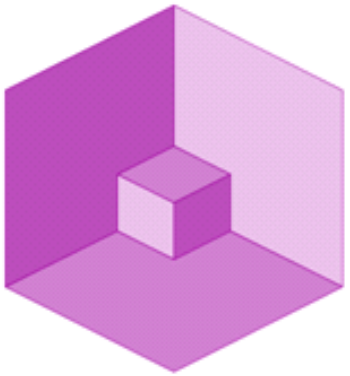
Linear Systems

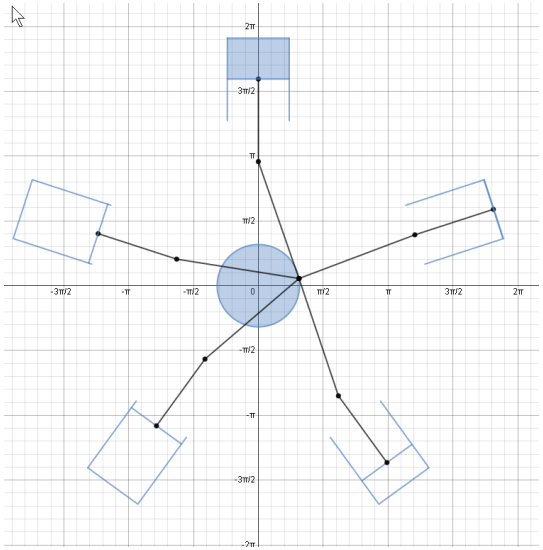
Spuds decides to take off on a bike ride from Helena to Butte Montana (100 km away). He takes off at 8:00 A.M. in the morning riding at a steady speed of 8 miles per hour.

At 10:00 A.M. Millie takes off from Helena heading to Butte in her car at a speed of 68 mph to pick him up. To the nearest minute, when will they meet?

