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Thank you for downloading the Study Guide to go along with the performance presented by Arts On Stage. The last page of this Study Guide is a **Letter to Families** for you to send home with the child that includes information on what they saw to encourage parents to ask their child about the field trip.

Please direct any questions or correspondence (letters to performers from staff and/or students) to Arts On Stage. Make sure you note what performance and we will make sure they get into the right hands.

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***Presenting Live Professional Theatre Field Trips for Students & Families***

# MatheMagic!<sup>TM</sup>

(A Teacher's Guide to post-show activities)

## Adding 100 Numbers

Two hundred years ago in Germany, the teacher of an unruly class set his students a task designed to keep them quiet for the rest of the day: Add all the numbers from zero to one hundred. Instantly, one six-year-old came up with the solution. He was Karl Friedrich Gauss who went on to become one of the world's great mathematicians.

Magical Effect:

Duplicate Gauss's trick and convince your audience you are a mathematical genius.

Secret:

Arrange the numbers in fifty pairs, each adding up to 101:

Example

$$1+100=101$$

$$2+ 99=101$$

$$3+ 98=101$$

$$4+ 97=101$$

etc.

to:  $50+51=101$

Since you have 50 pairs of numbers which equal 101, simply multiply:

$$50 \times 101=5,050$$

To multiply by 50 with mathematical speed, first multiply by 100 (add two zeros), then divide by 2.

**Hint:** To make the trick more mystifying (after all, you could have easily memorized 5,050), invite the audience to give you any starting number and add the 100 numbers from there.

Example: To add the hundred numbers starting 25 and ending with 124

a) Add  $25+124=149$

b) Multiply  $149 \times 100 = 14,900$

c) Divide  $14,900 / 2=7,450$

## Lightning Multiplication

Magical effect: Prove you can multiply double-digit numbers instantaneously!

How to perform:

### Example

Ask your audience to name any two-digit number ending in 5

35

Announce that you will square it in your head.

Without hesitating, give the answer:

1225

### **Secret:**

Take the first digit of the number the audience gave you:

3

Add 1

$$3 + 1$$

X 4

Multiply these two numbers

$$3 \times 4$$

12

Tag on 25 to the end

1225

Hint: To make your performance more impressive, invite the audience to use a calculator and race you in squaring numbers. Always give the whole number when you announce the answer (one thousand, two hundred, twenty-five, rather than twelve

## Birthday Mind-Reading

**Magical effect:** Guess the age and birth-month of anyone in your audience.

**How to perform:** Ask someone to concentrate on the number that corresponds to her birthday month (January is 1, February is 2, March is 3, etc.) Then tell her to do the following calculations but keep them hidden from you.

		<b><u>Example</u></b>
		January-- 1
Multiply that number by 2	$1 \times 2 =$	2
Add 5	$2 + 5 =$	7
Multiply by 50	$7 \times 50 =$	350
Add her age	(say, 20)	370
Subtract 365	$370 - 365 =$	5
Add 115 and tell you the final answer:	$5 + 115 =$	120

Once you have that final answer, you can reveal her birthday month:

January

& her age:

20

**Secret:** The first digit is the birthday month, the remaining digits reveal age.

## Mysterious Dice

**Magical effect:** Defy the laws of probability! Of the six possible numbers on a game die, you guess the two your audience is thinking of.

### **How to perform:**

Have a member of the audience choose any two sides on a die, but keep them secret:

### **Example**

3 & 2

Now, ask him to do the following calculations and keep them secret until he has his final answer:

Multiply one of the numbers by 5:

$$3 \times 5 = 15$$

Add 7 to that product:

$$15 + 7 = 22$$

Double that sum:

$$22 \times 2 = 44$$

Add the other number chosen from die:

$$44 + 2 = 46$$

Ask him to tell you his final answer:

46

Now reveal his original secret numbers:

3 & 2

### **Secret:**

Subtract 14 from his final result:

$$46 - 14 = 32$$

Or: 3 & 2

## Division Prediction

**Magical effect:** Before you even see the problem, you predict the answer to a 3-digit division problem.

### **How to perform:**

Announce that you can predict the answer to a 3-digit division problem using any digit the audience chooses. Write your prediction on a piece of paper, seal it in an envelope and ask a member of the audience to hold it. Ask the audience to give you any 3-digit number with all the digits the same. Invite them to join you as you:

### **Example**

555

Add the three digits:

$$5 + 5 + 5 = 15$$

Divide the original number by their sum:

$$555 / 15 = 37$$

Ask the envelope-holder to open the seal and show what you predicted. Lo and behold it is:

37 !!!

