Math Whizzes in the Making

Parent Notes

Thanks for having your child participate in Math Wizards in the Making! These notes are provided to help you assist you child in mastering the tricks. The notes are based on our 30 hour program . If yours is less hours, not all this material will be covered, so some of it will be extra. If you have questions on anything, please let us know. 314-961-6912   info@abrakid.com Good luck!

Addition Opener: 1-100 Story

Years ago, a teacher wanted to get some done, so he gave the class a problem that would keep them busy for a long time: add the numbers 1-100. As the teacher started working on his project, he was surprised when a young student came up after 2 minutes with an answer. It proved to be correct! This young student's name was Carl Friederick Gauss, who wound up becoming one of the greatest mathematicians in history. How did he add 100 numbers so quickly?

Gauss saw that there were 50 pairs of numbers: 1-100, 2-99, 3-98,…, each of which added to the same total: 101. He simply multiplied 50x101 and got 5050, the correct total!

Lightning Addition: Adding 4 Consecutive Numbers

21
22
23
+24

Effect: The audience names a # 1-10 or 1-20. You write it & beneath it, the next 3 consecutive #s. The audience totals the 4 #s on a calculator. You lightning total mentally & announce your answer. It's correct!

Props: Pencil and worksheet to practice this.

Secret: Add the first & last numbers. Double them. E.g. 21+24=45. 45+45=90. Tell Gauss Story of adding 1-100.

Why does this work? Similar to the Gauss story, #s 1+4 = #s 2+3. So adding #1 + #4, then doubling it yields the answer.

Show/Young Vs. Older Students: Begin with starting #s in the single digits. Then see if you can progress to starting #s 1-20. If students are able, go to any 2 digit #, and, if they are really good, 3 digit #s.

Tip: Add as you write. Try to know the total as you write the last #. If it helps, write the 1st #, then the last # so you can start calculating as you write the middle 2 #s.

Scaling for Younger Kids: You can vary # of digits: 1 or 2.

Einstein-Like Addition

Effect: Show 5 sheets of card stock, each with different numbers on front and back. E.g. 52-53, 60-61, 78-79, 84-85, 96-97. While your back is turned, have a spectator set out the 5 cards on the table in a column. Then the spectator adds them with a calculator. You turn around and, within 5 seconds, announce the total. The spectator who added with the calculator affirms that you are correct!

Props: Yellow sheet with 5 perforated cards, each with a number on each side, rubber band, and a calculator.

Secret: Add the number of odds to 370 to get the total! (370 + # of odds = answer). E.g. if spectator puts out: 52, 61, 79, 84, & 97, you think: 370 + 3 (3 odds) = 373.

Why does this work? The even numbers add to 370. The odd numbers are each 1 higher than the even number on the other side. So each odd number adds 1 to the 370 total.

Preparation: Have students tear along the perforations to create 6 cards: 5 with numbers, and 1 with instructions for their reference. Rubber band the cards to keep them together.

Presentation:
(To start, have the 5 cards in a pile mixed up.)
"You know, we lightning calculators carry strange things. I have 5 cards that have different numbers on each side. 52, 61, 78, 85, 96,... (Show them all briefly, naming a few representative numbers that seem all over the place—high ones, low ones, etc. Don't show front & back in order of each, as you don't want to make it obvious that the front & back of each are consecutive numbers.)

I will turn away and I'd like you to put these 5 cards in a column on the table, with any numbers you want showsing. I will turn away. Let me know when you have done that. (Done) Good, now, would you total the 5 numbers in the calculator. Let me know when you have it. Don't let me see the total on the calculator. Ready? I am going to turn around, look at the 5 2-digit numbers you selected, and try to total them in my head in less than 10 seconds. Hopefully I won't get a headache! Are you ready? (Turn around, count # of odds, add to 370, announce total—e.g. 373.) How did I do? A round of applause for my assistant!"

What if…
…you only used the first 4 cards. Would it work? What would the total formula be? 52+60+78+84=274. 274+ # of odds.
…you had 6 cards, the last being 22-23. How would you know the total? 370+22=392 + # of odds.

