

<b>K-12 Outreach STEM Presentations</b>	<b>Recommended Grades</b>	<b>Virtual</b>	<b>In-person</b>	<b>Time</b>
<a href="#">Adventures in Countable County</a>	K 1 2 3 4 5 6 7 8 9 10 11 12		Y	45 mins
<a href="#">Buried Treasure</a>	K 1 2 3 4 5 6 7 8 9 10 11 12	Y	Y	45 mins
<a href="#">But Who's Counting</a>	K 1 2 3 4 5 6 7 8 9 10 11 12		Y	45 mins
<a href="#">Careers at NSA</a>	K 1 2 3 4 5 6 7 8 9 10 11 12	Y	Y	30 mins
<a href="#">Cryptanalysis 101</a>	K 1 2 3 4 5 6 7 8 9 10 11 12	Y	Y	45 mins
<a href="#">Cryptoball</a>	K 1 2 3 4 5 6 7 8 9 10 11 12	Y	Y	60 mins
<a href="#">Cryptowheel</a>	K 1 2 3 4 5 6 7 8 9 10 11 12	Y	Y	30 mins
<a href="#">Cyber Safety 101</a>	K 1 2 3 4 5 6 7 8 9 10 11 12	Y	Y	45 mins
<a href="#">Defending the Nation</a>	K 1 2 3 4 5 6 7 8 9 10 11 12	Y	Y	45 mins
<a href="#">Experimenting with Chance</a>	K 1 2 3 4 5 6 7 8 9 10 11 12	Y	Y	45 mins
<a href="#">Fermat's Last Theorem</a>	K 1 2 3 4 5 6 7 8 9 10 11 12	Y	Y	60 mins
<a href="#">Fractals</a>	K 1 2 3 4 5 6 7 8 9 10 11 12	Y	Y	60 mins
<a href="#">Gold Bug</a>	K 1 2 3 4 5 6 7 8 9 10 11 12	Y	Y	60 mins
<a href="#">How to Talk like a Computer</a>	K 1 2 3 4 5 6 7 8 9 10 11 12		Y	30 mins
<a href="#">Manipulating Math</a>	K 1 2 3 4 5 6 7 8 9 10 11 12		Y	45 mins
<a href="#">Marshmallow Challenge</a>	K 1 2 3 4 5 6 7 8 9 10 11 12		Y	55 mins
<a href="#">Mission Possible</a>	K 1 2 3 4 5 6 7 8 9 10 11 12		Y	60 mins
<a href="#">Operations Research</a>	K 1 2 3 4 5 6 7 8 9 10 11 12		Y	50 mins
<a href="#">Pascal's Triangle</a>	K 1 2 3 4 5 6 7 8 9 10 11 12		Y	50 mins
<a href="#">Patterns and Number Sequences</a>	K 1 2 3 4 5 6 7 8 9 10 11 12		Y	60 mins
<a href="#">Sir Cumference Math Adventures</a>	K 1 2 3 4 5 6 7 8 9 10 11 12		Y	30 mins
<a href="#">Skittles Guessing Game</a>	K 1 2 3 4 5 6 7 8 9 10 11 12		Y	50 mins
<a href="#">Strega Nona</a>	K 1 2 3 4 5 6 7 8 9 10 11 12		Y	45 mins
<a href="#">Taking Polls and Making Faces</a>	K 1 2 3 4 5 6 7 8 9 10 11 12		Y	30 mins
<a href="#">Winning Games: Luck or Logic</a>	K 1 2 3 4 5 6 7 8 9 10 11 12		Y	45 mins
<b>K-12 Outreach Language Presentations</b>				
<a href="#">Chinese Logic</a>	K 1 2 3 4 5 6 7 8 9 10 11 12	Y	Y	30 mins
<a href="#">Chinese New Year</a>	K 1 2 3 4 5 6 7 8 9 10 11 12	Y	Y	30 mins

## ADVENTURES IN COUNTABLE COUNTY

This interactive adventure is geared toward familiarizing students with mathematical terminology, fostering logical thinking, and demonstrating the usefulness of mathematics. This includes working with basic geometric shapes, telling time, counting, and measuring.



