

CURRICULUM & INSTRUCTION

# School of Education

- PREPARING LEADERS
- IMPACTING THE WORLD
- SHAPING THE FUTURE



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# **Making Mathematics A Habit!**

**Presented by:**

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**at the**

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# What are habits of mind?

Cuoco, Goldenberg, Mark

JOURNAL OF MATHEMATICAL BEHAVIOR 15, 375-402(1996)

- Elementary to Middle to **high school**
- “mental habits that allow students to develop a repertoire of general heuristics and approaches that can be applied in many different situations.”
- Our Focus today: **General habits of mind**
  - Pattern sniffers
  - Experimenters
  - Describers
  - Tinkerers
  - Inventors
  - Visualizers
  - Conjecturers
  - Guessers

# Common Core State Standards

<http://www.corestandards.org/the-standards/mathematics>

- Standards for Mathematical Practice
  - Make sense of problems and persevere in solving them.
  - Reason abstractly and quantitatively.
  - Construct viable arguments and critique the reasoning of others.
  - Model with mathematics.
  - Use appropriate tools strategically.
  - Attend to precision.
  - Look for and make use of structure.
  - Look for and express regularity in repeated reasoning.



# Polya

(from a lecture on teaching)

*“Mathematics is not a spectator sport. To understand mathematics means to be able to do mathematics. And what does it mean to be doing mathematics? In the first place, it means to be able to solve mathematical problems.”*

# *Mathematical Immersion and Emergence*

- Importance of DOING mathematics
- What does it mean to be a mathematician-doing the work of a mathematician?
- Engaging both math teachers (us) & their (our) students in mathematical problem solving



# Goal

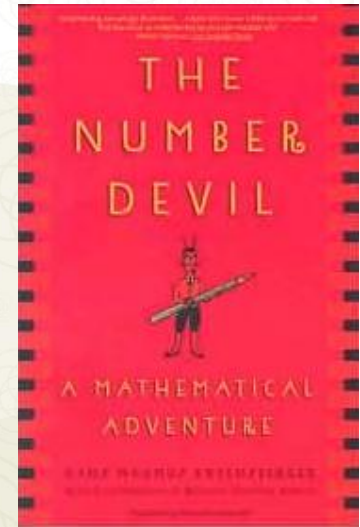
For students to engage in mathematical **problem solving** and **problem posing** immersing them in mathematics providing emergence of **mathematical understandings** to **develop strategies** that support lifelong learning of mathematics

# The Number Devil: A Mathematical Adventure

by Hans Magnus Enzensberger, 1997

*"There are times when I don't understand a thing".*

Robert, P. 107

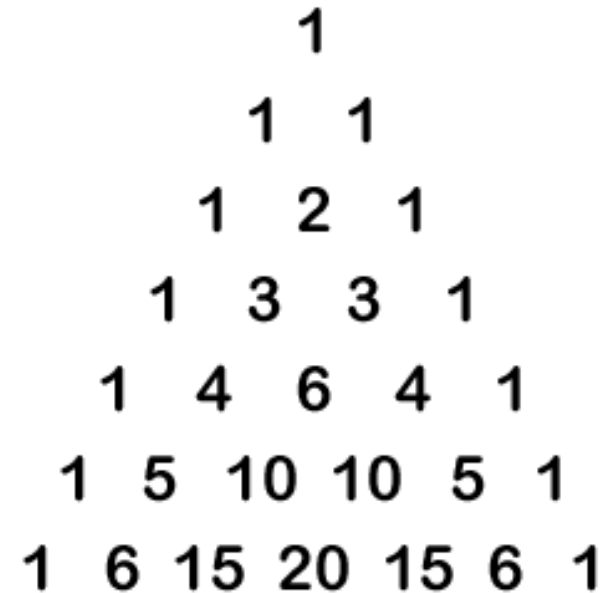


- Pascal's Triangle
- Fibonacci Sequence
- Handshake Problem
- Triangular Numbers
- Permutations & Combinations
- Continued Fractions
- Sieve of Eratosthenes
- Geometric Shapes
- Euler's Formula
- Fractals
- Imaginary Numbers
- Fractions
- Golden Mean
- Goldbach's Conjecture
- Exponents
- Irrational Numbers
- Prime Numbers
- Pythagorean Theorem
- Factorial