Scaling for Younger Students: Hopefully no scaling is needed, as the secret is pretty simple: 370 + # of odds. However, if 370 is too big of a number, you can make a version with 1 or 2 digit #s. Have the kids pick their own numbers. Or you can use these:

2 digit cards: 10-11 14-15 18-19 22-23 26-27 Solution: 90+ # of odds
1 digit cards: 2-3 4-5 6-7 8-9 10-11 Solution: 30 + # of odds

Lightning Dice Addition

Effect: You ask a spectator to roll 5 dice. Then, as you look away, you ask your volunteer to turn each upside down , showing a side that you cannot see, and to total the 5 new sides. You turn around and announce the total within 3 seconds—correctly!

Props: 5 dice per student

Secret: Opposite sides of a die add to 7. You total the #s that the spectator rolled, subtract from 35 (5 dice x 7), and you have the total of the dice bottoms!

Presentation: "I have a set of dice here. Would you like to examine them? (Offer them to spectator. As her hands come forward to take them, pull them back.) Thank you very much! (you say, joking.)

Can you roll the dice. Are you happy with your roll or do you want to roll again? (As you talk, mentally add the 5 dice—suppose they total 20.) Now the top of the dice I can see. However, the bottom of the dice I have no idea what's on them. You can't see them, I can't see them, no one can. I will turn around. (Do so.) Would you please turn each die over so that the bottoms of all the die are now facing upward. Have you done that? (yes) Good. Now would you total the 5 dice please. Let me know when you have a total. (Mentally subtract the total—in this example, 20—from 35 to get 15—the total of the bottoms.) (Done, spectator says.) I am going to turn around, look at the dice, and attempt to add the 5 numbers in my head with no pencil and paper in less than 2 seconds. This is a very dangerous feat, but I stop at nothing for your entertainment. Are you ready? Go! (Turn around and immediately announce your total.) How did I do? (Correct) Ladies and gentlemen, a round of applause for my assistant!"

Scalability for Younger Kids: The less dice you use, the easier the trick is to do. E.g. if you use 1 die, subtract the total from 7. 2 dice: subtract total from 14. 3 dice: from 21. 4 dice: from 28.

Math Learning: Mental subtraction.

Petals Around the Rose

Effect: In this puzzle, you roll the 4 dice repeatedly, in each roll announcing how many petals are around the rose. You then see if any of the audience can catch on so they know how many petals are around the rose.

Props: 3 or more dice

Secret: "Petals around the rose" refers to spots on the dice face that are around a dot in the middle. So, 3 has 2 petals around the rose (i.e. 2 spots around the middle spot on its dice face). 5 has 4 petals around the rose (1 dot in the middle and 4 around it). 1,2,4, and 6 have 0 petals around the rose. So, e.g. if you roll a 1,3, and 5, there are 6 petals around the rose (0+2+4). If you roll three 5's, there are 12 petals around the rose (4+4+4). If you roll a 1, 2, and a 4, there are 0 petals around the rose.

Presentation:

Make a few rolls, announcing how many petals are around the rose in each roll. See if anyone can catch on so they know how many petals are around the rose. If 1 or 2 people get it, and others still don't, it drives them even more crazy!

Math Learning: This trick helps teach numerical patterns.

Lightning Multiplication Opener

Question: How much dirt is in a hole 2 feet x 2 feet x 2 feet?

Answer: None. There is no dirt in a hole!

Props: None.

Lightning Multiplication Class #1: 3 Tricks: x5, x50, & Re-ordering

Each of these tricks uses flash cards. The audience holds them up and you lightning calculate the answer mentally. Demo to the audience, having them pick from these 3 types of flashcard problems. You lighting calculate the answers! Props include: flash cards, a worksheet covering the tricks on this page, and a pencil.

Multiplying x 5

Effect: Audience members hold up flash cards with x5 multiplication problems. E.g . 24x5, 66x5, 168x5, etc. You mentally lightning calculate the answers (in this case, 120, 330, 840)!

