

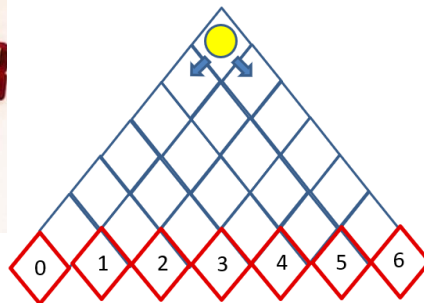
2026 Canberra Mathematical Association Conference



Canberra  
Mathematical  
Association

# Mathematics: Are You Game?

Saturday 28 March • 9am–5pm



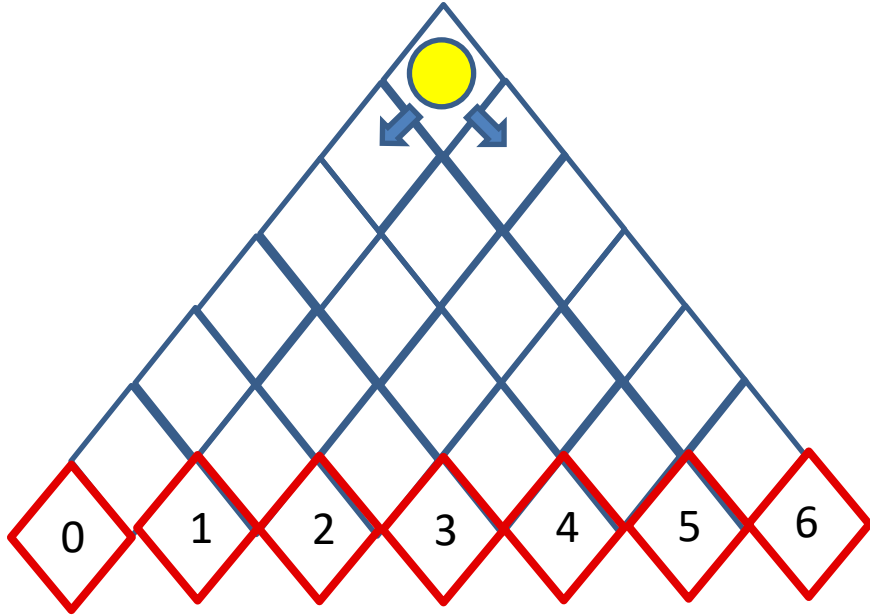
28 March 2026

# From a simple game to powerful patterns

Brian Lannen

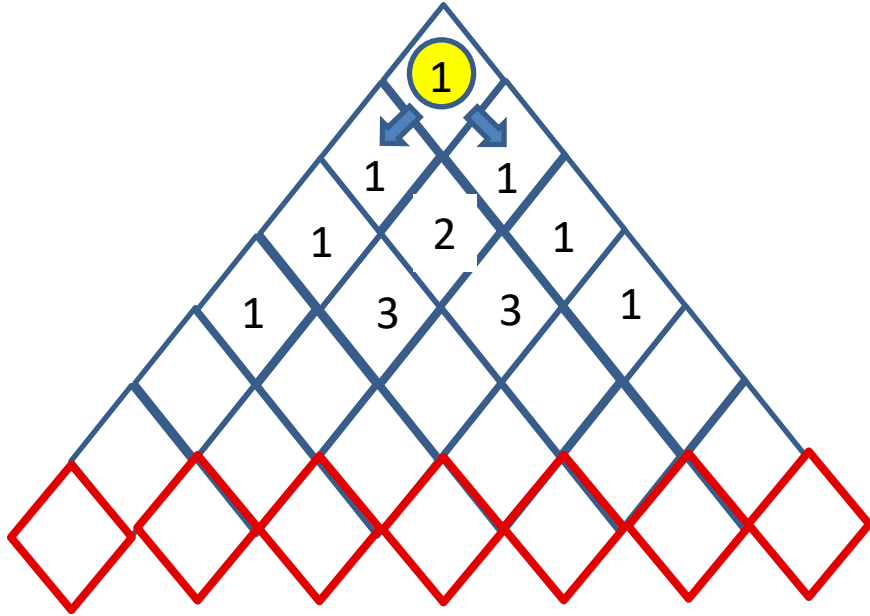


# Boardgame



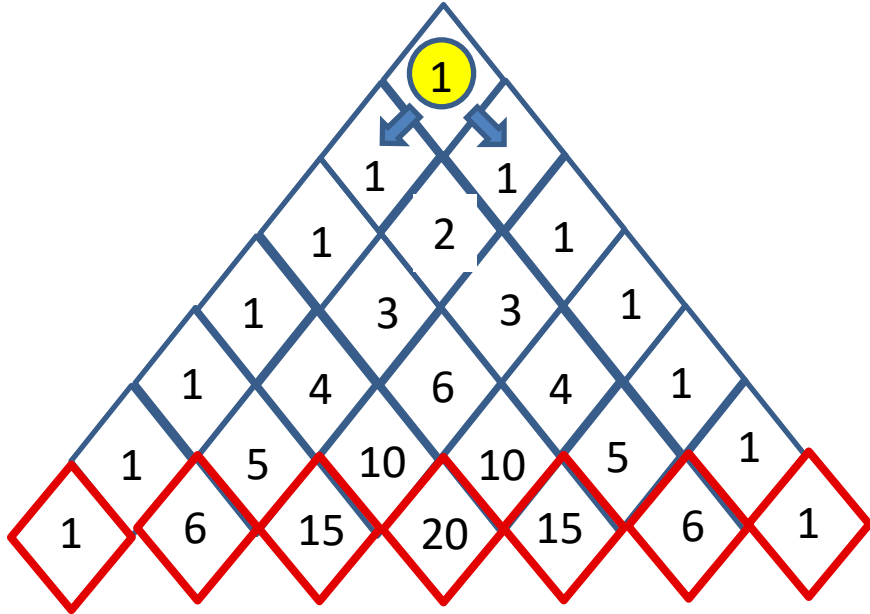
- The game is played by one person.
- Start by placing a moveable counter in the top space.
- Toss a coin and observe Heads or Tails.
- If Heads, move the counter down the board to the left.
- If Tails, move the counter down the board to the right.
- After 6 coin tosses the counter will be in one of the red spaces at base of the gameboard.
- Take note of the space number 0-6.

# How many possible pathways are there to each place on the board?



- Take note of the symmetry.
- You complete the next row.

# How many possible pathways are there to each place on the board?



- Take note of the symmetry.
- You complete the next row.
- Take note how each new value is generated from preceding values in the row above.
- You complete the rest.
- Yes, this is the famous **Pascal's Triangle**.
- It contains many magical number sequences within it.