# Let's explore!

- The Problems:
  - Pascal's Triangle
  - Handshake Problem

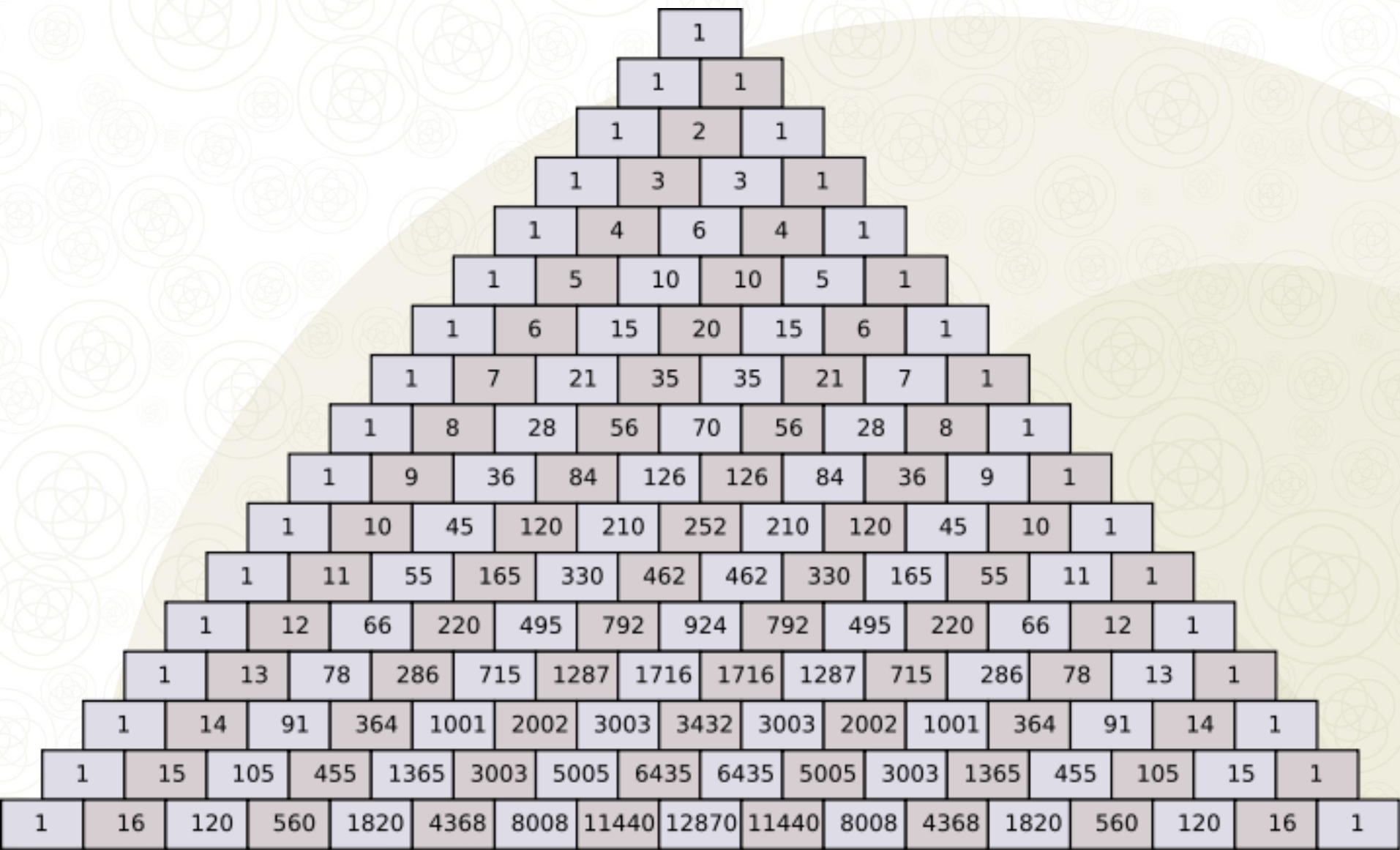


A Pascal's Triangle with 7 rows, enclosed in a black border. The numbers are arranged in a triangular pattern, with each number being the sum of the two numbers directly above it.

						1
					1	1
				1	2	1
			1	3	3	1
		1	4	6	4	1
	1	5	10	10	5	1
1	6	15	20	15	6	1

- Individually-Partner-Small Group
  - Observations
  - Conjectures
  - Strategies
  - Connections

How many different handshakes are possible in a room with 20 people?