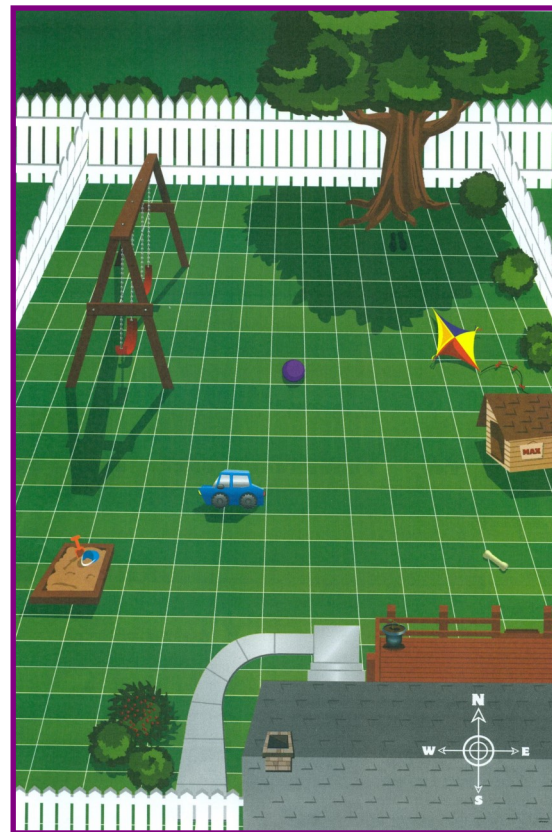
*Adventures in Countable County is appropriate for grades K-2 and requires 45 minutes to complete. This presentation is only offered in-person.*

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## BURIED TREASURE

This is a wonderful introduction to cryptology! Students are challenged to help Grandpa decode a secret message to find where a buried treasure is located. Students are introduced to the logic and math behind code breaking.

*Buried Treasure is appropriate for grades 3-5 and requires 45 minutes to complete. This presentation is offered both virtually and in-person.*



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## BUT WHO'S COUNTING?

Students play a game to create numbers based on a spin of the wheel! This is a very versatile and highly interactive talk which may be used to reinforce a number of mathematic concepts such as place value and probability. Students spin a wheel which has digits between 0 and 9, and are challenged to create specific numbers, such as the lowest, five-digit number. Other variations of this game include building a number that satisfies a speaker-defined math condition such as largest odd number or constructing addition or multiplication problems to satisfy that math condition.



*But Who's Counting is appropriate for grades 2-5 and requires 45 minutes to complete. This presentation is only offered in-person.*

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## CAREERS AT NSA

Is your school having a career day? Students are introduced to the diverse careers available at NSA, emphasizing the technical skills of the workforce. Students are invited to consider activities they like to do now and how these may fit into a future career. Alternatively, some talks may be adapted to fit into a condensed time frame. When requesting a speaker for a career day, please identify whether the Careers at NSA talk is preferred or request additional information about possible adapted talks. Material is tailored to the appropriate grade level.

*Careers at NSA is appropriate for grades 1-12 and requires 30 minutes to complete. This presentation is offered both virtually and in-person.*



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## CRYPTANALYSIS 101

CA 101 outlines basic cryptology terminology and techniques, plus examines the mathematics behind cryptanalysis (frequency counts and cipher patterns). Students will decrypt several messages using substitution and transposition techniques. Material is tailored to the appropriate grade level.



*CA 101 is appropriate for grades 4-10 and requires 45 minutes to complete. This presentation is offered both virtually and in-person.*

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## CRYPTOBALL

Students are introduced to substitution and transposition encryption methods by encoding and decoding select messages. The students then play an indoor football-like game in which the offensive team creates a secret code to designate which player will receive the pass. The defense tries to break the code to intercept the ball.



*Cryptoball is appropriate for grades 6-10 and requires 60 minutes to complete. This presentation is offered both virtually and in-person.*