- - including the **Fibonacci Sequence**.

# Use of technology to simulate the data

TI-84 Plus CE calculator screen showing random number generation:

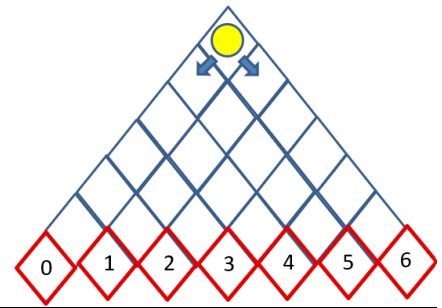
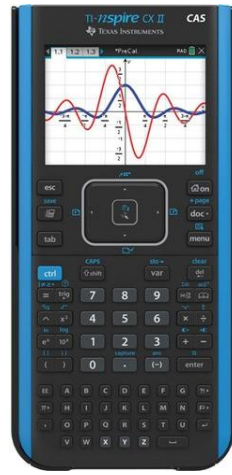
```

1.1  *Doc  RAD
randInt(0,1) 0
randInt(0,1) 1
randInt(0,1) 0
randInt(0,1) 1
randInt(0,1,6) {1,0,1,0,0,0}
sum(randInt(0,1,6)) 3
    
```

TI-84 Plus CE calculator screen showing a list of random numbers:

```

RANDOM
1:rand
2:randint(
DEG
randint(0,1) 0
randint(0,1) 1
randint(0,1) 1
Σx=16 (randint(0,1)) 3
    
```



TI-84 Plus CE calculator screen showing a function table:

```

DEG
FUNCTION TABLE
1: Add/Edit Func
2: f(
3: 9(
DEG
f(x) = Σx=16 (randin
    
```

TI-84 Plus CE calculator screen showing list settings and 1-Var statistics:

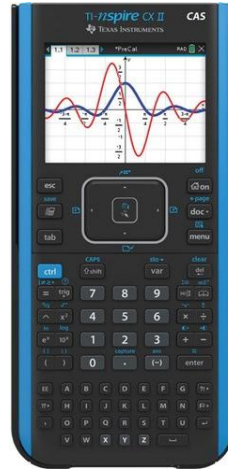
```

DEG
L2(1)E3
DEG
EXPR IN X: X
START X: 1
END X: 50
STEP SIZE: 1
DEG
1-Var: L2, 1
1: n=50
2: x̄=3
3: Sx=1.27775313
    
```

# Use of technology to simulate the data

TI-Nspire CAS interface showing random number generation and summation:

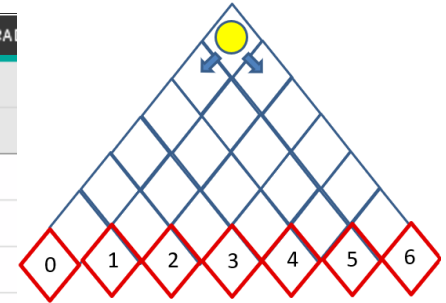
```
randInt(0,1) 1  
randInt(0,1) 0  
randInt(0,1) 1  
randInt(0,1,6) {1,0,1,0,0,0}  
sum(randInt(0,1,6)) 3
```



TI-Nspire CAS interface showing a statistical table and summary statistics:

A	game	B	C	D
=			=OneVar(	
2	1	$\bar{x}$		3.
3	4	$\Sigma x$		300.
4	2	$\Sigma x^2$		1064.
5	5	$s_x := s_{n-...}$		1.28708
6	0	$\sigma_x := \sigma_{n-...}$		1.28062

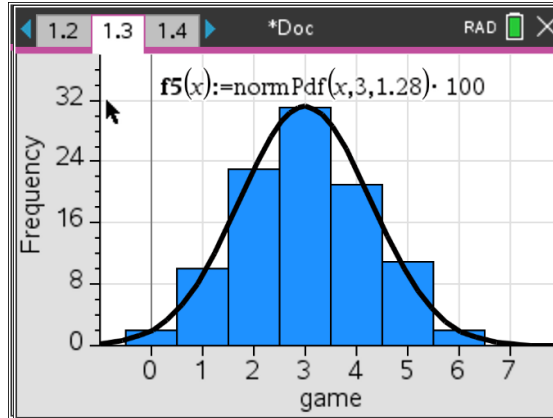
AI =sum(randint(0,1,6))



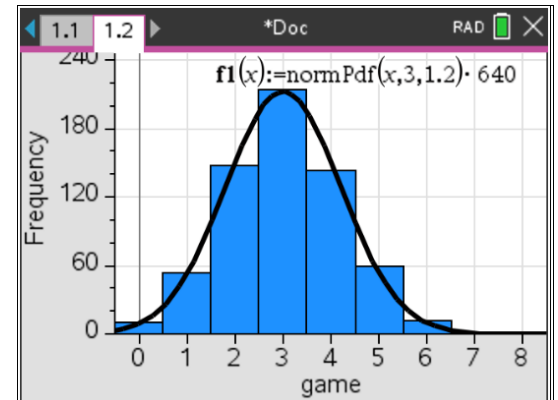
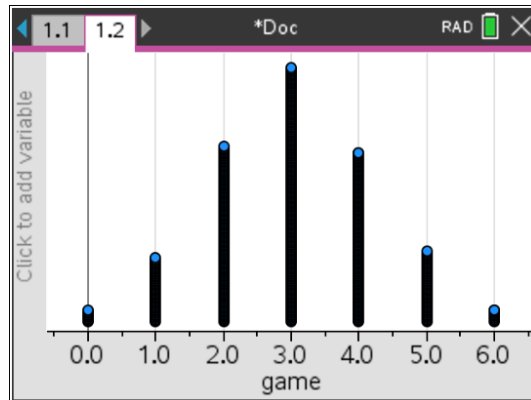
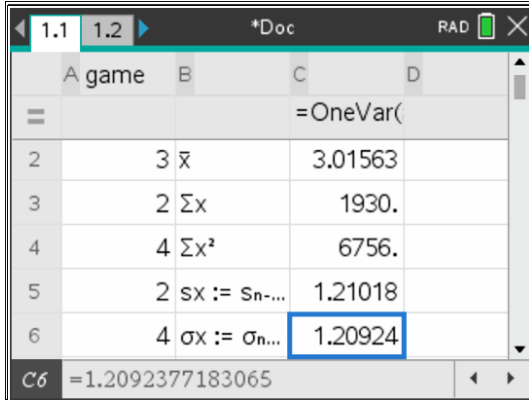
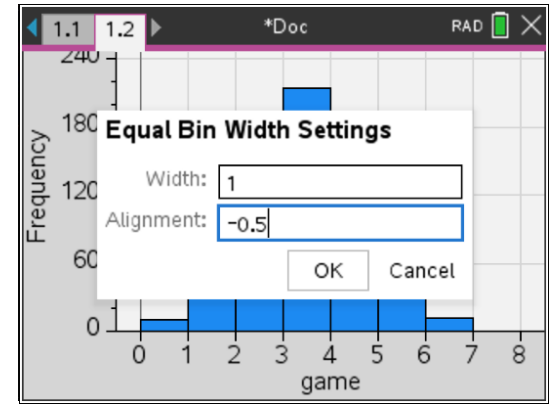
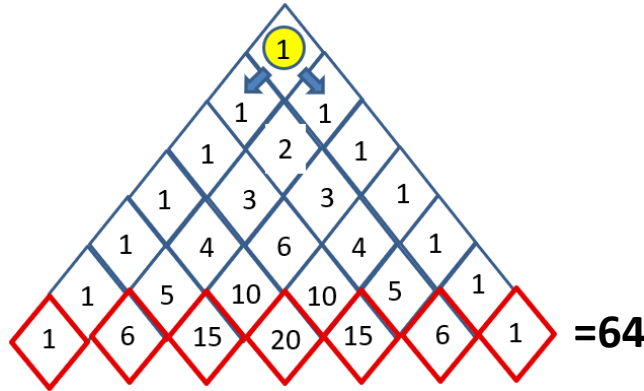
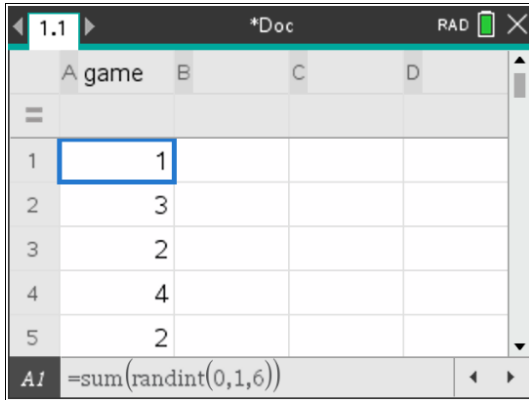
TI-Nspire CAS interface showing a data table and a summation formula:

A	game	B	C	D
=				
1	4			
2	3			
3	3			
4	2			
5	3			

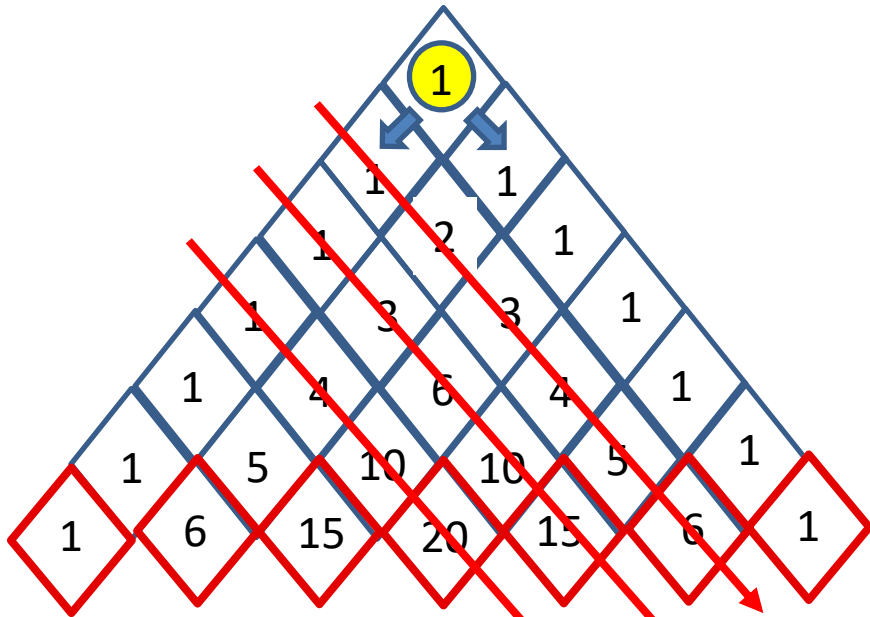
AI =sum(randint(0,1,6))



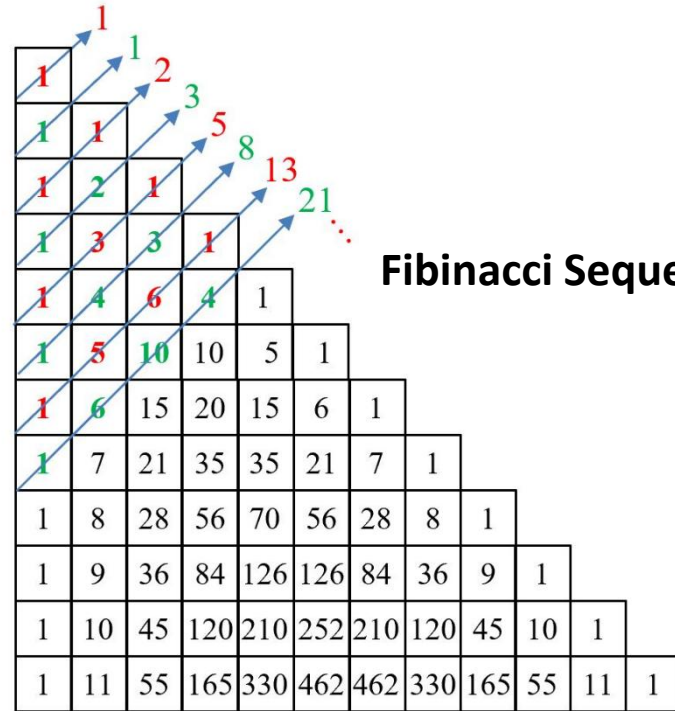
# Empirical results V theoretical prediction



# Patterns in the Pascal



**Natural Numbers**  
**Triangular Numbers**  
**Tetrahedral Numbers**



**Fibonacci Sequence**

# Use of technology to generate these sequences

1.1 \*Doc RAD

	A natural	B	C	D
=	=seqgen(			
1	1			
2	2			
3	3			
4	4			
5	5			

A/ =1

1.1 \*Doc RAD

	A natural	B triang...	C tetrah...	D fibona...
=	=seqgen(t =seqgen(r			
1	1	1		
2	2	3		
3	3	6		
4	4	10		
5	5	15		

B/ =1

1.1 \*Doc RAD

	A natural	B triang...	C tetrah...	fibona...
=	=seqgen(t =seqgen(r ='natural*(			
1	1	1	1	
2	2	3	4	
3	3	6	10	
4	4	10	20	
5	5	15	35	

