

0 WARM-UP ACVITITY

BIG IDEAS: Identifying Patterns, Making Connections, Algorithms

The letters in the phrase "What is Discrete Math" have been scrambled and placed in groups of three.

Scramble #1:	HTA	TEM	ERC	DIS	SIT	WHA
Scramble #2:	WET	HRE	ACM	TSA	IIT	SDH
Scramble #3:	STE	DMA	ITT	HAW	REI	SCH
Scramble #4:	AHW	TME	IAT	STE	DHR	ISC

One of the scrambles was generated by randomly selecting the message letters from a hat while the other three scrambles were generated using an algorithm based on a basic geometrical concept.

1. Identify which is the random selection scramble and explain how/why you arrived at your decision.

2. What geometrical concept was central to the scrambling algorithm?

Some Connections/Ideas for Extensions

- How would using other shapes affect the scrambling algorithm?
- How many total possible ways are there for scrambling the letters in the phrase?
- What are some modifications could you make to the scrambling algorithm?

1 QUICK START >> ANIMAL SURVIVAL

BIG IDEAS: Visual Representations, Equivalence, Appearance vs. Structure

source of this activity: <http://www.colorado.edu/education/DMP>

The zoo keeper of a major zoo wants to redo the zoo in such a way that the animals live together in their natural habitat. Unfortunately, it is not possible to put all the animals together in one location because some are predators of others. The X marks in the chart at right show a predator-prey relationship, so those pair of animals cannot be safely placed in the same location.

Create a graph that represents the relationships indicated in the chart.

	A	B	C	D	E	F	G	H
A		X			X			
B	X			X			X	
C								X
D		X				X		
E	X							
F				X				
G		X						
H			X					

Some Connections/Ideas for Extensions

- What is the minimum number of locations required to safely house all of the animals?
- If the graph represented a computer network, what are the most crucial edges?
- If you needed to deliver items to 6 different classrooms, what would be the most efficient route?

2 ACTIVITY: SPROUTS

BIG IDEAS: Quantifiable Differences, Data Collection & Analysis, Pattern Recognition

The Game of Sprouts was invented in 1967 by Princeton mathematician John H. Conway and by Michael S. Paterson, when both were at the University of Cambridge in the UK.

With a partner, play a couple of Sprouts game that begins with 3, 4, or 5 vertices.

**Determine the maximum number of moves possible in a Sprouts game that begins with 42 vertices.
(without actually playing a game with that many vertices)**

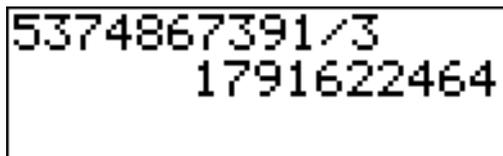
Some Connections/Ideas for Extensions

- What would happen to the game if you changed some of the rules?
- How could you figure out if there is a winning strategy?
- How are Sprouts games connected to 3-dimensional nets and Euler?

3 QUICK START >> DECEPTIVE CALCULATOR

BIG IDEAS: Partitions, Divisibility Rules, Number System, Limits of Technology

Below is a screen capture from a division calculation done using a TI-84 calculator.



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5374867391/3
1791622464
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Discuss at least two different ways that you can show that the calculator is providing false information.

Some Connections/Ideas for Extensions

- What is “casting out nines” and why was it important before computing devices?
- Is there a divisibility rule for multiples of 7?
- What are some algorithms for determining if a number is prime or composite?

4 ACTIVITY: UNLUCKY 13

BIG IDEAS: Organizing Patterns, Modular Arithmetic, Taming the Infinite, Proof

What is the maximum number of times Friday the 13th that can occur within a single January to December calendar year? Show/Explain your method.

Is it possible to not have a Friday the 13th within a single January to December calendar year? Show/Explain your method.

Some Connections/Ideas for Extensions

- How can you tell if a book ISBN number is valid or not?
- What is Goldbach's Conjecture and how is it related to partitions?
- How do you deal with negative numbers in a modular system?

5 ACTIVITY: BYPASSING THE CHARTS

BIG IDEAS: Modular Arithmetic, Functions, Combinatorics, Going Backwards is Usually Harder

Here are two different schemes for replacing
plaintext with ciphertext
(i.e. encrypting a message)

Random Scramble:	Y	X	D	N	K
	↕	↕	↕	↕	↕	↕	↕	↕
Plaintext:	A	B	C	D	E
	↕	↕	↕	↕	↕	↕	↕	↕
Modular Scramble:	E	J	O	T	Y

Based on the information given, write the word "SECRET" using the Random Scramble ciphertext.

Based on the information given, write the word "SECRET" using the Modular Scramble ciphertext.

W S Z A K
B L S M Y

We've received a secret word that has been
encrypted using each of the schemes.

Your job is to decode this secret word.

Some Connections/Ideas for Extensions

- What are some ways to increase the number of modular scrambles?
- How can you use matrix algebra in conjunction with modular arithmetic to encipher/decipher?
- Create your own cipher system!