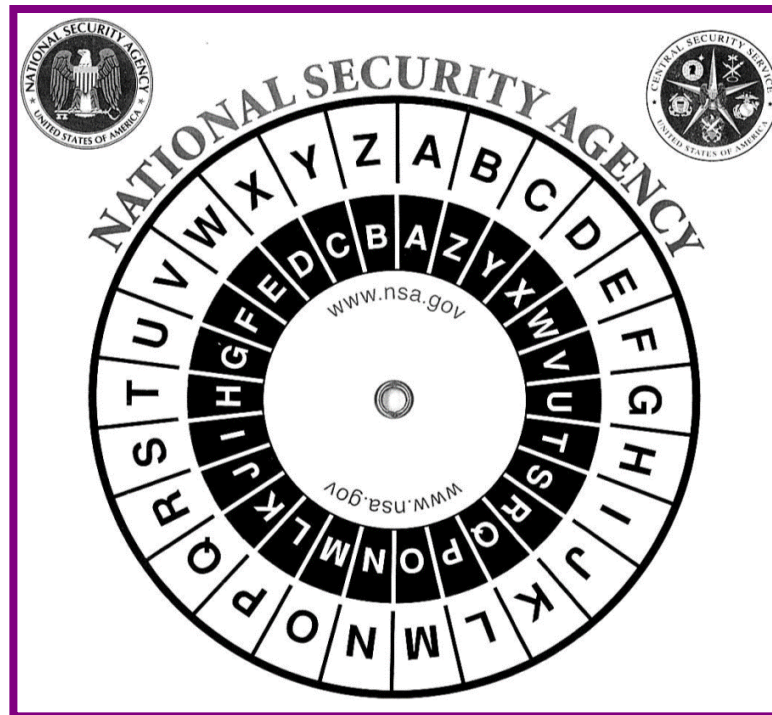
**TACKLING**

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## CRYPTOWHEEL

This talk introduces younger students to the basics of substitution cryptography. Using a cipher wheel, students match separate alphabets to determine the 'slide' of the alphabet. Students are then challenged to solve a simple substitution cipher to put their new skills to the test.

*Cryptowheel is appropriate for grades K-5 and requires 30 minutes to complete. This presentation is offered both virtually and in-person.*

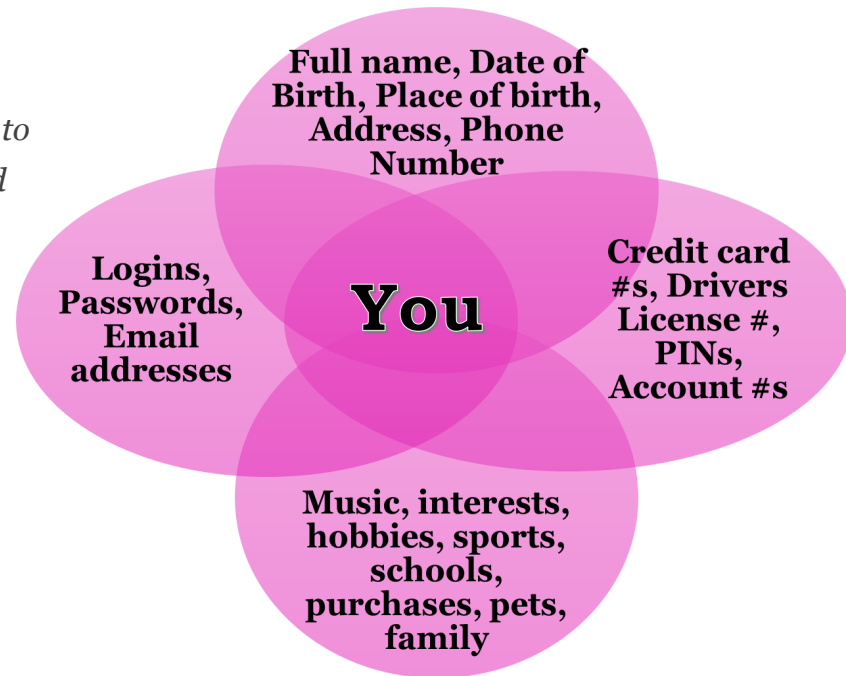




## CYBER SAFETY 101

Smartphones, computers, tablets, the internet, social media, email—these and other communication devices and methods are ever-present and ever-changing. One common thread is the need for the user to be aware of the possible threats in the cyber realm. This talk introduces cyber-security principles to increase students' knowledge about safely navigating the internet, including email and social media. Topics covered include viruses, worms, Trojan horses, identity theft, phishing, and social engineering.

