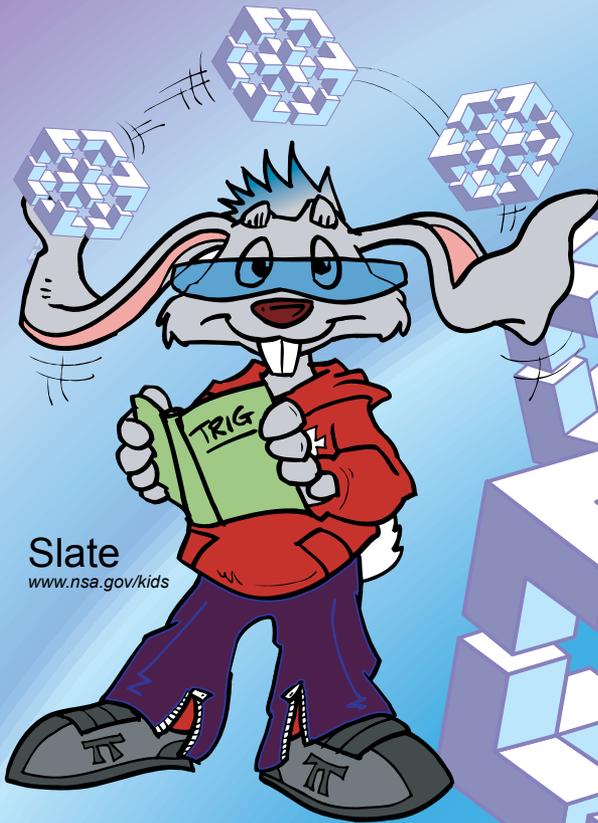


NSA
Math Education Partnership Program

Speakers Bureau

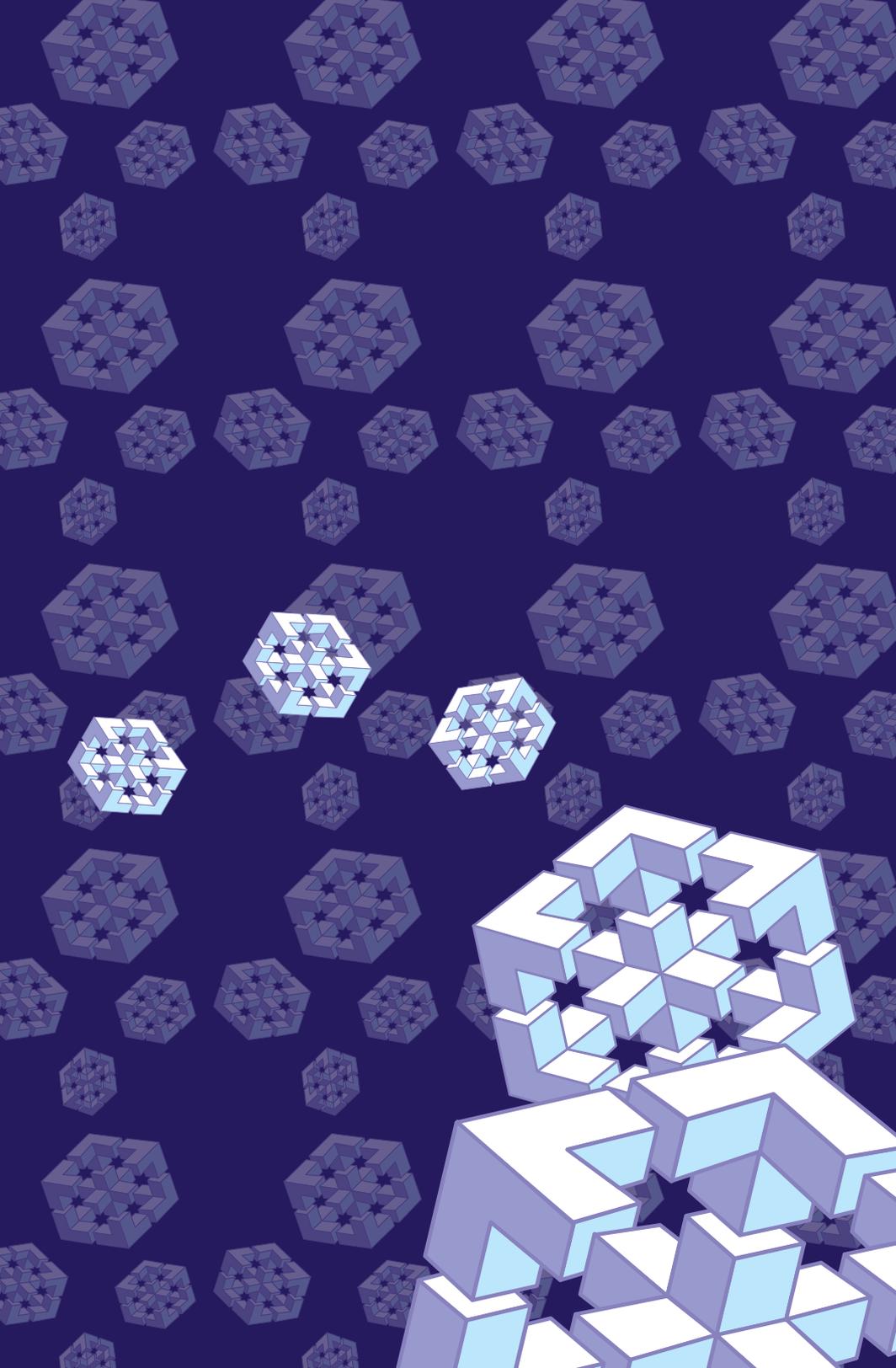
*Interactive Talks for
Kindergarten through 12th grades*