**Secret:** Take any 3-digit number with all three digits the same, and divide it by the sum of the three digits as we did here, and the answer will always be 37.

## Easy Mind-Reading

**Magical effect:** You guess any number your audience is thinking.

**How to perform:**

Ask a member of the audience to think of any number  
but keep it secret:

**Example:**

10

Now ask them to do the following:

Double the secret number:

20

Multiply by 5

$20 \times 5 = 100$

Ask them to give you their final answer and  
reveal their secret number:

10

**Secret:** Once you know their final answer, simply  
(secretly, mentally) slice off and discard the right hand digit.

## You Can't Fool Me!

**Magical Effect:** The audience selects any number with any number of digits, then chooses one of those digits to keep secret from you; but they can't fool you, you guess that secret digit every time!

### **How to perform:**

Ask the audience to give you any number with any number of digits:

### **Example**

32,645

Invite them to join you (with their own pencil and paper) as you:

Add the digits together:

$$3 + 2 + 6 + 4 + 5 = 20$$

Subtract that sum from the original number:

$$32,645 - 20 = 32,625$$

Now, ask one person to choose one of those digits and secretly cross it out:

6

Ask him to add the remaining digits and tell you that sum:

$$3 + 2 + 2 + 5 = 12$$

Now you reveal his secret crossed-out number:

6

**Secret:** Subtract his final sum from the next higher multiple of 9

$$18 - 12 = 6$$

If the sum itself is a multiple of 9, the secret crossed-out number will be 9.



## More Fun with Nines

**Magical effect:** You predict in advance the answer your audience will reach when they add and subtract the numbers they choose themselves.

### Example:

#### **How to perform:**

Write your prediction, seal it in an envelope and ask someone to hold it.

Ask the audience to give you any number with any number of digits (a phone number works well):

Invite them to join you as you: 9 070 057

Scramble the digits any way: -5 079 700

Subtract the smaller number from the larger: 3 990 357

Add up the digits in that sum:  $3+9+9+0+3+5+7 = 36$

Now add up those digits until you are left with one digit:  $3+6= 9$

Ask the envelope-keeper to unseal and reveal your prediction.

Amazingly, it is the same----->9 !!!

**Secret:** When you perform these operations, the answer will always be 9.

**Hint:** Other dramatic ways to hide and reveal your prediction:

1. Seal it inside a blown-up balloon. When it's time to reveal it, ask someone to prick the balloon and extract your prediction.
2. Write down the first and last words on the ninth page of your dictionary (eg.: accessible/accomplice). Seal those words in your prediction envelope and when it is time to reveal your prediction, ask the envelope holder to read the words aloud. Then hand her the dictionary and ask her to find on which page those words appear.  
Naturally, since you've prepared in advance, those words will be on page 9 !!!
3. Paint the prediction (in this case, 9) on an egg. Your secret paint should be a mixture of one teaspoon of alum (available at drug stores), dissolved in 1/3 cup clear vinegar. Use a Q-tip as a paint brush. Allow the paint to dry for a few minutes. The paint will be invisible. Now, boil the egg for fifteen minutes. Keep the egg refrigerated so it doesn't rot before performance day. As you introduce the trick, ask someone to hold the egg. Then when it is time to reveal the prediction, have them gently crack and peel the egg. There inside the shell will be your prediction--"9"!

## Binary Trick Cards

### **Magical effect:**

The audience chooses any number between 1 and 31 and you guess it with the aid of these special cards.

### **How to perform:**

Cut out the five groups of numbers on the next page and paste each of them on a 3x5 card.

### Example

Ask someone in the audience to choose any number from 1 to 31 and to keep the number a secret.

29

Show him the cards and ask him to point to the cards that contain his chosen number.

Presto! You reveal his secret number 1

**Secret:** Simply add the first (top, left) numbers on each card your subject says contain his number:

$$1 + 4 + 8 + 16 = 29$$

**Hint:** This trick is based on the binary system. The first numbers in each square are all powers of 2.

Binary Trick Cards—Cut out each group of numbers to make 5 rectangular cards:

Mathemagic! --9A

1	3	5	7
9	11	13	15
18	19	22	23
26	27	30	31

---

4	5	6	7
12	13	14	15
20	21	22	23
28	29	30	31

---

2	3	6	7
10	11	14	15
18	19	22	23
26	27	30	31

---

8	9	10	11
12	13	14	15
24	25	26	27
28	29	30	31

---

16	17	18	19
20	21	22	23
24	25	26	27
28	29	30	31

## Magic Squares

The earliest known magic square was invented in China over 3,000 years ago. In ancient times, people ascribed all sorts of magical powers to them.