*Cyber Safety 101 is appropriate for grades 6-12 and requires 45 minutes to complete. This presentation is offered both virtually and in-person.*



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## DEFENDING OUR NATION

How are you protecting yourself from threats in cyberspace? How are we protecting our country from threats in cyberspace? Combining protection and defense defines cybersecurity. This unique presentation provides a view of cybersecurity and its threats, such as infected web-sites, infected emails, phishing attacks, and social engineering from a national-level down to the home user, and presents how it takes a team to make cyberspace more secure. The talk provides “homework” on how to secure your home computer via a variety of recommended tasks.



*Defending Our Nation is appropriate for grades 8-12 and requires 45 minutes to complete. This presentation is offered both virtually and in-person.*

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## EXPERIMENTING WITH CHANCE

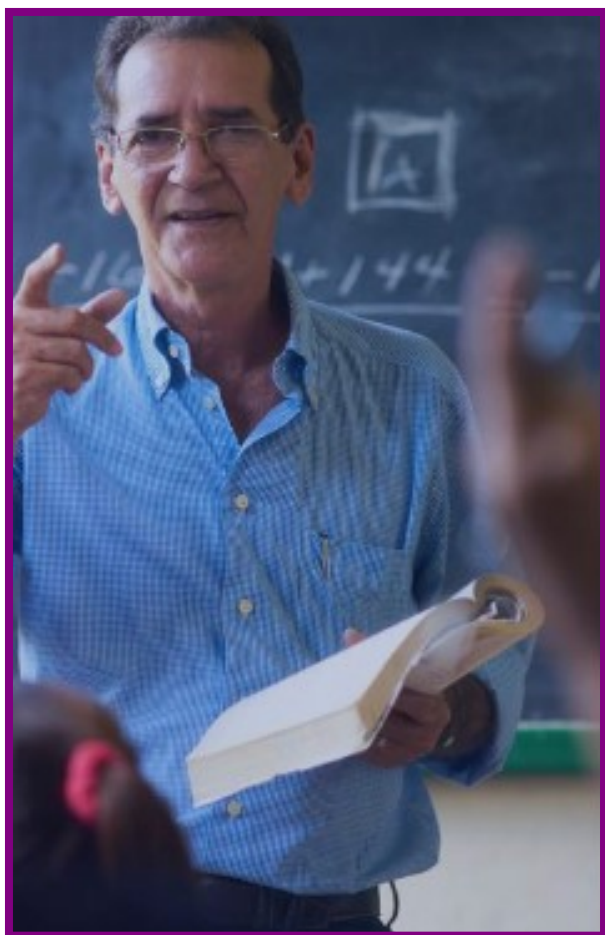
This talk introduces students to the concept of probability by exploring the scientific method. The ideas of testing hypotheses, collecting data by simulation, and empirical probability will be emphasized. Pairs of students will perform statistical experiments to test their hypotheses regarding the results of: (1) tossing a coin; (2) rolling a single die; or (3) rolling a pair of dice and taking the sum of the two faces.

*Experimenting with Chance  
is appropriate for grades 4-8  
and requires 45 minutes to  
complete. This presentation  
is offered both virtually and  
in-person.*



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## FERMAT'S LAST THEOREM



*Fermat's Last Theorem is appropriate for grades 8-12 and requires 60 minutes to complete. This presentation is offered both virtually and in-person.*

Fermat's Last Theorem is a discussion of the differences among a conjecture, a proof, and a theorem. Pierre de Fermat was a 17th century French attorney, Member of Parliament, and amateur mathematician. In number theory, Fermat's Conjecture stated that no three positive integers  $a$ ,  $b$ , and  $c$  can satisfy the equation  $a^n + b^n = c^n$  for any integer value of  $n$  greater than two. He wrote in the margin of his copy of *Arithmetica*, *Book III* by Diophantus that he had a proof, but there was insufficient room in the margins of the book to write it down. Two potential solutions (proven incorrect) are offered from an unusual source, demonstrating the rigor a proof must meet. Intended for high school students and gifted/talented middle school students. Familiarity with raising to a power is necessary.

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## FRACTALS: THE ART OF MATH

Students are introduced to fractals—geometric objects created by endlessly repeating patterns. Fractals are found almost everywhere in nature and have become a popular art form in the past decade. This talk targets students whose interests lie more in the arts than in math as it connects art and nature to math without focusing upon numbers and equations. Students draw their own fractals and learn where fractals can be found in everyday life. Material is tailored to the appropriate grade level.