Slate
www.nsa.gov/kids

Published Fall 2010

Science, Technology, Engineering, and Mathematics
STEM & NSA: A Long-Term Partnership





National Security Agency Mathematics Speakers Bureau

The National Security Agency (NSA) is the largest employer of mathematicians in the nation and, therefore, is critically dependent on the continuing development of first-class American mathematicians. In response to concerns about a decline in the health of mathematics education in the United States, NSA has initiated several programs to support the mathematics education reform effort at the local, state, and national levels. One of these programs is the Mathematics Education Partnership Program (MEPP) Speakers Bureau, a local program with the objective of increasing students' interest in Science, Technology, Engineering and Mathematics (STEM) while presenting instruction that models the recommendations of the National Council for Teachers of Mathematics (NCTM) Standards.

The MEPP Speakers Bureau offers a large variety of fun and fascinating STEM-related talks given by NSA employees to elementary, middle or high school students. NSA hopes that the speakers' knowledge of and excitement about STEM topics will inspire students to be more enthusiastic about their future encounters with any of these subject areas.

This program is only available to schools located in the Baltimore-Washington area due to the proximity of these schools to NSA, Ft. Meade.

Introducing the CryptoKids!



NSA/CSS
CryptoKids[™]
America's Future Codemakers & Codebreakers

Meet the CryptoKids gang and get to know all about our hobbies, interests, and favorite classes.

Make your own secret codes and ciphers so that you can send secret messages to your friends.

Learn how to say hello in different languages and the art of Morse code.

Test your skills with fun games and activities.

Learn how you can work for NSA by visiting our student resources section.

Hang out with us on the web at www.nsa.gov/kids.

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Socket
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Requesting a Speaker

If you are interested in requesting a speaker, please email mepp@nsa.gov with the subject line of “<your school name>: MEPP Speakers Bureau” and the below information:

School Name:

School Address:

City:

County:

State:

Zip:

Teacher Name:

Work Phone:

Email:

Fax:

Other contact number:

Talk Requested: (please list title from catalog of topics):

1st Choice:

2nd Choice:

3rd Choice:

Grade:

Number of Homerooms:

Approximate number of students per homeroom:

Comments:

If you prefer, a copy of the form may be downloaded from the website at: http://www.nsa.gov/academia/early_opportunities/math_edu_partnership/index.shtml.

This page also links to an on-line version of this catalog. After completing the form, please fax or mail to:

National Security Agency
MEPP Speakers Bureau
ATTN: MEPP / Suite 6637
Ft. Meade, MD 20755-6637
E-mail: mepp@nsa.gov
Fax: 443-479-1193
Phone: 301-688-6214

Requests cannot be taken over the telephone. However, if you have any questions, please feel free to call us at the MEPP office on the previously mentioned phone number.

Many of the talks are interactive and, therefore, work better if the audience is small. Note that “appropriate grade levels” and “minimum time needed” are specified for each talk. Please pay attention to this information when you request a talk.

To better meet the needs of all schools, we limit each class at any school to one speaker per academic year. Please provide first, second, and third choice topics for each request to improve our ability to serve you.

Once a speaker has volunteered to visit your school, that speaker will then contact you to arrange a mutually convenient date and time to visit your classroom. To assist in this process, please be sure to include complete contact information. The more flexible you are, the better we can serve your needs! We will honor requests as our resources permit.

Please understand that all our speakers are mathematicians, computer scientists, engineers, cryptanalysts, and other NSA professionals who speak in the schools in addition to their normal duties. Speaker availability varies.

The talk must be scheduled during a time that the regular teacher, and not a substitute, will be present in the classroom; and the teacher must remain in the classroom for the entire presentation. At no time are NSA speakers to be left alone in the classroom. NSA Speakers are not responsible for classroom discipline and cannot accept liability for the students.

A speaker evaluation form is available online at http://www.nsa.gov/academia/early_opportunities/math_edu_partnership/index.shtml.

After your talk, please make a copy of this form and send it back to us with your comments.

THERE IS NO CHARGE FOR THESE TALKS.