Visual Lines

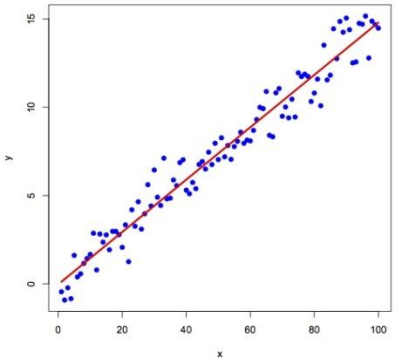




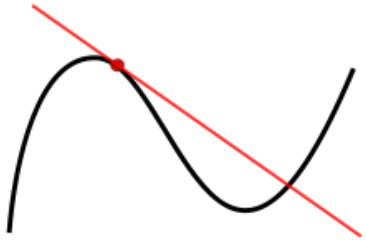


Advanced Lines

- Of best fit



- Tangent to a curve



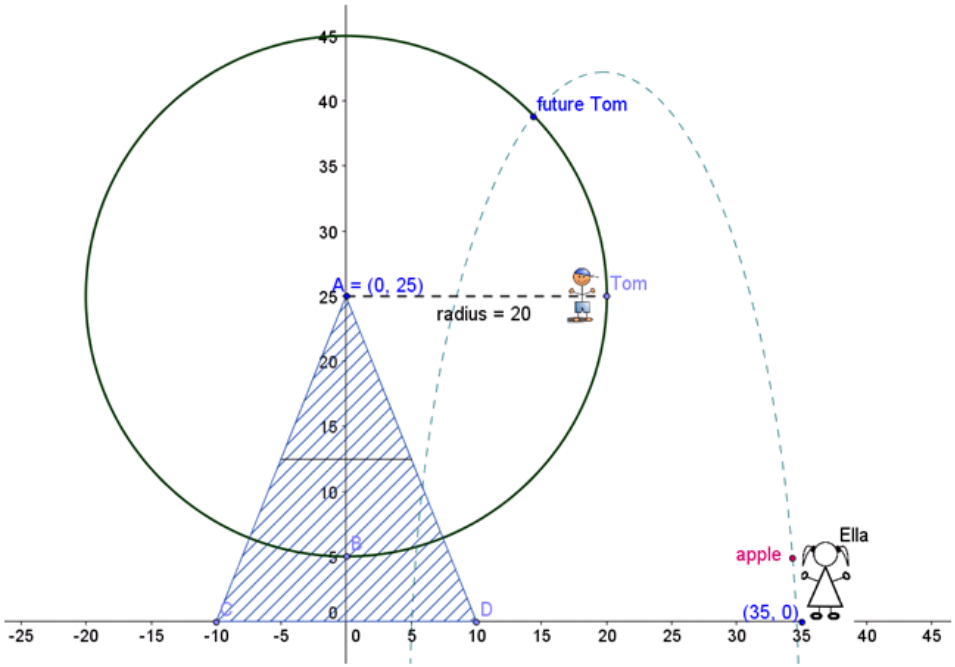
- In vector, parametric, polar, … form

Friday Topics – targeted to concepts

- Parametric equations for modeling curves
- Parametric circles
- Parabolic motion

Ferris Wheel & Romance Problem

Problem: Advise Ella as to the best angle and velocity to toss an apple to Tom.