*Fractals: The Art of Math is appropriate for grades 4-12 and requires 60 minutes to complete. This presentation is offered both virtually and in-person.*

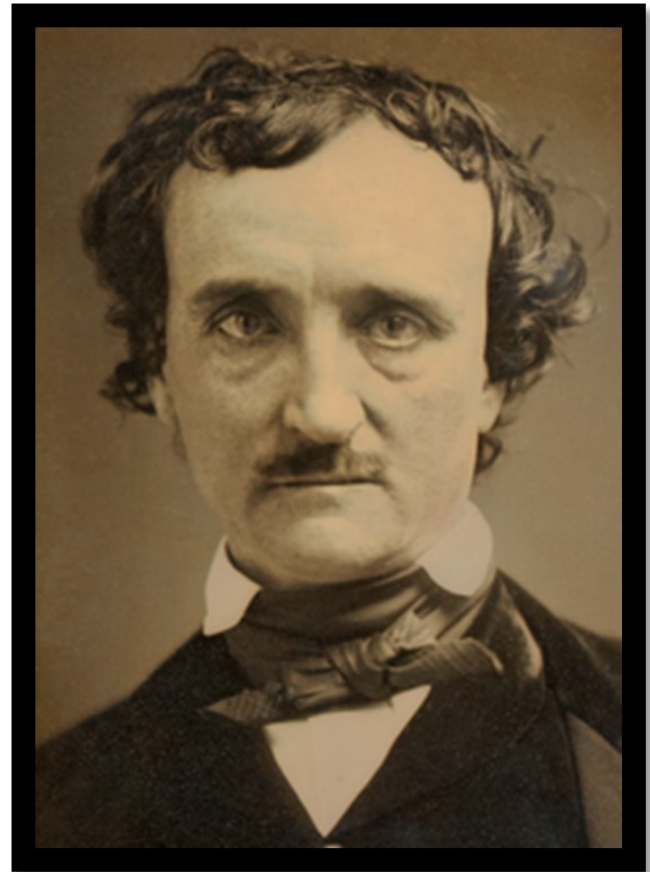
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## GOLD BUG

Edgar Allen Poe's "The Gold Bug" is a fascinating story of pirates and buried treasure. Poe tells about a slightly eccentric man who deciphers a secret message to find Captain Kidd's hidden treasure. The students hear a summary of "The Gold Bug" story and learn the problem-solving skills needed to break the code. By working together and with the presenter, the students solve this puzzle with a logical, step-by-step attack using simple statistics.

*Gold Bug is appropriate for grades 5-8 and requires 60 minutes to complete. This presentation is only offered in-person.*



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## HOW TO TALK LIKE A COMPUTER

Computers and other devices talk to each other constantly. But how do they communicate? What language is used? This talk introduces the underlying character encoding—binary, also known as the base-2 number system—essential to computer communications. Students explore how to count and interpret binary numbers and are challenged to ‘use’ the language.

```
0100001101101111011011010111000
0011101010111010001100101011100
1001110011001000000111010101101
1100110010001100101011100100111
0011011101000110000101101110011
0010000100000011000100110100101
1011100110000101110010011110010
```

*How to Talk Like a Computer is appropriate for grades 6-8 and requires 30 minutes to complete. This presentation is only offered in-person.*

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## MANIPULATING MATH

The study of statistics is mathematically rigorous, but the statistics themselves can be used, often incorrectly, in non-mathematical ways. Advertisers do not usually falsify statistics as they can be sued or fined for that; however, they still may mislead us through a variety of methods. Advertisers may present statistics that are taken out of context; that are based on too small a sample size or on a biased sample; or that are based on biased questions or words with no generally agreed-upon meaning. For example, a prominent aspirin manufacturer asked 100 doctors, if they were stranded on a desert island, would they rather have aspirin or acetaminophen? More doctors chose aspirin. But the advertisement does not tell you why. Aspirin is also an anti-inflammatory drug. This does not mean that aspirin would be their drug of choice for a headache. The statistic may be true but the question on which it is based is misleading. Consumers should be aware of how statistics can be misused to sway consumer opinions. The talk builds this awareness and is not a rigorous examination of statistics.