Section I: Talks for Elementary School

Adventures in Countable County

(Appropriate for grades K-2; minimum time needed is 45 minutes)

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

Bubble Sorting

(Appropriate for grades K-2; minimum time needed is 30 minutes)

In this talk the students simulate a simple sorting algorithm by acting as components of a computer. $N+6$ children are needed, where N is the number of children to be sorted ($N=4$ or 5 is a good sort length). The N children to be sorted sit in memory and the remaining 6 children residing in the CPU are assigned jobs such as fetch, store, and swap. Concepts covered include computer architecture, algorithm, order, bubble sort, address, pointer and compare. Additional topics that could be discussed are other sorting algorithms, sort fields, complexity, efficiency, ties, time/memory trade-off, other computer algorithms, and class development of an algorithm.

Buried Treasure

(Appropriate for grades 3-5; minimum time needed is 45 minutes)

This is a wonderful introduction to cryptology! Based on the theme of a popular cartoon, students will be asked to decode directions and follow a buried treasure map in order to find the treasure.

But Who's Counting?

(Appropriate for grades 2-5; minimum time needed is 45 minutes)

Students play a game to create numbers based on the results of a spin of the wheel! A very versatile talk which may be used to reinforce a number of mathematic concepts. Students spin a wheel which has digits between 0 and 9 , and then are challenged to create specific numbers, such as the lowest, five-digit number. Other variations of this game include the class as a whole building a number that satisfies a math property given by the NSA Speaker (such as largest odd number) or the class constructing addition or multiplication

problems whose answer satisfies a math property given by the NSA Speaker. This game can also include an introduction to probability.

Careers at NSA

(Appropriate for grades K-5; minimum time needed is 30 minutes)

Is your school having a career day? Very often only 30 minutes are allotted for a speaker session on career days. We have a Career Talk to address basic career opportunities at NSA. In addition, some talks may be adapted to fit into this time frame, such as Elementary Cryptanalysis, Mathematical Ways of Thinking, and Sir Cumference Math Adventures. Please let us know if you would like the Careers at NSA talk, or whether you would prefer an adapted talk.

Elementary Cryptanalysis

(Appropriate for grades 4-10; minimum time needed is 45 minutes)

This presentation defines the basic terminology used in code breaking. It then introduces a variety of elementary ciphers. Students are led through the deciphering of several messages using various substitution and transposition ciphers. The frequencies of letters in English are discussed. For more advanced classes, a message in English is deciphered by using frequency counts. Background material and additional problems are given as handouts.

Exclamation Explanation!

(Appropriate for grades 4-6; minimum time needed is 45 minutes)

This talk is designed to take your students through the process of developing (and understanding) the mathematical concept of factorials one step at a time, by recognizing patterns, extending their thinking, and just having some fun. This talk is best for students who have never seen factorial numbers before.

Experimenting With Chance

(Appropriate for grades 4-8; minimum time needed is 45 minutes)

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. As time permits, pairs of students will perform statistical experiments to test their hypotheses regarding the

results of: (1) tossing a coin; (2) rolling a single die; (3) rolling a pair of dice and taking the sum of the two faces; or (4) rolling a 10-sided die. Relevant worksheets and charts will be provided to the students. If time permits, students will draw the bar graphs or histograms that depict the probability distribution of the outcomes of these experiments.

Fun With Geometry

(Appropriate for grades 4-6; minimum time needed is 45 minutes)

Students learn, by participating at their desks, how to quickly construct triangles, squares, hexagons (or stars) and octagons using only a compass and a straight edge. If time permits, the exercise can be extended to dividing a circle into twelve parts and drawing chords inside it with colored pencils, thus creating a kaleidoscopic effort.

Gold Bug

(Appropriate for grades 4-8; minimum time needed is 60 minutes)

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 some of Captain Kidd's hidden treasure. The students will hear a summary of "The Gold Bug" story and will learn the problem-solving skills needed to break the code. By working together and with the instructor, the students will solve this puzzle with a logical, step-by-step attack using simple statistics.

Graph Theory Every Day

(Appropriate for grades 3-5; minimum time needed is 45 minutes)

This talk introduces basic concepts of graph theory and optimization through examples that might include placing police officers on the grid of a neighborhood or finding the shortest path between two locations. Emphasis will be placed on ways that we already use these concepts in everyday life.

Likenesses and Differences

(Appropriate for K-early 1 only; minimum time needed is 30 minutes)

A domino-like game is played using large cards with pictures of shapes in differing sizes in order to explore the concept of likenesses and differences.

M&M's/Skittles Guessing Game

(Appropriate for grades 1-4; minimum time needed is 50 minutes)

This talk introduces students to the important concept of estimation by exploring the scientific method. Every student is given a fun-size bag of M&M's candies (data) from which they are asked to estimate: (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 his/her "guesses," the real fun begins. Every student is asked to open his/her bag of M&M's to gather and analyze the data, then form conclusions. All necessary worksheets and candies will be provided to the students.

Note: Plain M&M's candies carry a peanut warning. Please be aware of peanut allergies in your class before requesting this presentation. You may request that Skittles be used in place of M&M's.

M-A-T-H...It's Not Just Another Four-Letter Word!