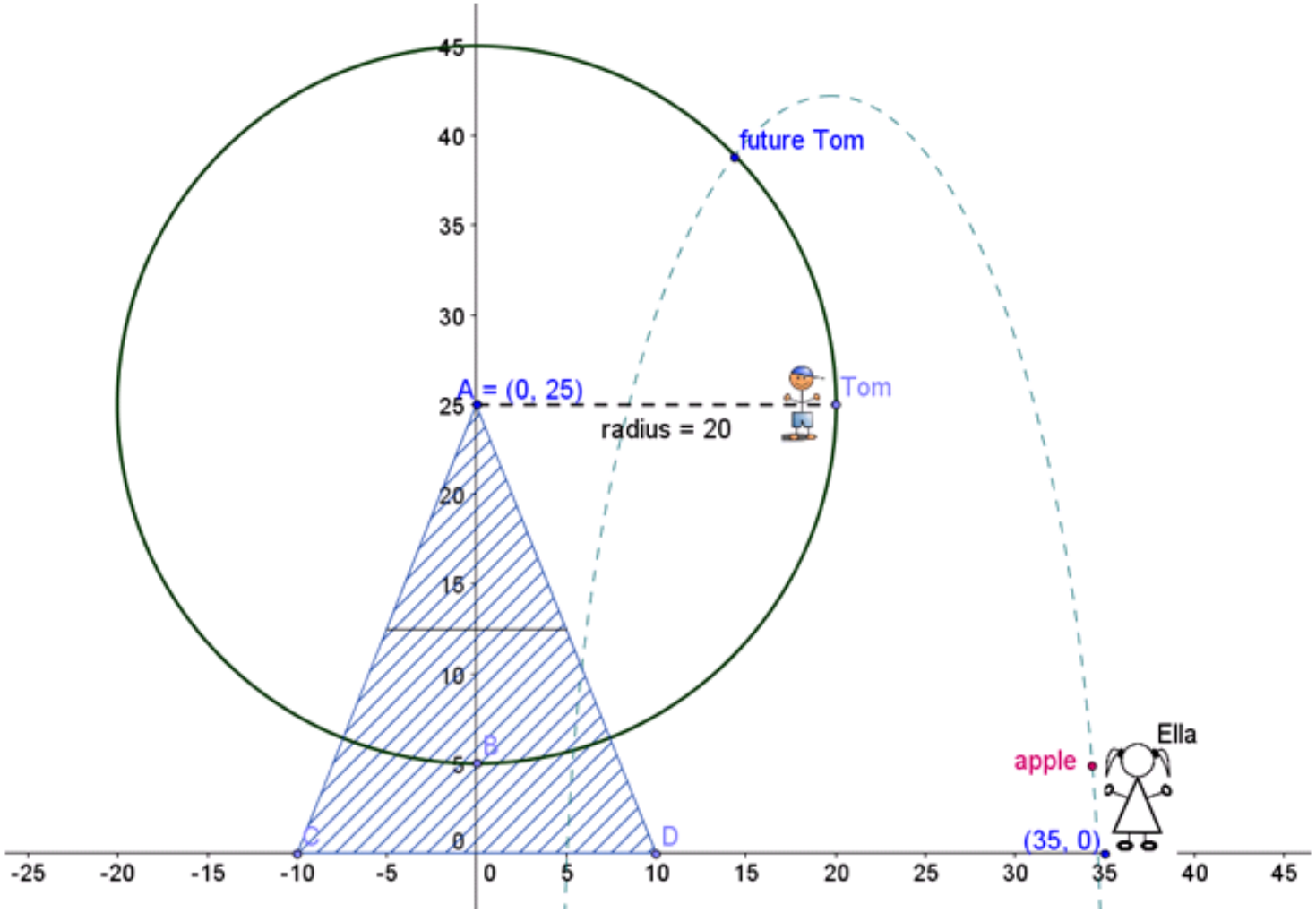


Tom is riding a Ferris wheel and his friend Ella (seeing that he looks a bit hungry) decides to toss him a Gala apple. At time 0, Tom is exactly ½ way to the top of the 45' tall wheel.

Ella and Tom, both loving math, know that the wheel has a radius of 20', is 5' off the ground, and is rotating counterclockwise at the astounding rate of 6 *rpm* or 1 revolution every 10 seconds!

Ella is standing 35' away from the middle of the base of the Ferris wheel and will let the apple go at the exact height of 6' with the intent that it should arrive within 3' of long armed Tom. Ella is allowed to move 5' closer or up to 10' further away. She can also build up suspense by waiting until Tom comes around again to make the toss!

Details


future Tom
A = (0, 25)
Tom
radius = 20
B
C
D
apple
Ella
(35, 0)
45
40
35
30
25
20
15
10
5
0
-25
-20
-15
-10
-5
0
5
10
15
20
25
30
35
40
45

More High Interest Friday Topics

- Miras, Mirrors, Concave, Convex
- Vi Hart YouTube Videos
- Zome Tools
- Polyhedra Models
- Translations with graphing calculators
- Basic Programming on graphing calculators
- …

Math Contests

- HiMCM High School - 36 hours
- http://www.comap.com/highschool/contests/himcm/previous%20problems.html

- Moody's Mega Math Challenge
  http://m3challenge.siam.org/

Software

- Sway
- GeoGebra
- Desmos
- PowerPoint
- Excel
- Word

Why Fun Fridays

- To teach real problem solving
- To kick start deeper conceptual understanding
- To builds a sense of play and fun

- Thanks!
- Richard Seitz ottoseitz@hotmail.com

Appendix of More Ideas

Montana Mathematics Projects Version 1.4 RSeitz

- Recursive Drawings for Designs
- Teepee Problems
- Bouncing Balls: Use mathematical models to explain the mathematics of a ball bounce. Include connections to exponential decay, quadratic equations and thoughts about the physics of what has occurred.
- Biking: Procure a 10 to 18 speed bike and calculate the mechanical and speed advantage of the gear system and predict normal speeds for each gear. Contrast road bikes to cruisers to BMX to mountain bikes.
- Surveying: Use a student survey to gather and analyze single and two variable statistics. Write press releases of the results.
- Motoring: Choose your favorite type of car and gather "book" prices for the last 10 years. Describe the mathematical model of the data. Use the price data for Caddie's to develop a long-term mathematical model of prices.
- Populating: Calculate the population center of the State of Montana or any state. Use several methods and contrast the difference in answers that are generated.
- Rocketing: How high does a Hope's water rocket really travel? Determine the initial speed of the rocket and figure out the initial speed needed to place a rocket above the flagpole in front of the school.
- Catapulting: Design and build a catapult that will send a marble off at an angle of 45 and travel 20 feet.
- Teepee Two: Investigate different layouts for a rendezvous for 200 teepees. Determine the number of acres needed. How would you design a minimum configuration? What is the perimeter of your designs?\
- Smoking – A Thought - If a person smokes a pack of cigarettes every day, how much does it cost to smoke for a month? A year? 10 years?
- If a person decides to save $150 a month how much would they have at the end of a year? 5 years? 30 years? Assume the annuity could grow at 9%. At the end of 30 years how much interest would you earn each month?
- Ten Duck Hunters (who never miss) each shoot (one shot per hunter) at 10 ducks. How many ducks would you expect to be shot? (They may pick out the same duck since they also never talk to each other.)
- Mental math races: List all the multiples of a number, fibonacci numbers, square numbers, cubes, fractions equivalent to 3/7 …
- Pencils cost 15 cents and erasers cost 4 cents and you have $3.00 to spend. Can you create a complete table of values that will spend exactly $3.00?
- China wanted to limit the number of kids. Research what happened and analyze the math.