C/ =1

1.1 \*Doc RAD

**Sequence**

Formula:  $u(n) = u(n-1) + 1$

Initial Terms: 1

n0: 1

nMax: 20

nStep: 1

Ceiling Value:

OK Cancel

1.1 \*Doc RAD

**Sequence**

Formula:  $u(n) = n \cdot (n-1) / 2$

Initial Terms: 1

n0: 2

nMax: 21

nStep: 1

Ceiling Value:

OK Cancel

1.1 \*Doc RAD

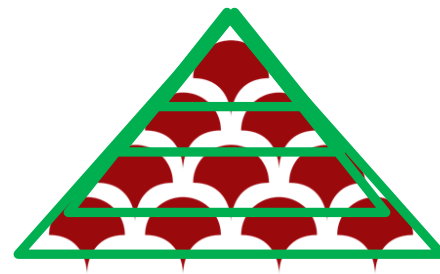
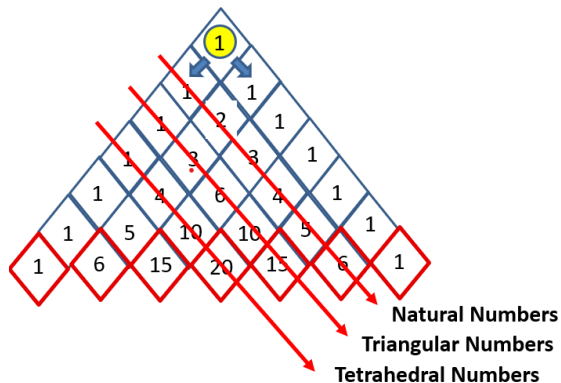
	A natural	B triang...	C tetrah...	fibona...
=	=seqgen(t =seqgen(natural+2)			
1	1	1	1	
2	2	3	4	
3	3	6	10	
4	4	10	20	

C

$\frac{\text{natural} \cdot (\text{natural} + 1) \cdot (\text{natural} + 2)}{6}$

# Use of technology to generate these sequences

	A natural	B triang...	C	D
1	1	1		
2	2	3		
3	3	6		
4	4	10		
5	5	15		



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INTERNATIONAL SCHOOL

**Quadratic Regression**

X List: 'natural' ▶

Y List: 'triangular' ▶

Save RegEqn to: f1 ▶

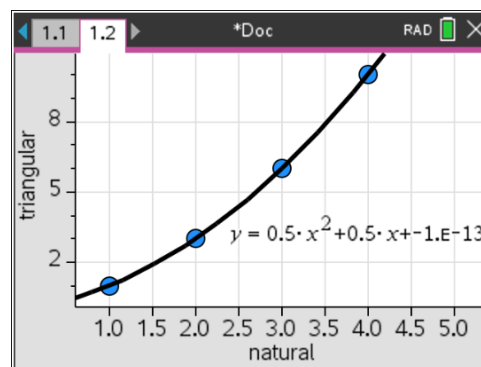
Frequency List: 1 ▶

Category List: ▶

Include Categories: ▶

OK Cancel

	A natural	B triang...	C	D
2	2	3	RegEqn	a*x^2+b...
3	3	6	a	0.5
4	4	10	b	0.5
5	5	15	c	-1.E-13
6			R <sup>2</sup>	1.



# What is a “difference equation” and why is the Fibonacci sequence considered a “second order difference equation”?

1.1 \*Doc RAD

	A fibona...	B	C	D
=				
1		1		
2		1		
3		$=a1+a2$		
4				

1.1 \*Doc RAD

	A fibona...	B	C	D
=				
16		987		
17		1597		
18		2584		
19		4181		
20		6765		

A3:A20

1.1 \*Doc RAD

**Sequence**

Formula:  $u(n)=u(n-1)+u(n-2)$

Initial Terms: 1,1

n0: 1

nMax: 20

nStep: 1

Ceiling Value:

1.1 \*Doc RAD

	A fibona...	B	C	D
=		$=\text{seqgen}(u$		
1		1	1	
2		1	1	
3		2	2	
4		3	3	
5		5	5	

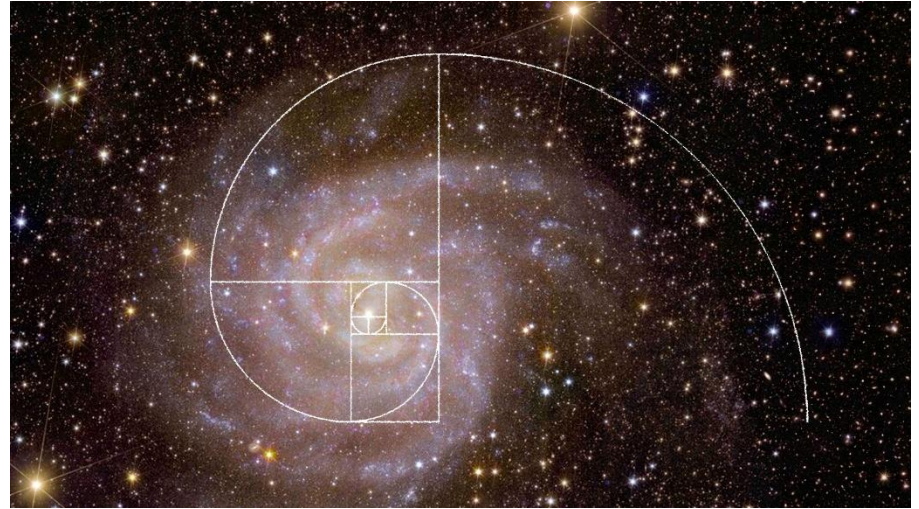
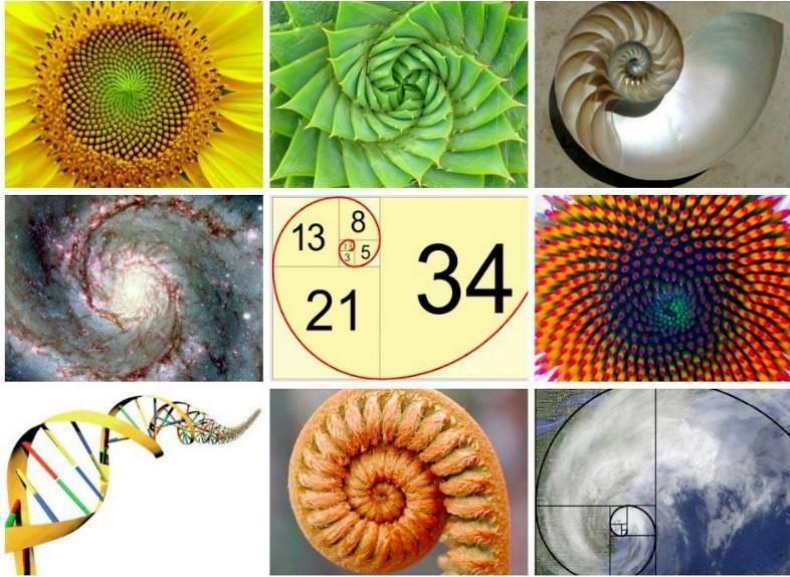
B  $=\text{seqgen}(u(n-1)+u(n-2),n,u,\{1,20\})$

1.1 \*Doc RAD

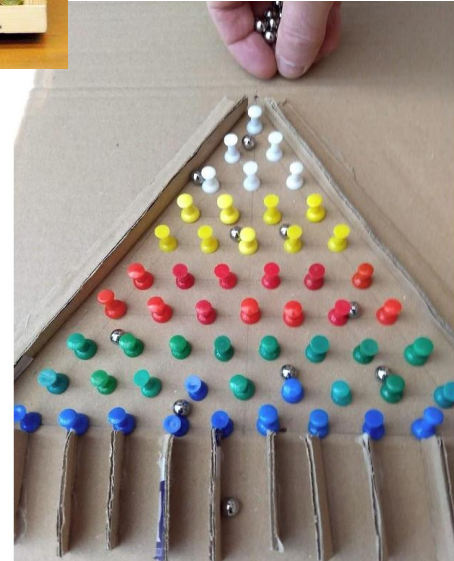
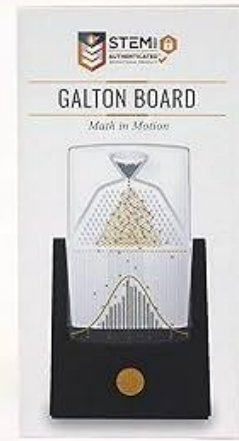
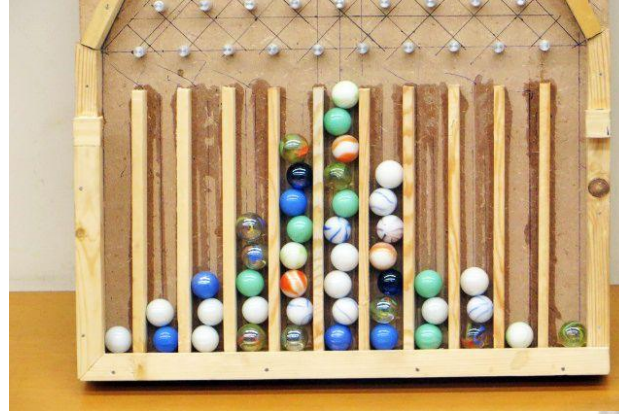
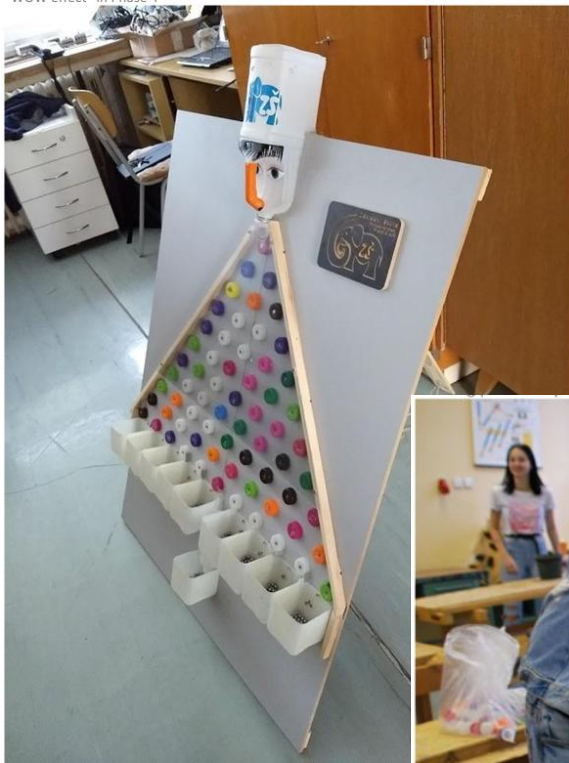
	A simple	B comp...	C	D
=				
1	10000	10000		
2	11000	11000.		
3	12000	12100.		
4	13000	13310.		
5	14000	14641.		