(Appropriate for grades 4-6; minimum time needed is 45 minutes)

This talk is aimed at lower-level math students and students who think that math is not fun. The students participate in activities involving a television show and solving a mystery surrounding the show. The focus is not on arithmetic but on problem solving and decision making.

Mathematical Ways of Thinking

(Appropriate for grades 3-8; minimum time needed is 45 minutes)

Students are introduced to inductive and deductive reasoning through a variety of games and puzzles.

Mission Possible

(Appropriate for grades 5-8; minimum time needed is 60 minutes)

Your mission, should you choose to accept it, is to recover the secret code which holds the key to this briefcase... During this session, 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. They will then be divided into teams. Each team will have an encrypted message in which they

must diagnose the type of cryptography used and then decipher using the appropriate cryptanalysis techniques. 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. This interactive session presents basic cryptanalytic concepts and focuses on problem-solving techniques with a lot of teamwork.

One Dollar Shirt

(Appropriate for grades 3-4; minimum time needed is 45 minutes)

The lesson provides a general review of geometric shapes: point, line, rectangle, triangle, circle, and oval. After describing these basic geometric shapes, a fun exercise is presented to show how these shapes can be used in paper folding (Origami) using a dollar bill to create a small shirt. The students can bring in their own crisp one dollar bill, or we will supply play money.

Pascal’s Triangle

(Appropriate for grades 4-8; minimum time needed is 50 minutes)

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. During the class, the speaker will guide the students through the generation of Pascal’s Triangle and then investigate some of the marvelous mathematical properties of Pascal’s Triangle. Applications covered in class will vary according to the level and ability of the class and include: elementary probability, binary arithmetic, sequences and patterns.

Patterns and Number Sequences

(Appropriate for grades 4-8; minimum time needed is 60 minutes)

Students will be introduced to patterns by examining various arithmetic sequences. The students will determine the “rule” for generating each sequence. Non-arithmetic sequences will also be used. Students will then learn about properties of the English language, such as expected letter frequencies, in order to combine this knowledge with their pattern-identifying skills to decrypt a secret message.

Polls, Probability and You

(Appropriate for grades 3-6; minimum time needed is 45 minutes)

This talk introduces students to the concept of probability through the vehicle of a statistical survey. Appealing to the natural curiosities of students about themselves, the speaker will conduct a poll to determine prominent attributes and marked preferences of the class. Students are then given the opportunity to reveal their class profile using worksheets to answer pertinent probability questions. Venn diagrams will be used to assist students in their assessment of both conditional and unconditional probabilities. At least two examples of Venn diagrams will be used with two sets of student characteristics, such as the set of all left-handed students and the set of all girls in the class. Depending on the level of the class, a Venn diagram with three sets will be constructed and analyzed.

Science Fair Projects – A Judge’s Perspective

(Appropriate for grades 3-8; minimum time needed is 45 minutes)

Over the past years, NSA has provided science fair judges to numerous science fairs in the Baltimore-Washington area. These science fairs have ranged from non-competitive elementary school to highly competitive regional high school fairs. This talk is a compilation of our observations and is intended for both the student and teacher alike. It covers the major steps in the scientific method (problem statement, hypothesis, materials, testing/procedure, analysis, conclusion), and focuses on experiment versus demonstration, repeated trials/stratified testing, presentation and the interview.

Sir Cumference Math Adventures

(Appropriate for grades K-2; minimum time needed is 30 minutes)

These are interactive presentations based on the illustrated children’s books by the same names. They are designed to be fun while teaching mathematical ideas such as geometry, measurement, angles, shapes, solids, problem solving and mathematical reasoning. Available stories 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, together 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?

Solving Sudoku

(Appropriate for grade 4; minimum time needed is 60 minutes)

Sudoku is a Japanese word meaning "single digits only" and today is used to identify a form of logic puzzle using nine elements. Puzzle creators use numbers, symbols, letters, shapes, colors, etc. or any combination of these to differentiate between the elements. In this talk, the students will be introduced to the types of logic/ problem-solving skills they will need to use in order to complete the series of beginner-level Sudoku puzzles at the end of this talk.

Strega Nona

(Appropriate for grades 1-3; minimum time needed is 45 minutes. Patterns is appropriate for grades 1-2. Time is appropriate for advanced 2nd graders and 3rd grade. Money is appropriate for 3rd grade.)

“Strega Nona,” a children’s book written 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 different mathematical activities are available to students for this presentation with the areas of emphasis being patterns, time or money. When selecting this topic, please indicate your preferred activity (patterns, time, or money).

Taking Polls and Making Faces

(Appropriate for grades K-early 1; minimum time needed is 30 minutes)

Students will answer age-appropriate questions and will match their answers to geometric shapes. The students then draw the geometric shapes on paper plates to create faces, and compare faces to see how much they are alike and different from each other.