Secret: Divide the # by 2, then tack a 0 onto the end. E.g. 24x5=? 24/2=12. Answer: 120.

Why Does This Work? 1) To multiply by 10, just tack on a 0. E.g. 8x10=80. 2) When multiplying a # by 5, if you double the 5 to make it 10, you can halve the # and the answer is still the same. E.g. 4x6=24. If I double the 6 to 12, I can halve the 4 to 2, changing the equation to 2x12=24. Same answer. 24x5=12x10. 12x10 is easy: 120. 3) Note: If the # is odd, multiplying by 10 means moving the decimal over 1 place to the right. E.g. 33x5= 16.5x10=165. 4) How to handle tough ones—e.g. 77x5? Half of 80=40. Half of 78=39. So half of 77=38.5.

Worksheet: Have students complete row #1 of the Multiplication Worksheet that covers x5, x50, x12, & AxBxC.

Scaling This To Younger Vs. Older Kids: 2-digit numbers that are both even (e.g. 24) are easiest. Progress to 3-digit numbers, and numbers where 1 or both digits are odd for more of a challenge.

Multiplying x 50

Effect: Audience members hold up flash cards with x50 multiplication problems. E.g . 82x50, 148x50, etc. You mentally lightning calculate the answers (in this case, 4100, 330, 7400)!

Secret: Divide the number (you are multiplying by 50) by 2, then multiply x 100 (i.e. tack on 2 0's).

Why Does This Work? This is the same as multiplying by 5 with a 0 added to make the 5 into 50. As explained above, 82x50 is a tough problem to solve mentally. But double the 50 and halve the 82, and you get 41x100, which is a much easier problem: 4100.

Worksheet: Have students complete row #2 of the Multiplication Worksheet that covers x5, x50, x12, & AxBxC.

Scaling This To Younger Vs. Older Kids: Same as above. 2 digit #s where both are even (e.g. 46) are the easiest to quickly divide by 2. 3 digits and odd digits are more challenging.

Multiplying 3 Numbers—Reordering for Ease of Calculation

Effect: Audience members hold up flash cards with multiplication problems in the format AxBxC=?. E.g . 25x17x4=? You mentally lightning calculate the answers (in this case, 1700)!

Secret: Reorder the numbers to make it easier. Multiply the 1^{st} & last numbers first. E.g. 25x17x4=? 25x17 is tough. But 25x4 is easy. 100. 17x100 is easy: 1700. Look for ways to re-order to make it easier.

Why Does This Work? AxBxC = AxCxB. I.e. the order in which the numbers are multiplied doesn't matter.

Worksheet: Have students complete rows #4-5 of the Multiplication Worksheet that covers x5, x50, x12, & AxBxC.

Scaling This To Younger Vs. Older Kids: Problems where 2 numbers multiply to 10 or 100 are easiest.

Mult: x5, x50, & AxBxC Worksheet

14	27	35	62	86	101	123	148	169	180
x 5	x 5	x 5	x 5	x 5	x 5	x 5	x 5	x 5	x 5

18	26	33	41	52	65	79	124	166	190
x50	x50	x50	x50	x50	x50	x50	x50	x50	x50

25x16x4=   8x12x50=   12x2x6=   75x8x4=   45x7x2=

35x7x3=   5x37x20=   15x8x2=   5x55x2=   25x3x7x4=

Row 1: x5.
Row 2: x 50.
Row 3 & 4: AxBxC

ANSWERS
x5, x50, and AxBxC Worksheet

14	27	35	62	86	101	123	148	169	180
x 5	x 5	x 5	x 5	x 5	x 5	x 5	x 5	x 5	x 5
70	135	175	310	430	505	615	740	845	900

18	26	33	41	52	65	79	124	166	190
x50	x50	x50	x50	x50	x50	x50	x50	x50	x50
900	1300	1650	2050	2600	3250	3950	6200	8300	9500

25x16x4=1600 8x12x50=4800 12x2x6=144 75x8x4=2400 45x7x2=630

35x7x3=735 5x37x20=3700 15x8x2=240 5x55x2=550 25x3x7x4=2100

Adding 5 Consecutive Numbers in Your Head

Effect: While you look away, ask someone to write 5 consecutive numbers in a column, and total them on a calculator. You turn around, look at the numbers, and instantly announce the correct total!