D4

# STEM connections



# STEM connections



# Just a few more interesting links:

<https://www.mathsisfun.com/data/quincunx.html>

<https://www.mathsisfun.com/data/quincunx-explained.html>

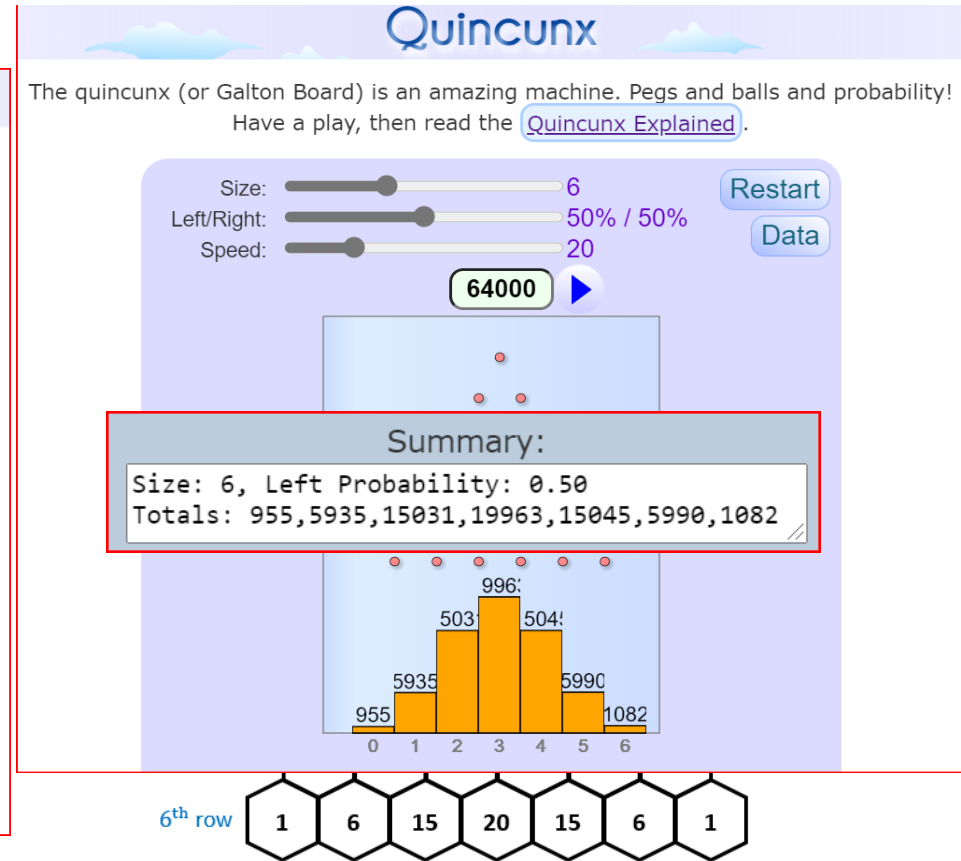
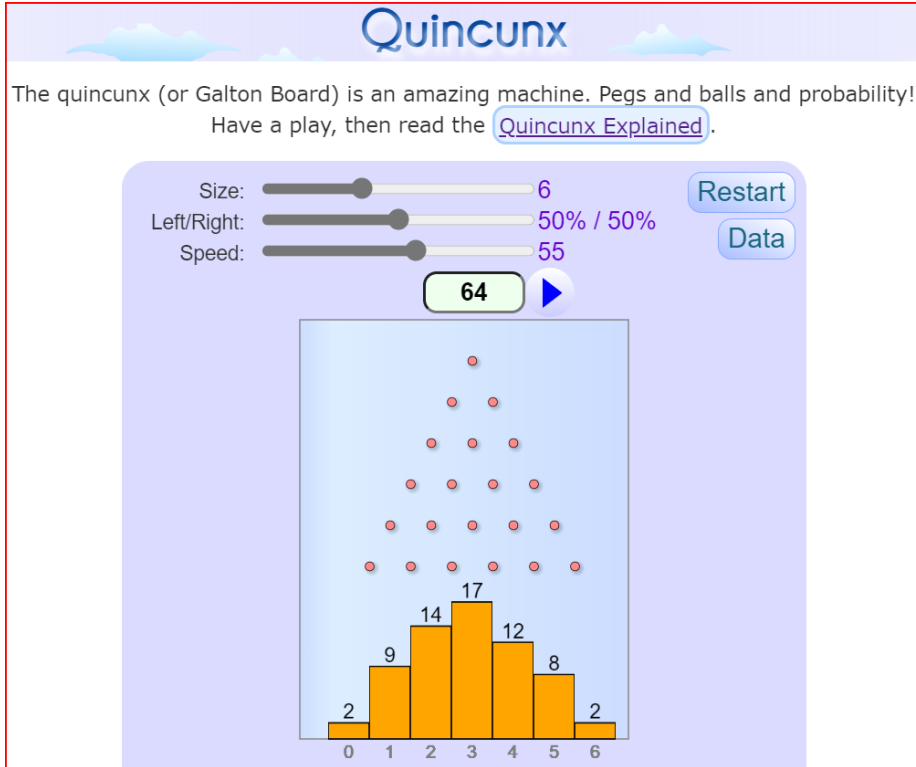
<https://galtonboard.com/>