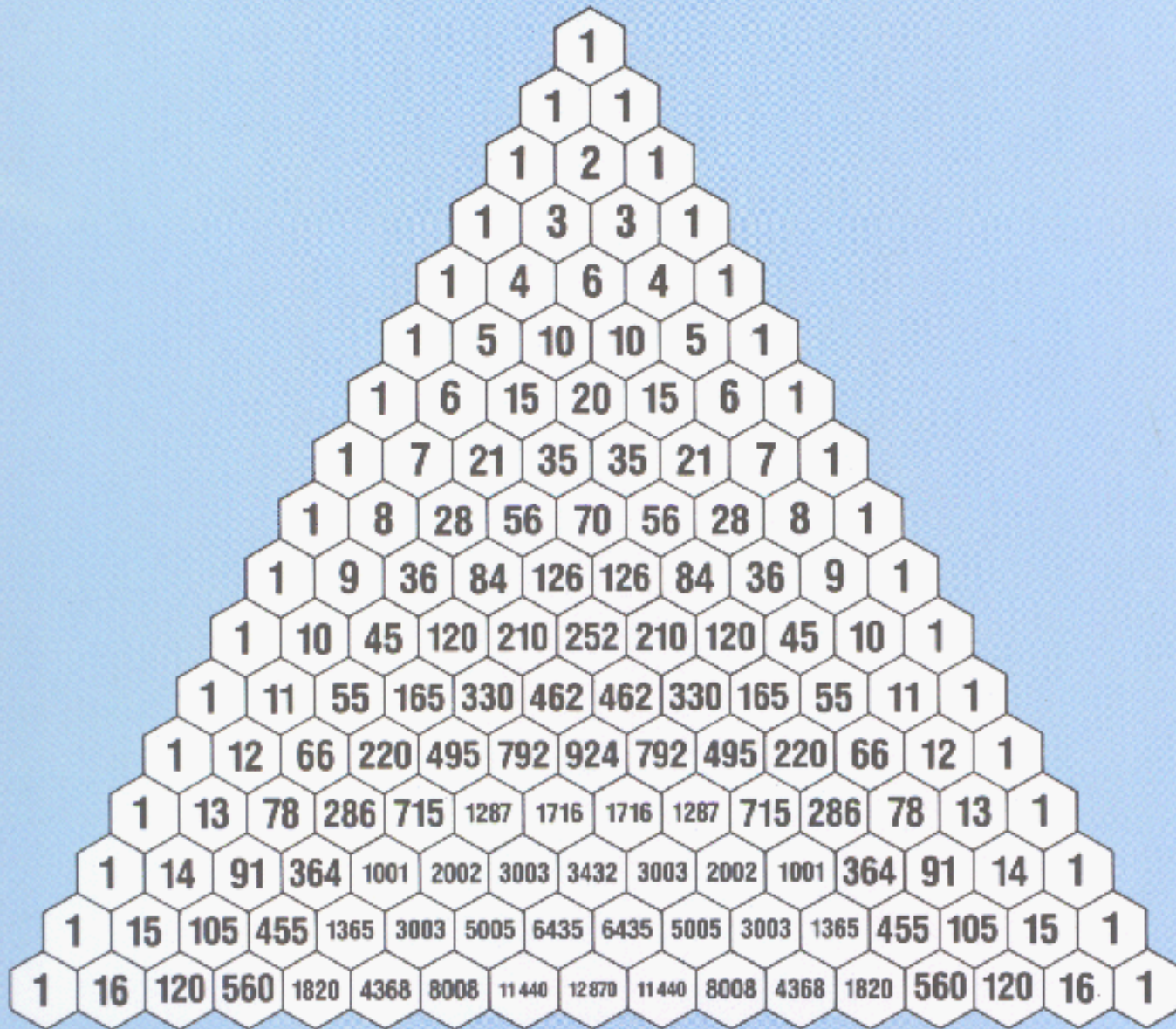
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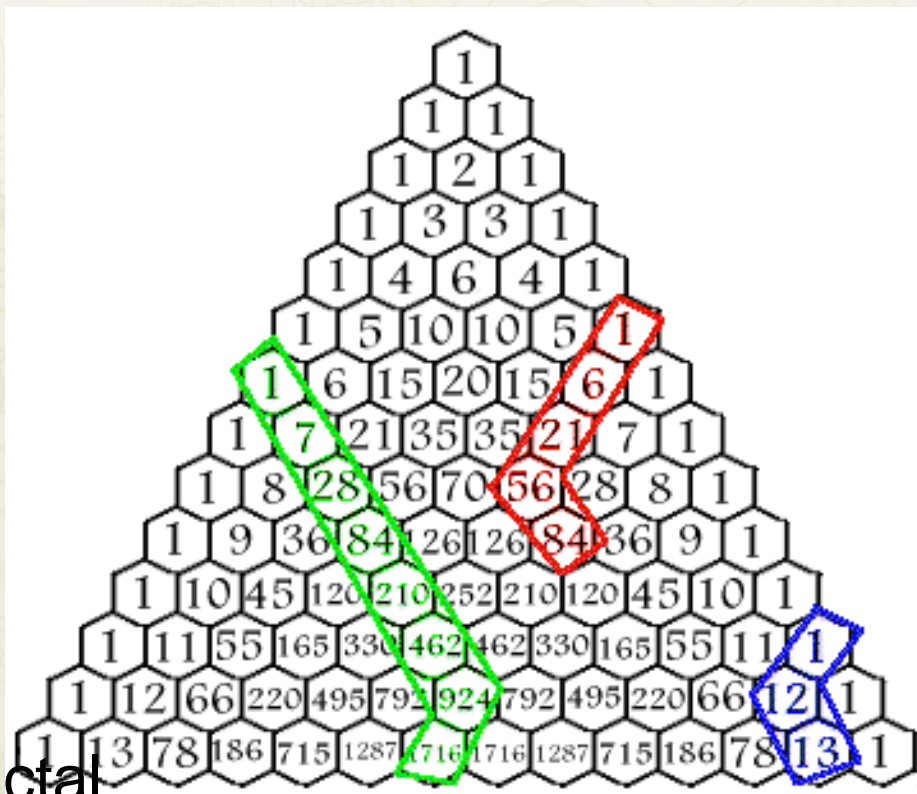


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<http://ptri1.tripod.com/>

<http://www.mathsisfun.com/pascals-triangle.html>

- Diagonal of ones
- Counting Numbers
- Sums of Rows
- Prime Numbers
- Hockey Stick
- Magic 11's
- Fibonacci Sequence
- Triangular Numbers
- Square Numbers
- Points on a Circle
- Connection to Sierpinski Fractal
- Polygonal Numbers
- Tetrahedral numbers





# Handshake Problem

How many different handshakes are possible in a room with 20 people?