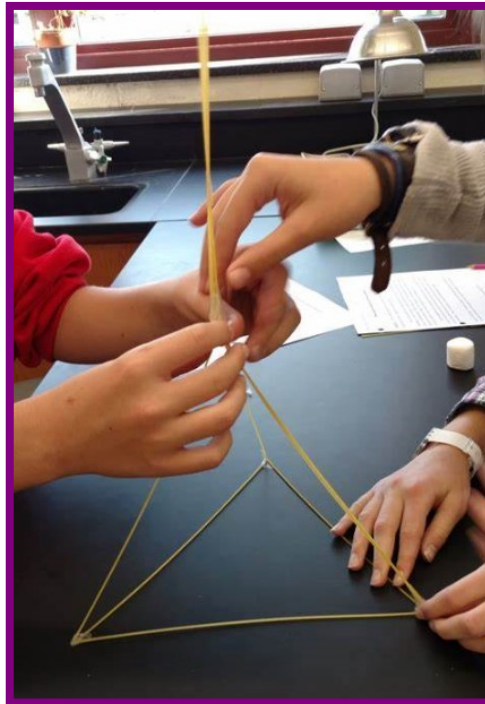


*Manipulating Math is appropriate for grades 6-12 and requires 45 minutes to complete. This presentation is only offered in-person.*

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## MARSHMALLOW TOWER CHALLENGE

Bring the Marshmallow Tower Challenge to your class. Ignite your students' engineering and leadership skills while exploring teamwork, engineering design, prototyping, success, and failure. Working in small groups, students are challenged to use the materials provided to create a standalone structure—how high will each team's tower reach?



*The Marshmallow Tower Challenge is appropriate for grades 2-12 and requires 55 minutes to complete. This presentation is only offered in-person.*

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## MISSION POSSIBLE

Your mission, should you choose to accept it, is to recover the secret code which opens a briefcase. The class will join “the Agency,” an elite group of cryptanalysts and problem solvers. They will be trained on two basic topics of cryptography and the elementary statistical properties demonstrated by each. Students work in teams to diagnose and decipher a unique encrypted message. The success of “the Agency” depends upon all teams solving their messages and then working together on one final problem to recover the secret code to the briefcase.

*Mission Possible is appropriate for grades 5-8 and requires 60 minutes to complete. This presentation is only offered in-person.*



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## OPERATIONS RESEARCH

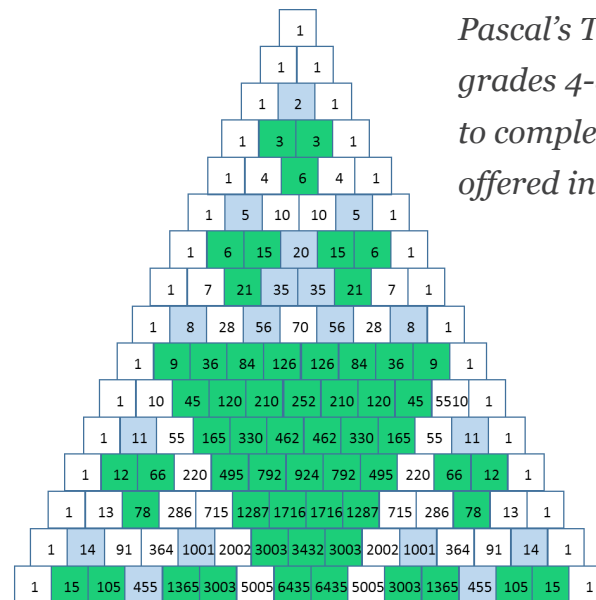
Multiple criteria decision making is a structured Operations Research methodology designed to handle the trade-offs inherent in making a decision that involves multiple criteria. It's a systematic approach for quantifying preferences. In this talk, students look at how a future college student uses multiple criteria decision making to compare unrelated factors, such as the colleges' academics, location, costs, and social life to select the best college to attend.



*Operations Research is appropriate for grades 10-12 and requires 55 minutes to complete. This presentation is only offered in-person.*

# PASCAL'S TRIANGLE

Blaise Pascal was a renowned 17th Century French scientist and mathematician. One of his most important discoveries was a collection of integers arranged in a triangular fashion which can easily be computed using only simple addition. Today, we call this construction Pascal's Triangle. The speaker guides the students through the generation of Pascal's Triangle and investigates some of the marvelous mathematical properties of Pascal's Triangle. Applications covered vary according to the level and ability of the class and include elementary probability, binary arithmetic, sequences and patterns.