[Classroom Activities: Pascals Triangle Hidden Gems - Texas Instruments - content](#)



# Results from a simulator:

[Quincunx \(Galton Board\) \(mathsisfun.com\)](https://mathsisfun.com)



# Resources for more activities

## Triangular Numbers

### Teacher Notes & Answers

7 8 9 10 11 12



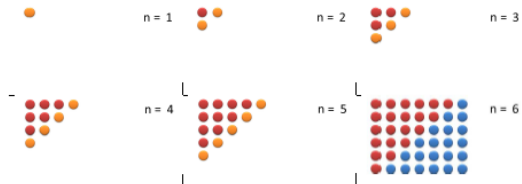
### Introduction to Induction

What is the sum of the first  $n$  whole numbers?

There are several ways this problem can be solved. Given any value for  $n$  you could add the numbers up, one by one, but if  $n$  is large this could take a lot of time. A formula would be a much quicker way to determine such a sum. In this activity you will work with a range of visual and numerical methods to arrive at a formula. However, the formula is based on observation, intuition and a relatively small sample of numbers. There are many cases where formulas seemed to work, but are later found to be flawed. In the final stage of this activity you will prove that your formula works for all whole number values for  $n$ .

### Visual Observation

The series of diagrams below shows one way to visual sums of the first  $n$  whole numbers. In each case the new row (orange) shows the quantity being added. The diagrams show why the pattern is referred to as 'triangular' numbers. The last representation includes a duplication of the pattern.



#### Question: 1.

The following questions refer to the last pattern ( $n = 6$ ).

- How many dots in the last pattern?
- Explain how you determined this quantity.
- What is the sum of the first 6 whole numbers?

#### Question: 2.

Determine the sum of the first 7 whole numbers without using 'addition'.

#### Question: 3.

Generalise your answer to Question 2 for the sum of the first  $n$  whole numbers.

Author: P. Fox

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L1	L2	DEG
1 3 6 10 15 21 28 36 45 55	-----	
L1(10)=55		
DEG EXPR IN $x:(x*(x-1)/2)$ ↑ START $x:2$ END $x:11$ STEP SIZE:1 SEQUENCE FILL		

## Activity Starters

APPROVED FOR  
HSC EXAMS

education.ti.com/australia

TEXAS INSTRUMENTS

DEG	▲▼
10 $\sum_{x=1} (x)$	55
11 nCr 2	55
DEG	▲▼



# Tetrahedral Numbers



## Student Worksheet

7 8 9 10 11 12



TI-30XPlus  
MathPrint™



Activity



Student



50 min

## Finding Patterns

What are the Tetrahedral numbers? The prefix 'tetra' refers to the quantity four, so it is not surprising that a tetrahedron consists of four faces, each face is a triangle. This triangular formation can sometimes be found in stacks of objects. The series of diagrams below shows the progression from one layer to the next for a stack of spheres.



Row Number	1	2	3	4	5
Items Added					
Complete Stack					

### Question: 1.

Create a table of values for the row number and the corresponding quantity of items that are added to the stack.

Answer:

Row	1	2	3	4	5
Items:	1	3	6	10	15

### Question: 2.

Create a table of values for the row number and the corresponding quantity of items in a complete stack.

Answer:

Row	1	2	3	4	5
Items:	1	4	10	20	35

```

DEG
CLR FORMULA OPS
1:Sort Sm-Lg...
2:Sort Lg-Sm...
3:Sequence...
    
```

```

DEG
EXPR IN x:x^3/6+x^2/2+x+x/3 ↑
START x:1
END x:12
STEP SIZE:1
SEQUENCE FILL
    
```

LN	DEG	LN
1	1	-----
3	4	
6	10	
10	20	

L2(1)=1

```

DEG
Σ ( x^2+x )
x=1
35
    
```