Total Integer Workout

(Appropriate for grades 3-4; minimum time needed is 45 minutes)

This presentation reinforces addition, subtraction, multiplication, and division skills. It will also show associative and commutative properties while encouraging independent, creative problem solving. Given a set of numbers between 1 and 9, the students will be asked to “build” another specified number between 1 and 9 using the basic arithmetic operations.

Who Can You Trust? – Cyber Safety for Kids

(Appropriate for grades 3-5; minimum time needed is 45 minutes)

Students learn about staying safe on the Internet through a variety of scenarios and role playing.

Section II: Talks for Middle School

Careers at NSA

(Appropriate for grades 6-8; minimum time needed is 30 minutes)

Is your school having a career day? Very often only 30 minutes are allotted for a speaker session on career days. We have a Career Talk to address basic career opportunities at NSA. In addition, some talks may be adapted to fit into this time frame, such as Elementary Cryptanalysis, Ethical Use of Computers, Mathematical Ways of Thinking, and STEM and Life-Long Learning. Please let us know if you would like the Careers at NSA talk, or whether you would prefer an adapted talk.

Coding Theory in Your Mailbox

(Appropriate for grades 6-12; minimum time needed is 45 minutes)

Do you ever wonder what those lines are for on the bottom of business reply postcards? This talk lets students answer this question in a hands-on manner, and, time permitting, shows other applications of “check digits” in the modern world. In more advanced classes, students can investigate questions such as, “What types of errors will such checking catch?”

Cryptoball

(Appropriate for grades 6-10; minimum time needed is 60 minutes)

Students are first introduced to various encryption methods, such as Caesar substitution, 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.

Cryptology: Past and Present

(Appropriate for grades 8-12; minimum time needed is 50 minutes)

This talk will cover the basics of cryptography. Basic terminology, historical information, and current topics will be discussed and illustrated with slides, including: (1) Simple substitution – Caesar cipher, cipher disk (Italy 1470, Civil War, WWI), Vigenere square (1586); (2) Simple transposition; (3) Combination of substitution and transposition; (4) The Enigma (WWII German cipher device); (5) Data Encryption Standard; and (6) public key cryptography.

Cyber Ethics

(Appropriate for grades 6-12; minimum time needed is 45 minutes)

Cyber ethics refers to a code of safe and responsible behavior for the Internet community. Practicing good cyber ethics involves understanding the risks of harmful and illegal behavior on-line. The information presented will help students understand the ethical issues as related to computers. Terms will be introduced and cases will be presented to help the students understand the material. Topics that will be presented include: (1) Computers and Privacy; (2) Crime, Abuse, and Hacker Ethics; (3) Responsibility; and (4) Social Implications and Consequences. The students will leave with simple guidelines on how to make an ethical decision and the Ten Commandments of Computer Ethics.

Defense Against the Dark Arts – Cyber Security Basics

(Appropriate for grades 6-12; minimum time needed 45 minutes)

Just as young wizards in the Hogwarts Academy must learn about dark magic and dark creatures to defend themselves, so must young cyber wizards learn about malware and hackers. Topics covered include viruses, worms, Trojan horses, identify theft, phishing and social engineering.

Elementary Cryptanalysis

(Appropriate for grades 4-10; minimum time needed is 45 minutes)

This presentation defines the basic terminology used in code breaking. It then introduces a variety of elementary ciphers. Students are led through the deciphering of several messages using various substitution and transposition ciphers. The frequencies of letters in English are discussed. For more advanced classes, a message in English is deciphered by using frequency counts. Background material and additional problems are given as handouts.

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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. As time permits, pairs of students will perform statistical experiments to test their hypotheses regarding the results of: (1) tossing a coin; (2) rolling a single die; (3) rolling a pair of dice and taking the sum of the two faces; or (4) rolling a 10-sided die. Relevant worksheets and charts will be provided to the students. If time permits, students will draw the bar graphs or histograms that depict the probability distribution of the outcomes of these experiments.

Fun With Geometry

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Students learn, by participating at their desks, how to quickly construct triangles, squares, hexagons (or stars) and octagons using only a compass and a straight edge. If time permits, the exercise can be extended to dividing a circle into twelve parts and drawing chords inside it with colored pencils, thus creating a kaleidoscopic effort.

Gold Bug

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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 some of Captain Kidd’s hidden treasure. The students will hear a summary of “The Gold Bug” story and will learn the problem-solving skills needed to break the code. By working together and with the instructor, the students will solve this puzzle with a logical, step-by-step attack using simple statistics.

How Many Dinosaurs Are There?

(Appropriate for grades 6-8; minimum time needed is 50 minutes)

In this talk, students are introduced to the basic notions of nonparametric statistics by learning how to statistically estimate the sizes of various populations, e.g., the number of fish in a lake, the number of deer in a forest, or the number of marbles in a jar.

The “capture-recapture” method of estimation will be addressed. Through the use of manipulatives, students will become familiar with the process of capturing, tagging, and recapturing toy dinosaurs in order to estimate the total number of dinosaurs in a given “population.” Other examples of this capture-recapture model and its assumptions may be discussed if time allows.

