youcubed®

Pascal's Triangle
Grades 6-8

Introduction
Many students, when asked to describe math, will say it is all about rules and procedures. But most mathematicians will tell you that math is about the study of patterns. Keith Devlin, Stanford Mathematician, wrote a book called: 'The Science of Patterns' in which he talks about mathematics being, at its heart, about pattern seeking. In this activity we invite students to be mathematicians and to find and study patterns in the world's most famous triangle that has fascinated people for centuries.

Agenda

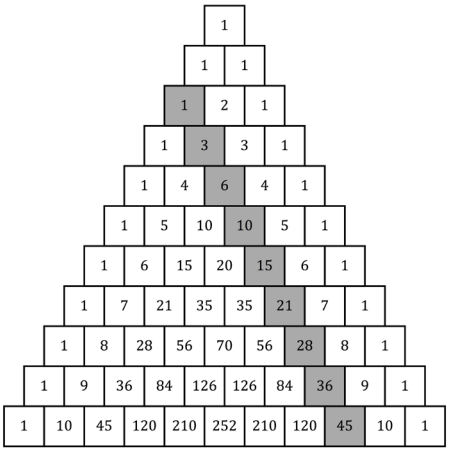
Activity	Time	Description/Prompt	Materials
Introduce	5 min	Give background on Pascal's Triangle	
Explore	25 min	1. Find the missing numbers on the Pascal's Triangle handout while working in pairs (page 3) 2. Investigate the 4 questions on the Pascal handout (page 4)	• Paper, pencil/pen • Colored pencils/ markers • Pascal's Triangle Handout, page 3 • Pascal's Investi-gation Handout, page 4
Present	10 min	Ask students to share any patterns or other interesting observations	• Pascal's Triangle display, page 5
Debrief Mindset Messages	5 min	Debrief the mindset messages for this activity.	

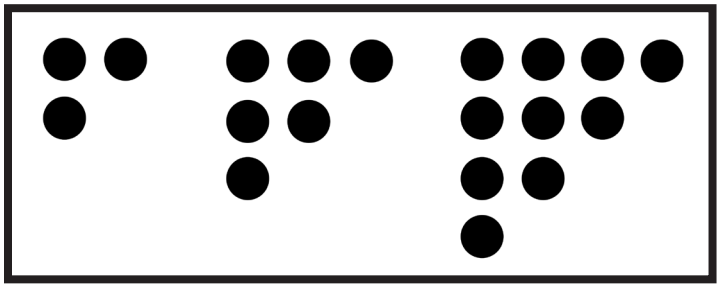
Activity
We started the lesson by saying that we were going to explore a really famous triangle that is full of patterns, some of which may not even be discovered yet. We told students that the triangle is often named Pascal's Triangle, after Blaise Pascal, who was a French mathematician from the 1600's, but we know the triangle was discovered and used much earlier in India, Iran, China, Germany, Greece

and Italy. When we told students this many students, particularly those with ancestry in those countries, seemed excited.

We then gave all the students a copy of Pascal's triangle with some missing numbers and asked students to work in pairs to find the missing numbers. We chose pairs over groups as finding the numbers is not a very open ended task and we did not want students to feel left out, which can happen in a group of 4. After the students had found the missing numbers we gave them the Pascal handout we have created. The handout asks students to first find the sum of the numbers in the rows and then to shade the odd numbers to think about patterns, then we ask students to explore and find their own patterns. In the past we tried a version of this where we only asked students the more open question of exploring and finding patterns, but we found that was not engaging enough for some of the students. This version resulted in very high levels of engagement.

In the handout we show students what triangular numbers are and ask them to find some triangular numbers. You may prefer to teach students about triangular numbers if students don't know about them. It is really nice for the students who don't know these numbers to see them, work some more out, and then to see that they are represented in Pascal's triangle:





Extensions

- Lattice task, page 6
- Pascal's Triangle with empty rows, page 7
- Can you start with a different number, other than 1? What would the triangle look like?

youcubed®

Pascal's Triangle Handout

Look for patterns and fill in the missing numbers.

					1					
				1		1				
			1		2		1			
		1		3		3		1		
	1		4				4		1	
1		5		10		10		5		1
	1		6		15		20		15		1
		1		7		21		35		21		7		1
	1		8				56		70		56		8		1
1		9		36		84		126		126		84		36		9		
1	10		45		120		210		252		210		120		45		10		1

youcubed®

Pascal's Triangle Handout

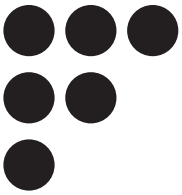
In pairs investigate these patterns.

1. Find the sum of each row in Pascal's Triangle. Is there a pattern?

2. Shade all of the odd numbers in Pascal's Triangle. Is there a pattern?

3. Triangular numbers are numbers that can be drawn as a triangle.
For example, 3 is a triangular number and can be drawn like this.

6 is a triangular number and can be drawn like this.



Find and represent the next two triangular numbers.

Can you find triangular numbers in Pascal's Triangle?

4. Find one more pattern in Pascal's Triangle and be prepared to share your findings with the class.

youcubed®

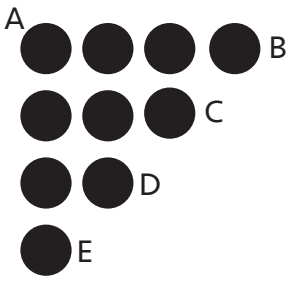
Pascal's Triangle
Display

					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	
		1		7		21		35		35		21		7		1	
	1		8		28		56		70		56		28		8		1	
1		9		36		84		126		126		84		36		9		1
1	10		45		120		210		252		210		120		45		10		1

youcubed®

Pascal's Triangle
Extension Activity

Extension Activity: Lattice

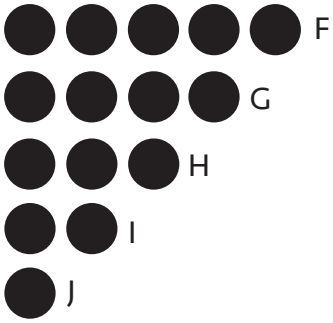


You are at point A. As you move around the grid, you are only allowed to take steps to the right or down. How many ways are there to get to the following points:

B?
C?
D?
E?

How did you find these answers? Can you justify why they are correct? What would happen if you were allowed to move any direction? Would your answers change?

Now suppose we add another diagonal row of dots to our lattice:



How many ways are there to get to all of the new points:
F? G? H? I? J?

How did you find these answers?

youcubed®

Pascal's Triangle
Extension Activity

					1					
				1		1				
			1		2		1			
		1		3		3		1		
	1		4		6		4		1	
1		5		10		10		5		1