<b>4</b>	<b>9</b>	<b>2</b>
<b>3</b>	<b>5</b>	<b>7</b>
<b>8</b>	<b>1</b>	<b>6</b>

No matter which way you add the numbers: down, across or even on the diagonal, the sum is always 15.

An even more remarkable square appeared in an engraving by Albert Durer in 1514:

<b>16</b>	<b>3</b>	<b>2</b>	<b>13</b>
<b>5</b>	<b>10</b>	<b>11</b>	<b>8</b>
<b>9</b>	<b>6</b>	<b>7</b>	<b>12</b>
<b>4</b>	<b>15</b>	<b>14</b>	<b>1</b>

All the rows and diagonals add up to 34. The four corners add up to 34. The four center numbers add up to 34. The two numbers in the middle of the top row and the two numbers in the middle of the bottom row add up to 34. There are many more combinations to be found...

## Magical Division Tests

### **Magical Effect:**

Tell at a glance whether any number is evenly divisible by another number.

**How to perform:** Memorize the following chart:

### Example

A number can be divided--

by 2 if the end digit on the right is even.

by 3 if the sum of the digits in that number  
can be divided by 3:

$2 + 1 = 3$  and  $3 / 3 = 1$ ,  
then 21 is divisible by 3

by 4 if the last 2 digits (on the right) can be  
divided by 4:

32 is divisible by 4, so  
9,732 is divisible by 4

by 5 if the last digit is 5 or 0:

by 6 if it is even and the sum of its digits  
can be divided by 3

$7 + 2 + 8 + 4 = 21$  &  $21 / 3 = 7$ ,  
7,284 is divisible by 3.

by 7 Challenge: No one has discovered this test yet.

by 8 In most cases, if the sum of the last 3 digits can  
be divided by 8 or if the last 3 digits are zeros.

by 9 If the sum of the digits can be divided by 9.

**Lightning Addition**

Ask your friends to give you two 3-digit numbers.  
Write them in columns on a board or large sheet of paper.

For example, they say: 697 their number  
and: 652 their number

In your head, working from left to right,  
subtract each digit of this second number  
from 9 and quickly write: 999  
They give you another 3-digit number (for example): 347 your number  
321 their number  
999

Subtract from 9 as before and write: +678 your number

Invite them to race you in adding these figures.  
While they're still fumbling with their calculators  
you scrawl down the correct answer –**instantly**: 2,695

**Secret:** With the numbers you so casually and quickly contributed, you made 2 groups of 999. Think of as 1000 (it's only one less). Add  $1000+1000=2000$ . Add 2000 to the top figure (simply put 2 in the thousands column), subtract 2 from the ones column and you have your lightning mathematical answer!

Hint: When you add your numbers to the problem, pretend the audience is too slow in giving you numbers so you are writing down any old digits just to speed up the pace. Never let on that you are doing mental gymnastics to get those digits.

Extension: Try the trick with 4- or 5-digit numbers.

**Miracle Number Prediction**

Announce that you will read your audience's mind. Ask someone to hold an envelope in which you have sealed your prediction of their mathematical thoughts.

Ask the audience to write down a number made of 3 different digits:  
(the first and last digits must differ by more than one) 937

Tell them to reverse the number and  
subtract the smaller number from the larger: -739

Have them reverse the difference and add: 198  
The answer will be: +891  
1,089

Now ask the envelope keeper to open your prediction and read it aloud. Amazing telepathy! Little do they know the answer will **always** be: **1,089**.

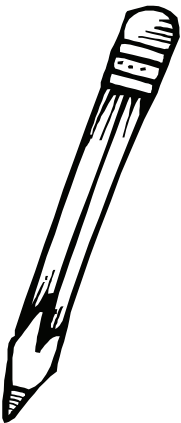
Dear Family,

Today, I saw a live, professional theatre performance presented by Arts On Stage called, Math-e-Magic! The performance involved math concepts with vocabulary, geography, history and everyday problem-solving. Mr. Bradley Fields, the performer, was amazing. He showed us math through his famous magic illusions and a large multimedia screen. Attending a live performance is very different from watching a television show or a movie. Please ask me about my favorite moments of the performance. I would like to tell you all the things I learned and remember best.

Love,

\_\_\_\_\_

*Child's Name*



We welcome you and/or your child's comments. Artwork is always appreciated too! Contact information below.



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