- Approaches & Strategies
- Geometric & Algebraic
- Visualize, kinesthetic
- Generalize
- [Sample Lesson](#)

# From *The Art & Craft of Problem Solving*

Paul Zietz, 1999 (p.x)

- Problem solving can be taught, and can be learned
- Psychological Factors
  - Confidence
  - Concentration
  - Courage
  - Persistence
  - Mental toughness
  - Flexibility
  - Creativity
- An intense investigation is as important as a rigorous argument
- Other aspects of p/s include strategy, focused approaches, and technical tools
- Problems are as important as mastery of technical tools



# Potential Outcomes

## What might happen!

- Develop of 'habits of mind'
- Increase positive attitudes toward mathematics
- Advocate the importance of sophisticated mathematical understandings
- Provide a supportive problem-solving environment
- Increase persistence & perseverance in problem solving
- Build confidence as a mathematician
- Appreciate the beauty of mathematics
- Enjoy the math journey!

# Chasing Vermeer by Blue Balliett

## – Geometry-*Pentominoes*

- Transformations
- Similarity & Congruency
- Nets
- Tessellations

## – Measurement

- Area & Perimeter

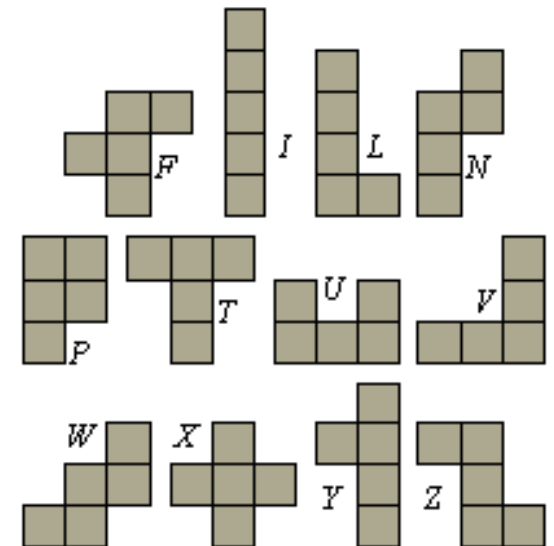
## – Algebraic Thinking

- Patterns
  - *ominoe* Investigations
- Graphing

## – Connections, Representations, Communication, Problem Solving



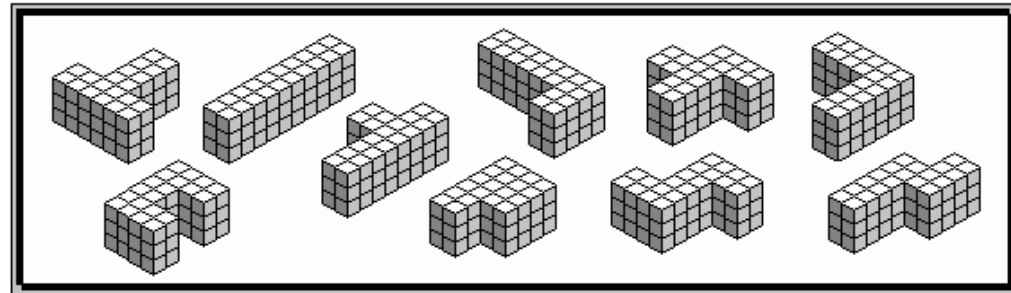
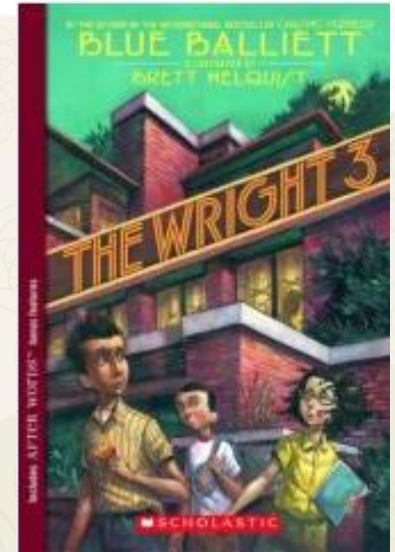
Five Squares





