

# **When is One not One?**

## **A Math Story for Chelsea & Eliza**



**Irvin M. Miller, Ph.D.  
The Math Magician  
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## Introduction

When one talks to hundreds of adults and children, one begins to realize that very few people understand math or even know how to teach it. As a result efforts to improve the teaching of math continue to fail year after year.

Mathematics in its purest form is a set of rules which allow us to develop a vast amount of intellectual games. The structure is designed such that if you learn how to study, you can digest a large chunk of this intellectual property. The first problem begins to appear as we try to apply mathematics to the world or universe in which we live and create. If the earth revolved and rotated such that there were exactly 360 days in the year, the moon revolved so that there were 30 days in the month, and there was exactly 24 hours in a day, the mathematics of time would be very simple. But, this is not the case! In the application of mathematics to time, a year is not a year, a month is not a month, and a day is not a day. The mechanics of our solar system is not geared to a integer number system. For a year, we throw a part of it away for three years and try to capture a part back in the fourth. The months vary their duration from 28 days to 31 days, and for days, the sunrise which defines the start varies throughout the year. Thus the mathematics for time is not like the mathematics of your checkbook.

But even when man controls the parameters, the math is compromised. When you take out a mortgage on your home, or you get interest on your investment, the results of the calculations have to be modified by a concept called round off in order for us to execute these financial payments. Even with round off, at the end of the mortgage period, there is an error of about ten cents which must be corrected by the lender for his benefit. Clever bank thieves have tried to siphon off the round off cents hoping that their activity will not be detected. Our choice for the denomination of money is rather interesting taken the great pride in our decimal system. The abacus, Roman numbers, and our monetary system are built on a base five– base two system ( five pennies equal one nickel, one nickel equal two dimes). Yet for the stock market, it is built on a base two system (1 dollar,  $1/2$ ,  $1/4$   $1/8$   $1/16$ ).

This becomes interesting when one tries to teach mathematics with manipulatives. What works for one application does not necessarily work for another. A number line, while good for assisting with negative numbers, and fractions can be useless for assisting with modular arithmetic where a circle is more applicable and negative numbers and fractions behave differently. Thus as we witness the failure of our students to understand and use fractions and negative numbers, we continue to invent more manipulatives to add to the confusion. Because of the abstract nature of mathematics, we must apply it to different situations to get a feel for how and why numbers work for the most part. The skill for mathematics can only be developed by working with numbers and developing out computation skills. Rather than back off on the use of calculators, we increase the need for them in more advanced studies. It is not that manipulatives and calculators should not be used in teaching of mathematics, it is that there application should be limited in teaching.

Having worked with children and parents over a long period of time, and analyzing my own studying techniques and weakness, I began to be able to evaluate the teaching of math and to predict the failures of many ventures. Several years ago, a new math series was introduced into the grade schools with much pomp and circumstance. The series in my opinion contained ten times too much text and its mixture of science and math violated the sensibilities of an experienced scientist. The series was quietly dropped from the consortium of schools that had adopted it. Today, there are hundreds of videos and video game based systems along with internet and computer based systems that have gathered great attention from the public. None will survive because they all use the techniques that were not successful without the technology and none address the root problems that I describe in the beginning of this discussion.

Collapse of the financial industry and housing market, large personal debt, and the inability of our politicians to have a logical and rational argument may be signs of what a poor education reaps. For even problems not involving numbers, Math teaches how to collect information, how to set up a problem, and then how to solve it—skills that have been lost by much of our population.

I have tried to address this problem in several fashions. First, I developed a non profit organization that is not motivated by profit optimization, but by educational optimization. Secondly, I wrote this book to make light of how math is taught and how children might perceive of what they where taught if allowed the freedom to express themselves and be taken seriously.