Props: Pencil, paper, & calculator.

64
65
66
67
+68

Secret: Look at the middle number and multiply it by 5. To multiply it by 5, divide the middle number by 2 and tack a 0 onto the end. E.g. in the example where the middle number is 66, 66/2=33. Tacking a 0 onto the end, we get 330 as the total.

Why does this work?

1. The middle number is the average number. Multiplying it by the # of numbers (5 in this case) yields the answer.
2. Suppose N is the middle number.
   Answer = N x 5.
   If we multiply 5x2 to get 10, an easy number to multiply by, we have to balance the equation by dividing N by 2. So, divide N (the middle number) by 2 and tack on a 0, which is the same as multiplying by 10!

Scaling this Trick to Younger Vs. Older Kids:

- Use 1 digit numbers for younger kids. Use 2 or 3 digit numbers for older ones.
- Ask spectator to write any 2 digit number where both digits are even—e.g. 42. This generally makes the middle number have 2 even numbers, making it easier to divide.
    - Next steps up would be: a) starting number is even. (i.e. 1st digit can be odd, making for a little harder problem). b) no restriction on starting number (it can be even or odd).

What if the middle number is odd?

Suppose, e.g. someone writes: 55,56,57,58,59. What is 57/2? 60/2=30. 58/2=29. So 57/2=28.5
What is 28.5x10? 285. Just move the decimal over 1 place to the right. Your total in this trick should always be a whole number.

Adding 10 Consecutive Numbers in Your Head

Effect: Number 1-10 (figure 1). While you are not looking, a spectator writes 10 consecutive numbers (see figure 2 below). When spectator is done, you turn around, draw a line under the numbers, asking spectator to total them using a calculator. You look away as spectator totals. (figure 3) You announce the correct total!

Props: Blackboard or sheet of paper, marker, and calculator.

Figure 1	Figure 2	Figure 3
1.	1. 54	1. 54
2.	2. 55	2. 55
3.	3. 56	3. 56
4.	4. 57	4. 57
5.	5. 58	5. 58
6.	6. 59	6. 59
7.	7. 60	7. 60
8.	8. 61	8. 61
9.	9. 62	9. 62
10.	10. 63	10. <u>63</u>

Secret: Append a 5 to #5. That's the total! E.g. #5 is 58. Answer: 585. Why does this work? There are 10 numbers. The answer is 10 times the average (or middle) number. What's the average number? There are 10 Numbers: 5 and 5. So the average number is between #5 & #6. In this case, 58.5. Multiply 58.5 x 10 = 585. In other words, just append a 5 to #5 and you'll have the total of the 10 consecutive numbers!

Presentation:
Before you begin, number 1-10 (figure 1). Why? This lets you quickly spot #5 without having to count. Use a blackboard so the audience can see. If no board is available, use a sheet of paper with some sort of backing—e.g. a book or notepad—so the person can hold it up and write so the audience can see.

"I need a volunteer from the audience. (Introduce yourself.) When I turn around, I'd like you to write 10 consecutive numbers—any consecutive numbers you'd like. For instance, 1-10, 50-59, 75-84, whatever. OK? As you write them, I'd like someone else to be adding them up in a calculator. OK? Let me know when you are done. (Turn away, holding a marker in your hand.)

(Spectator says he's done. Ask if the calculator has a total. Wait til it does.) I am going to turn around and when I do, I'll attempt to add the 10 numbers in my head and jot the answer on the board. I'd like you to count how long it takes me to add them all up. None of you are in a hurry, are you? Good. Ready? (Turn around, append a 5 onto the end of #5 and jot this as the total. You added 10 numbers in your head in less than 5 secs!) How does this answer compare with what you got on the calculator? (correct) A round of applause for my assistants!"