# *The Wright 3* by Blue Balliett

- Geometry
- 3-D *Pentominoes*
- Frank Lloyd Wright-  
Architecture
- Reflections
- Optical Illusions-Spatial  
Visualization
- Isometric Drawings

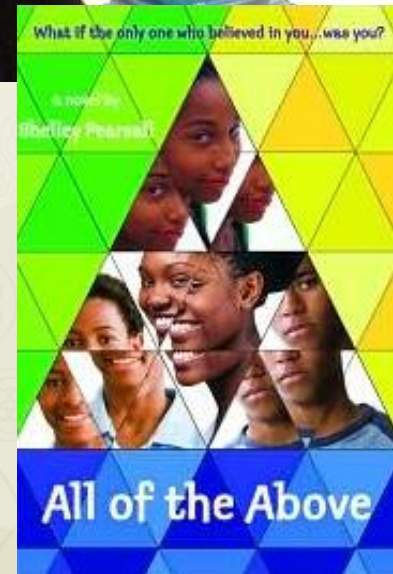
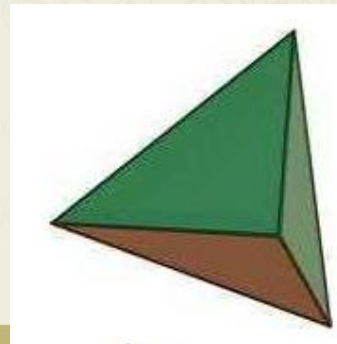


# *All of the Above* by Shelley Pearsall

- Geometry-
  - Tetrahedrons
  - Platonic Solids
- Measurement
- Functions/Algebraic thinking
  - Sierpinski's Triangle

## **Tetrahedron**

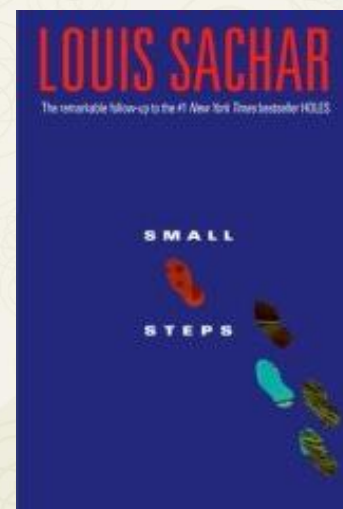
- 4 Faces
- 4 Vertices
- 6 Edges





# *Small Steps* by Louis Sachar

- Problem-Solving
  - Business Simulation
  - Advertising/Logo Design
- Linear Functions
  - Bats, Motion Detectors (CBRs)
- Map Skills-Coordinate Graphing



# New understandings as a mathematician

“I am struggling with the problem [proofs for various aspects of the problem] and am very surprised at how much I have already stretched myself. It is amazing and shows me what I could possibly be having my students do. The only problem is that I already have the drive to study this, while many of my students don't have that same drive.” (11/8/07-WPJ)



# The journey.....

1. I don't really wonder about stuff. I am a very cut and dry Math person. I guess I do have more interest in Geometry and formulas, but I am not really sure where to go from there." (8/23/07-WPJ)
2. I have enjoyed exploring the math and look forward to what I found [find] out next." (9/19/07-WPJ)
3. "The 1.8 thing is throwing me. I am going to do more to see if I "see" anything. 😊" (10/1/07-WPJ)
4. WOW! I did not think I had anything really worth sharing. That kind-of makes me feel good. 😊 (10/12/07)-e-mail)

# We need to be seekers ourselves developing our mathematical habits of mind!

- Pattern sniffers
- Experimenter
- Describers
- Tinkerers
- Inventors
- Visualizers
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- Guessers



**Thank you!**

**Contact Information**

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