How to Lie With Statistics

(Appropriate for grades 6-12; minimum time needed is 45 minutes)

The study of statistics is mathematically rigorous, but the statistics themselves can be used, often incorrectly, in non-mathematical ways. TV advertisers do not usually falsify statistics – they can be sued or fined for that. However, they still mislead us with 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, Bayer Aspirin asked 100 doctors, if they were stranded on a desert island, would they rather have aspirin or Tylenol? 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 at work. The statistic may be true, but the question on which it is based is misleading. Consumers must be aware of how statistics can be misused in order to avoid being taken in by others. This talk will illustrate how this is done.

Logic

(Appropriate for grades 6-12; minimum time needed is 45 minutes)

This talk presents an introduction to logic and mathematical reasoning. All students participate in solving logic puzzles and in identifying unstated yet mathematical true statements. The principles discussed will be reinforced by presenting concepts such as Venn diagrams, syllogisms, and advertisements from current magazines.

M-A-T-H...It's Not Just Another Four-Letter Word!

(Appropriate for grades 4-6; minimum time needed is 45 minutes)

This talk is aimed at lower-level math students and students who think that math is not fun. Students participate in activities involving television and solving a mystery. The focus is not on arithmetic, but on problem solving and decision making.

Mathematical Ways of Thinking

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generating each sequence. Non-arithmetic sequences will also be used. Students will then learn about properties of the English language, such as expected letter frequencies, in order to combine this knowledge with their pattern-identifying skills to decrypt a secret message.

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Science Fair Projects – A Judge’s Perspective

(Appropriate for grades 3-8; minimum time needed is 45 minutes)

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Social Network Sites

(Appropriate for grades 6-12; minimum time needed is 50 minutes)

Every few years, a new technology or capability arises that intrigues and excites the public. Social Networking Sites (SNSs) are one such technology. In providing a place where people can easily

post their thoughts, photos, and connect with friends and family in spontaneous ways, SNSs have seen great popularity in recent years. However, there have been many stories highlighting the dangers of being too open and free with important personal or business information. Teenagers are prevalent users of SNSs; this talk will help teach them the risks and how to apply basic security principles to their on-line profiles to safeguard themselves.

STEM and Life-Long Learning

(Appropriate for Grades 6-12; minimum time needed is 30 minutes)

This presentation provides a framework for encouraging students to study in Science, Technology, Engineering, and Mathematics (STEM) subjects. Key points of the talk: technology is a major driver of innovation; students are encouraged to take advantage of any learning opportunities; technology is rapidly advancing, and that learning continues throughout your career. Appropriate for career day activities.

Tessellations

(Appropriate for grades 6-8; minimum time needed is 45 minutes)

From architecture to textiles, tessellations are all around us. In this fun geometry talk, students discover how repeating patterns have been used around the world throughout history. There's plenty of room for creativity as students learn the basic features of pattern design and create their own tessellations.

Winning Games: Luck or Logic?

(Appropriate for grades 6-10; minimum time needed is 45 minutes)

This presentation introduces students to some of the basic concepts of game theory. By first discussing a simple game, then playing the game in pairs, fundamentals of picking strategies are demonstrated. After each game is played, the group discusses the strategies available and which ones worked the best.

Section III: Talks for High School

Careers at NSA

(Appropriate for grades 9-12; minimum time needed is 30 minutes)

Is your school having a career day? Very often only 30 minutes are allotted for a speaker session on career days. We have a Career Talk to address basic career opportunities at NSA. In addition, some talks may be adapted to fit into this time frame, such as Elementary Cryptanalysis, Ethical Use of Computers, and STEM and Life-long Learning. Please let us know if you would like the Careers at NSA talk, or whether you would prefer an adapted talk.

Coding Theory in Your Mailbox

(Appropriate for grades 6-12; minimum time needed is 45 minutes)

Do you ever wonder what those lines are for on the bottom of business reply postcards? This talk lets students answer this question in a hands-on manner, and, time permitting, shows other applications of “check digits” in the modern world. In more advanced classes, students can investigate questions such as, “What types of errors will such checking catch?”

Cryptoball

(Appropriate for grades 6-10; minimum time needed is 60 minutes)

Students are first introduced to various encryption methods, such as Caesar substitution, 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.

Cryptography and Cryptanalysis

(Appropriate for grades 9-12; minimum time needed is 60 minutes)

This talk will introduce students to the art of making and breaking codes/ciphers. For the cryptography portion of the talk, symmetric vs. asymmetric (traditional vs. public key) cryptography, keys and basic security services (confidentiality, integrity, authentication, nonrepudiation, and availability) will be discussed. Applications and use of cryptography for the government and private sector will also be discussed. For the cryptanalysis portion of the talk, codes

vs. ciphers will be discussed; examples of public codes (UPC, Morse, sign language) will be shown. The students will be introduced to transposition and substitution encipherment/decipherment through brief examples and will have an opportunity to decipher a cryptogram.