*Pascal's Triangle is appropriate for grades 4-8 and requires 50 minutes to complete. This presentation is only offered in-person.*

## PATTERNS AND NUMBER SEQUENCES

Students are introduced to patterns by examining various arithmetic sequences. The students determine the rule for generating each sequence. Non-arithmetic sequences are also used. Students learn about properties of the English language, such as expected letter frequencies, and combine this knowledge with their pattern-identifying skills to decrypt a secret message. Material is tailored to the appropriate grade level.



*Patterns and Number Sequences is appropriate for grades 4-8 and requires 60 minutes to complete. This presentation is only offered in-person.*

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## SIR CUMFERENCE MATH ADVENTURES

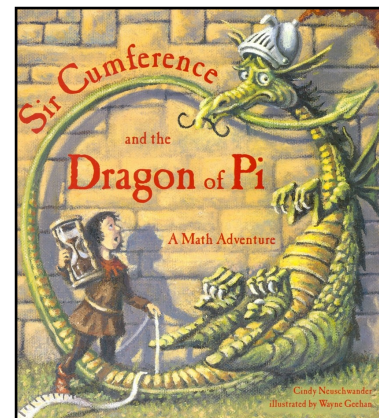
These interactive presentations are based on the illustrated children's books by the same names, written by Cindy Neuschwander and illustrated by Wayne Geehan. They are designed to be fun while reinforcing mathematical ideas such as geometry, measurement, angles, shapes, solids, problem solving, and mathematical reasoning. Available stories, as described by the author, are:

### **SIR CUMFERENCE AND THE FIRST ROUND TABLE**

*"King Arthur has a problem! He needs the perfect table to accommodate him and his knights. Assisted by his knight, Sir Cumference, and using ideas offered by the knight's wife Lady Di of Ameter and son Radius, they discover the perfect shape for the king's table."*

### **SIR CUMFERENCE AND THE DRAGON OF PI**

*"Sir Cumference, Lady Di of Ameter, and Radius are back in their second Math Adventure! This time, a potion has accidentally changed Sir Cumference into a fire-breathing dragon. Can Radius change him back in time? Join Radius on his quest through the castle to solve a riddle that will reveal the cure. It lies in discovering the magic number that is the same for all circles."*



### **SIR CUMFERENCE AND THE GREAT KNIGHT OF ANGLELAND**

*"An adventure by degrees!! Radius, son of Sir Cumference and Lady Di of Ameter, wants to be a knight more than anything. To earn his knighthood, he needs to venture alone on a heroic quest. With only an ancient family medallion (a protractor) for luck, Radius dodges dangers and dragons to find their neighbor, King Lell, who has disappeared. The ultimate challenge lies in a mysterious castle with a maze of many angles."*

### **SIR CUMFERENCE AND THE SWORD IN THE CONE**

*"King Arthur has hidden his sword, Edgecalibur. The knight who finds it will be the next king. Sir Cumference and Lady Di try to help point Vertex in the right direction. Vertex enlists the aid of the carpenters Geo and Sym of Metry in creating three-dimensional shapes from two-dimensional outlines. Will Vertex's sharp thinking give him the edge?"*

*Sir Cumference Math Adventures is appropriate for grades K-2 and requires 30 minutes to complete.*

*This presentation is only offered in-person.*

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## SKITTLES GUESSING GAME

This presentation introduces students to the important concept of estimation by exploring the scientific method. Every student is given a fun-sized bag of Skittles candy (data) and asked to predict (1) the total number of candies in the bag; (2) the most commonly occurring color in the bag; and (3) the numbers of each of the six colors occurring in the bag. After each student has made their predictions, the real fun begins. Every student will open their bag of candy to analyze the data and form conclusions. *(Skittles is a registered trademark of Mars, Inc.)*