Visit the following websites:

<http://www.mathphysicsexplore.org>

<http://www.itmeansmath.com>

Irvin M. Miller

## When is One not One?

One cloudy London afternoon, Chelsea and her sister Eliza were discussing some topics on math that seemed to create dilemmas. Eliza wanted to know if one was always one. Chelsea asked her what she meant. “Well, you see”, said Eliza, “my friend Eliza Toddler has a birthday on January 27th and in one month she is going to New York.” One month later is February 27th. My cousin Zoe has her birthday on January 30, and one month later for her would be February 30, but since there is no February 30th, one month later is March 2nd. Therefore, for Eliza Toddler  $1+1$  is 2; and for Zoe, one plus one is three since March is the third month. Chelsea replied, “And I thought I understood math.” For Zoe, if  $1+1$  is 3, then if she goes back one month from March 2, she will be at February 2, making  $3-1$  equal to two. In school, I learned that subtraction is inverse addition, so that if  $1+1$  were 3, then  $3-1$  should be 1.

<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>	<b>6</b>	<b>7</b>	<b>8</b>	<b>9</b>	<b>10</b>	<b>11</b>	<b>12</b>
Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec
<b>31</b>	28,29	<b>31</b>	30	<b>31</b>	30	<b>31</b>	<b>31</b>	30	<b>31</b>	30	<b>31</b>

### Days of the month

Eliza drew a diagram for Chelsea:

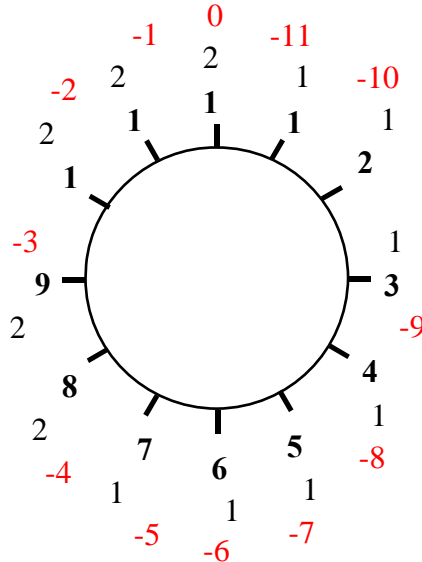
	<b>Eliza Toddler</b>		<b>Zoe</b>
	Jan(27)+month=Feb(27)		Jan(30)+month=Mar(2)
	1 + 1 =2		1 + 1 = 3
subtraction	1 =2 -1		1 = 3 -1
			Mar(2)-month=Feb(2) as it should be $3-1=2$

Eliza was just learning about division in school, where she was told that division was inverse multiplication. Thus, if  $1 \times 2 = 2$ , then  $2/2 = 1$ . The teacher told her that when a number is divided by itself, then the answer will be one. A broad smile appeared on Eliza’s face as she asked the teacher if  $0/0$  is one. The teacher asked her why she wanted to know. Eliza said that since  $0 \times 2 = 0$ , then  $0/0$  must be equal to 2, and if that is the case, 1 must be equal to 2. Her teacher said that when mathematicians run into dilemmas, they make up rules. Therefore, you are not allowed to divide zero by zero.

That evening Eliza’s granddad, who owns a Math “museum” was visiting Eliza, told her that mathematicians invented a new math called differential calculus so that they could deal with this dilemma of  $0/0$ . The inventor was an Englishman named Isaac Newton. Eliza wanted to learn more, but the evening was getting late and she had to be off to bed.

The next morning when Eliza went to school, the teacher was talking about number lines. Eliza being in a cheeky mood asked the teacher why she did not talk about number circles. The teacher asked Eliza what had piqued her curiosity about number circles. Beginning her remark, Eliza said, “Well you see, numbers on a clock go in a circle.” “Rather interesting observation”, her teacher said. Eliza continued, “On a clock  $12+12=12$  and  $12+12+12=12$ , so from the definition of multiplication,  $2 \times 12=12$  and  $3 \times 12=12$ .” However, yesterday, you told me that division is reverse multiplication, so therefore  $12/12=2$  or perhaps 3, though it should be one. The

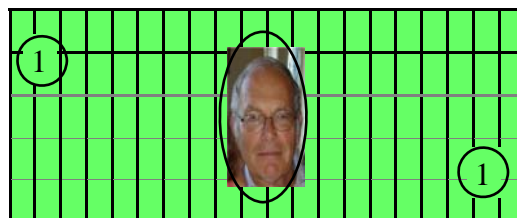
teacher was dumbfounded for a moment when Eliza said, “Please don’t tell me that I cannot divide 12 by 12.” The teacher responded that perhaps they should go to Oxford to visit and pay homage to the statue of Lewis Carrol. Eliza said somewhat seriously, “We cannot do that, my dad is a Cambridge graduate.” The teacher laughed as the bell rang—terminating the math session.