Cryptology: Past and Present

(Appropriate for grades 8-12; minimum time needed is 50 minutes)

This talk will cover the basics of cryptography. Basic terminology, historical information, and current topics will be discussed and illustrated with slides, including: (1) Simple substitution – Caesar cipher, cipher disk (Italy 1470, Civil War, WWI), Vigenere square (1586); (2) Simple transposition; (3) Combination of substitution and transposition; (4) The Enigma (WWII German cipher device); (5) Data Encryption Standard; and (6) public key cryptography.

Cyber Ethics

(Appropriate for grades 6-12; minimum time needed is 45 minutes)

Cyber ethics refers to a code of safe and responsible behavior for the Internet community. Practicing good cyber ethics involves understanding the risks of harmful and illegal behavior on-line. The information presented will help students understand the ethical issues as related to computers. Terms will be introduced and cases will be presented to help the students understand the material. Topics that will be presented include: (1) Computers and Privacy; (2) Crime, Abuse, and Hacker Ethics; (3) Responsibility; and (4) Social Implications and Consequences. The students will leave with simple guidelines on how to make an ethical decision and the Ten Commandments of Computer Ethics.

Defense Against the Dark Arts – Cyber Security Basics

(Appropriate for grades 6-12; minimum time needed 45 minutes)

Just as young wizards in the Hogwarts Academy must learn about dark magic and dark creatures to defend themselves, so must young cyber wizards learn about malware and hackers. Topics covered include viruses, worms, Trojan horses, identify theft, phishing and social engineering.

Elementary Cryptanalysis

(Appropriate for grades 4-10; minimum time needed is 45 minutes)

This presentation defines the basic terminology used in code breaking. It then introduces a variety of elementary ciphers. Students are led through the deciphering of several messages using various substitution and transposition ciphers. The frequencies of letters in English are discussed. For more advanced classes, a message in English is deciphered by using frequency counts. Background material and additional problems are given as handouts.

Geometrical Paradoxes?

(Appropriate for grades 9-12; minimum time needed is 45 minutes)

Mathematician George Polya said, “Geometry is the art of correct reasoning on incorrect figures.” This talk presents and proves a few funny “theorems” of geometry, such as “right angles are sometimes obtuse” (a favorite of Lewis Carroll) and “all triangles are isosceles.” The proofs are, of course, wrong, but it is a challenge to identify exactly why. In all cases, the problem resides in making assumptions from the drawing that goes with the proof. The lesson learned is an important one for mathematicians. The class should be familiar with geometric proofs, e.g., proving that two triangles are similar.

Geometry of the N th Dimension

(Appropriate for grades 9-12; minimum time needed is 45 minutes)

What does a hypercube look like? Are there any regular solids in higher dimensions? This talk provides a fascinating look at the 4th and higher dimensions. Students will learn how to visually construct fourth dimensional objects and will be introduced to how a higher dimensional object behaves. How does Euler’s formula generalize? This talk is especially interesting to students experimenting with three-dimensional geometry.

How to Lie With Statistics

(Appropriate for grades 6-12; minimum time needed is 45 minutes)

The study of statistics is mathematically rigorous, but the statistics themselves can be used, often incorrectly, in non-mathematical

ways. TV advertisers do not usually falsify statistics – they can be sued or fined for that. However, they still mislead us with 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, Bayer Aspirin asked 100 doctors, if they were stranded on a desert island, would they rather have aspirin or Tylenol? 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 at work. The statistic may be true, but the question on which it is based is misleading. Consumers must be aware of how statistics can be misused in order to avoid being taken in by others. This talk will illustrate how this is done.

Let's Solve Some Cipher!

(Appropriate for grades 9-12; minimum time needed is 45 minutes)

This talk will guide the class through a step-by-step diagnosis and solution of an unknown cryptogram. The speaker will make use of several statistical tests and mathematical techniques to arrive at a solution. Student participation is essential.

Logic

(Appropriate for grades 6-12; minimum time needed is 45 minutes)

This talk presents an introduction to logic and mathematical reasoning. All students participate in solving logic puzzles and in identifying unstated yet mathematical true statements. The principles discussed will be reinforced by presenting concepts such as Venn diagrams, syllogisms, and advertisements from current magazines.

Mathematics of Juggling

(Appropriate for grades 9-12; minimum time needed is 45 minutes)

The proportion of people who juggle in the mathematics community is fairly large. Some people believe that this is due to the combination of abstract patterns with simple motions, much like music. The talk will include an analysis of the different, possible juggling patterns. As mathematicians do, we'll set a few definitions and make some assumptions to simplify the setup (e.g., objects

are never dropped). Discussion will include how to determine all valid juggling patterns, including a simple zero-ball pattern. Demonstrations (with a positive number of balls) will be provided.

Miguel Chooses a College-Decision Making Using Multiple Criteria

(Appropriate for grades 9-12; minimum time needed is 50 minutes)

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 will 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.