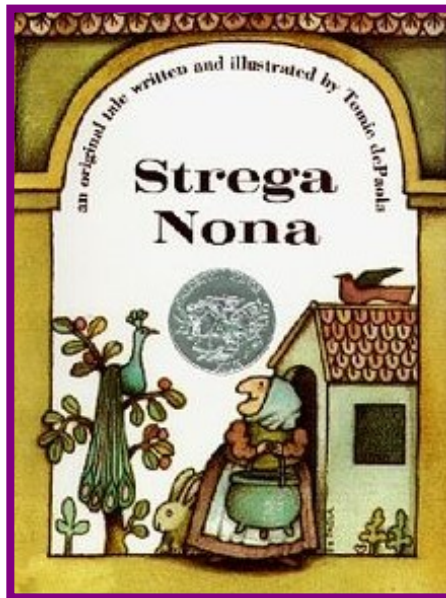
*Skittles Guessing Game is appropriate for grades 1-4 and requires 50 minutes to complete. This presentation is only offered in-person.*

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## STREGA NONA

Strega Nona, a children's book written and illustrated by Tomie de Paola, tells the story of Strega Nona, or “grandmother witch,” and Big Anthony, her hired hand. When Big Anthony doesn't pay attention and interferes with Strega Nona's magic pasta pot, he learns a very big lesson. Three mathematical activities are available: patterns, time, or money. When selecting this talk, please indicate your preferred activity (patterns, time, or money).

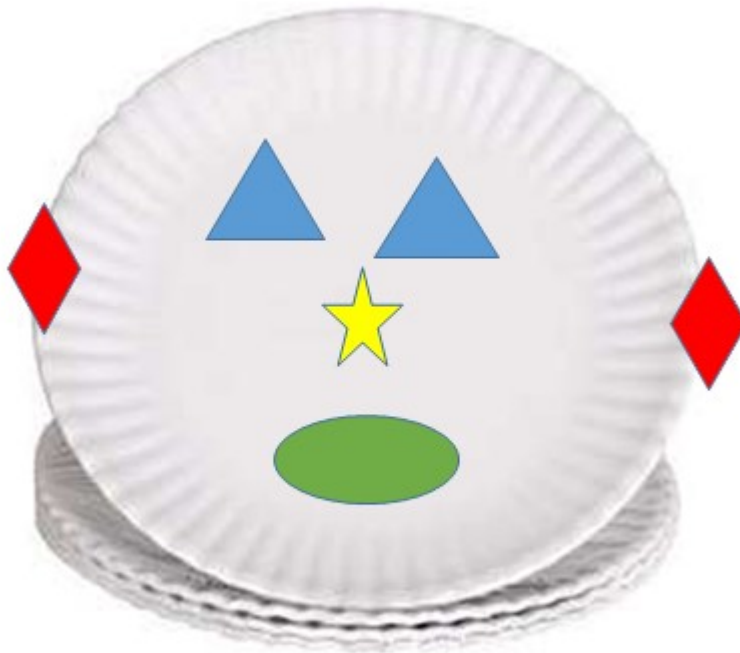


*Strega Nona is appropriate for grades K-3 and requires 45 minutes to complete. This presentation is only offered in-person.*

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## TAKING POLLS AND MAKING FACES

Students draw a face using geometric shapes to represent their answers to age-appropriate questions. By comparing their “faces” students discover how much they have in common.



*Taking Polls and Making Faces is appropriate for grades K-1 and requires 30 minutes to complete. This presentation is only offered in-person.*

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## WINNING GAMES: LUCK OR LOGIC


Students are introduced to the basic concepts of game theory. They play familiar games such as tic-tac-toe and rock-paper-scissors and examine the strategies required to win. Students are also introduced to variations on these games and must extend their analysis to determine how to adapt winning strategies.



*This activity is appropriate for grades 6-10 and requires 45 minutes to complete. This presentation is only offered in-person.*

## Chinese Logic

Chinese characters deciphered! Each picture has a meaning and by recognizing these pictures and combining them, the students will guess the meanings of new words. Through games, logic, and problem-solving, students will realize that learning a new language is fun.

海	+	马	=	
(HAI)		(MA)		SEAHORSE
Ocean		Horse		
小	+	马	=	
(XIAO)		(MA)		PONY
Small		Horse		

*Chinese Logic is appropriate for grades 3-8 and requires 45 minutes to complete. This presentation is offered both virtually and in-person.*

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## Chinese New Year

Why are there different animals associated with each Chinese New Year? Students will learn about the origin and the customs of the Chinese New Year, the character traits associated with the current year, and have fun learning the year's lucky greetings and phrases.



*This activity is appropriate for grades 3-12 and requires 30 minutes to complete. This presentation is offered both virtually and in-person.*

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