**A number circle**

As Eliza related her experience to Chelsea, Chelsea started to put on her silly thinking cap. Chelsea had been learning about fractions in school, however, she was learning pizza fractions as her granddad jokingly liked to say. Her granddad had told her that a fraction is not a part of something but a fraction of something. Thus a pence was 1/10 of a ten pence piece, because it took ten pence to be equal to the value of one ten pence piece. He said that because a slice of pizza looks like the whole piece, people will say that is part of a pizza. Coincidentally, that evening the family decided to have pizza, and Chelsea volunteered to pick it up.

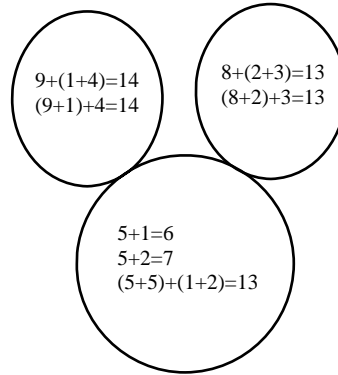
When it was time to pay for the pizza, she was three pence short. She found an old one pound note, and cut it into one hundred pieces and gave the merchant three of them. The merchant looked at her in disbelief and asked why she was giving him confetti. Chelsea said I owe you three pence, so I am giving you 3 one hundredths which is three pence. The merchant had to think fast. He said, “By the way young lady, paper pound notes are no longer legal tender in England, you will have to use a pound coin. With a straight face, Chelsea said that her scissors could not cut a coin. Amused, the merchant, forgave the three pence.



**Confetti**

When Chelsea got home with the pizza and told the story, everyone laughed as they enjoyed their pizza  $\pi$ . The last few days had been a “fun with math” holiday for Chelsea and Eliza. Their granddad had taught them many interesting things about math, one being not to use their fingers to do arithmetic. Chelsea and Eliza had noticed how poorly their friends in school did when they used their fingers for addition and multiplication. That evening, granddad wrote a rap song to express the concern over the use of fingers.

No more fingers, no more toes,  
 Dr. Miller is sure to know  
 counting backwards is the way to go.  
 Let the Math Mouse take his turn  
 to teach you to learn  
 that tens is upon what he depends.



Associate, concatenate, commute  
 exponentiate and watch your numbers grow  
 as you distribute them to and fro.  
 Ben was no square for he had a flair  
 for magic squares. Three by three, and  
 four by four--patterns galore.

Add, Multiply, and exponentiate a counting  
 we will go,  
 subtract, divide, logarithm as back we go.  
 practice more and more until we have to  
 practice no more.

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

No more fingers, no more toes,  
 Dr. Miller is sure to know  
 counting backwards is the way to go.

Let us not build our brains on a technology  
 so bland that it is like a foundation of sand.  
 Computers, calculators, and boards that think  
 they are so smart  
 through the portals of obsolescence they will  
 part.

Newton, Pascal, and Fibonacci are heroes beside  
 whom our teachers will stand to make our  
 knowledge so tall and grand. Our brains are a  
 thinking as we our leaders  
 awake.

No more fingers, no more toes,  
 Dr. Miller is sure to know  
 counting backwards is the way to go.

There's a space waiting in Poughkeepsie,  
 Math And Physics is the place. Exploration  
 is our expectation.

Geniuses we do make, so don't wait. Make  
 a date, we're here to wait.

No more fingers, no more toes,  
 Dr. Miller is sure to know  
 counting backwards is the way to go.



That next morning, granddad returned home to Poughkeepsie to teach children in the States  
 math. It is get stranger and stranger as things seem to be what they are not.