Public Key Cryptography & Public Key Infrastructure (PKI): Cyber Security

(Appropriate for grades 11-12; minimum time needed is 50 minutes)

One aspect of cyber security: Public Key Cryptography and Public Key Infrastructure (PKI) is one solution for addressing issues with integrity, confidentiality, authentication, and non-repudiation. This talk introduces students to the use of public key cryptography and PKI to enable users of an unsecured public network such as the internet to securely and privately exchange data and money. The difference between public key cryptography and symmetric cryptography will be explained. Students will be introduced to the key management problem and learn why public key cryptography is often used to solve this problem. The students will also learn why there is more to securing communications than applying cryptography – the need for a Public Key Infrastructure and the elements of a good Public Key Infrastructure. This talk is ideal for students studying discrete mathematics.

Social Network Sites

(Appropriate for grades 6-12; minimum time needed is 50 minutes)

Every few years, a new technology or capability arises that intrigues and excites the public. Social Networking Sites (SNSs) are one such technology. In providing a place where people can easily

post their thoughts, photos, and connect with friends and family in spontaneous ways, SNSs have seen great popularity in recent years. However, there have been many stories highlighting the dangers of being too open and free with important personal or business information. Teenagers are prevalent users of SNSs; this talk will help teach them the risks and how to apply basic security principles to their on-line profiles to safeguard themselves.

STEM and Life-Long Learning

(Appropriate for Grades 6-12; minimum time needed is 30 minutes)

This presentation provides a framework for encouraging students to study in Science, Technology, Engineering, and Mathematics (STEM) subjects. Key points of the talk: technology is a major driver of innovation; students are encouraged to take advantage of any learning opportunities; technology is rapidly advancing, and that learning continues throughout your career. Appropriate for career day activities.

Symbolic Logic

(Appropriate for grades 9-12; minimum time needed 45 minutes)

This talk presents an introduction to symbolic logic and mathematical reasoning. Students will learn how to state and prove theorems using symbolic logic. The students will learn about concepts such as implication, assumptions, conclusions, proof by contradiction, proof by cases, proof by induction, and, of course, direct derivation.

Winning Games: Luck or Logic?

(Appropriate for grades 6-10; minimum time needed is 45 minutes)

This presentation introduces students to some of the basic concepts of game theory. By first discussing a simple game, then playing the game in pairs, fundamentals of picking strategies are demonstrated. After each game is played, the group discusses the strategies available and which ones worked the best.



Section IV: National Initiative for Cyber Security Education

“...a national campaign to promote cyber security awareness and digital literacy from our boardrooms to our classrooms, and to build a digital workforce for the 21st century.”

President Barack Obama, 29 May 2009

The National Initiative for Cyber security Education (NICE) is a national effort to educate all citizens on the importance of the safe use of computers, personal electronic devices and the Internet. A multi-pronged approach addresses Cyber Security, Cyber Safety and Cyber Ethics. A variety of talks within the Math Speakers Bureau are available which address computers and the different facets of Cyber Education:

- * Bubble Sorting
- * Cyber Ethics
- * Defense Against the Dark Arts – Cyber Security
- * Public Key Cryptography & Public Key Infrastructure: Cyber Security
- * Social Networking Sites
- * STEM and Life-Long Learning
- * Who Can You Trust? - Cyber Safety

Full descriptions of the above talks are located within the appropriate catalog section (Elementary, Middle and High School). In addition to the above, if there is a particular area of interest, please contact the MEPP office to propose a specific topic.

Further information on Cyber security Awareness is available at: StaySafeOnline.org



Section V: Other Resources

Visit the MEPP web site!

Are you looking for some fresh ideas on lesson plans? NSA sponsors local area teacher workshops designed to encourage the learning of mathematics, the adoption of advanced teaching techniques, and the use of technology in the classroom. Teachers who participate in the Summer Institutes for Mathematics Teachers (SIMT) write concept development units (lesson plans) for classroom use which are designed in accordance with the National Council of Teachers of Mathematics (NCTM) Standards. These units are offered as a teaching resource for mathematics teachers everywhere. The units may be found at: http://www.nsa.gov/academia/early_opportunities/math_edu_partnership/collected_learning/index.shtml

While you're at the MEPP web site, check out the other programs MEPP offers for enriching math and science education.

Visit the NSA.gov Kids' Page for Cryptologic Fun!

For a new and exciting way to learn about Cryptology, students, teachers, and parents can visit NSA's Kids' Page at: <http://www.nsa.gov/kids/index.htm>.

This excellent on-line resource introduces students to the world of Cryptology in a fun, interactive and educational way. Students can become familiar with codes and ciphers by mastering games, encrypting and decrypting messages, solving puzzles and learning how to apply math and logic to solve problems.

Other added features of the site include coloring pages for younger students, information about the National Security Agency (NSA), a historical timeline highlighting cryptologic achievements at NSA and information about visiting the National Cryptologic Museum.

In-Service Talks

MEPP will be happy to send a representative to your teacher in-service day to explain our educational services. This includes previewing talks from our Math Speakers Catalog by presenting them as part of the in-service day activities. Contact the MEPP team for further information.

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