Notes:
- When you look at the spectator's numbers and draw the line beneath, make sure they are legible, neat, and that you can tell what #5 is. You can omit this step, but it helps to make sure that things are going smoothly before you complete the trick.
- It is easier to lightning add 10 consecutive numbers than 5!

Adding 20 Consecutive Numbers in Your Head

Effect: You have mentally added 5 consecutive numbers. Then 10. For your grand finale, you attempt 20 consecutive numbers, selected by an audience member starting between 1-50. You correctly get it within seconds!

Props: Adding 20 Consecutive Numbers – Answer Sheet (2 sided). Part of this is reproduced below.

Secret: Add the first and last numbers. Multiply by 10. E.g. The sum of the 20 consecutive numbers, 5-24 =? 5+24=29. 29x10=290, which is the answer!

Why does this work? 20 consecutive numbers consist of 10 pairs of numbers that all add to the same total. E.g. in 5-24, 5+24=29. 6+23=29. 7+22=29, …   This is similar to the Gauss story when he added numbers 1-100, recognizing that there were 50 pair of numbers that each totaled 101.

Mechanics: Because it would take a while to add 20 consecutive numbers in a calculator, give a spectator the above-referenced sheet, which contains the totals of all consecutive 20 number series starting with the #s 1-50. She can then easily check whether you are correct.

Presentation: "I am going to attempt a very difficult and perilous feat. I am going to attempt to add 20 consecutive numbers that you call out in my head in less than 10 seconds. Because it would take a few minutes to add these in a calculator, I have printed the answers on this sheet.

I will ask you to name any number 1-50, and I will attempt to mentally add the 20 consecutive numbers starting with that number. For instance, if you name 5, I will attempt to add 5+6+7, etc. up to 24. If you name 32, I will add 32 through 51. You can find the answer on the sheet and let me know how I did. Are you ready? Give me a starting number. (e.g. 11)   11 through 30 add to…410. (11+30=41. Tack on a 0 to get 410.) How close did I come? (You got it.) Thanks very much!"

Notes:

- Repeat with another number if you wish.
- If you like, have the spectator give the starting and ending number in the sequence.
- If you like, jot the numbers on the board to give you a little more time and to be able to see the numbers.

Start #	1	2	3	4	5	6	7	8	9	10	11	12
	2	3	4	5	6	7	8	9	10	11	12	13
	3	4	5	6	7	8	9	10	11	12	13	14
	4	5	6	7	8	9	10	11	12	13	14	15
	5	6	7	8	9	10	11	12	13	14	15	16
	6	7	8	9	10	11	12	13	14	15	16	17
	7	8	9	10	11	12	13	14	15	16	17	18
	8	9	10	11	12	13	14	15	16	17	18	19
	9	10	11	12	13	14	15	16	17	18	19	20
	10	11	12	13	14	15	16	17	18	19	20	21
	11	12	13	14	15	16	17	18	19	20	21	22
	12	13	14	15	16	17	18	19	20	21	22	23
	13	14	15	16	17	18	19	20	21	22	23	24
	14	15	16	17	18	19	20	21	22	23	24	25
	15	16	17	18	19	20	21	22	23	24	25	26
	16	17	18	19	20	21	22	23	24	25	26	27
	17	18	19	20	21	22	23	24	25	26	27	28
	18	19	20	21	22	23	24	25	26	27	28	29
	19	20	21	22	23	24	25	26	27	28	29	30
End #	+20	+21	+22	+23	+24	+25	+26	+27	+28	+29	+30	+31
Total	210	230	250	270	290	310	330	350	370	390	410	430

Secret Envelope (Rattlesnake Eggs)

<u>Effect</u>: Magician hands spectator an envelope that says it has rapid calculation secrets inside. Spectator opens the envelope and is startled when it rattles!

<u>Props</u>: Rattlesnake eggs & a pen.

<u>Preparation:</u>

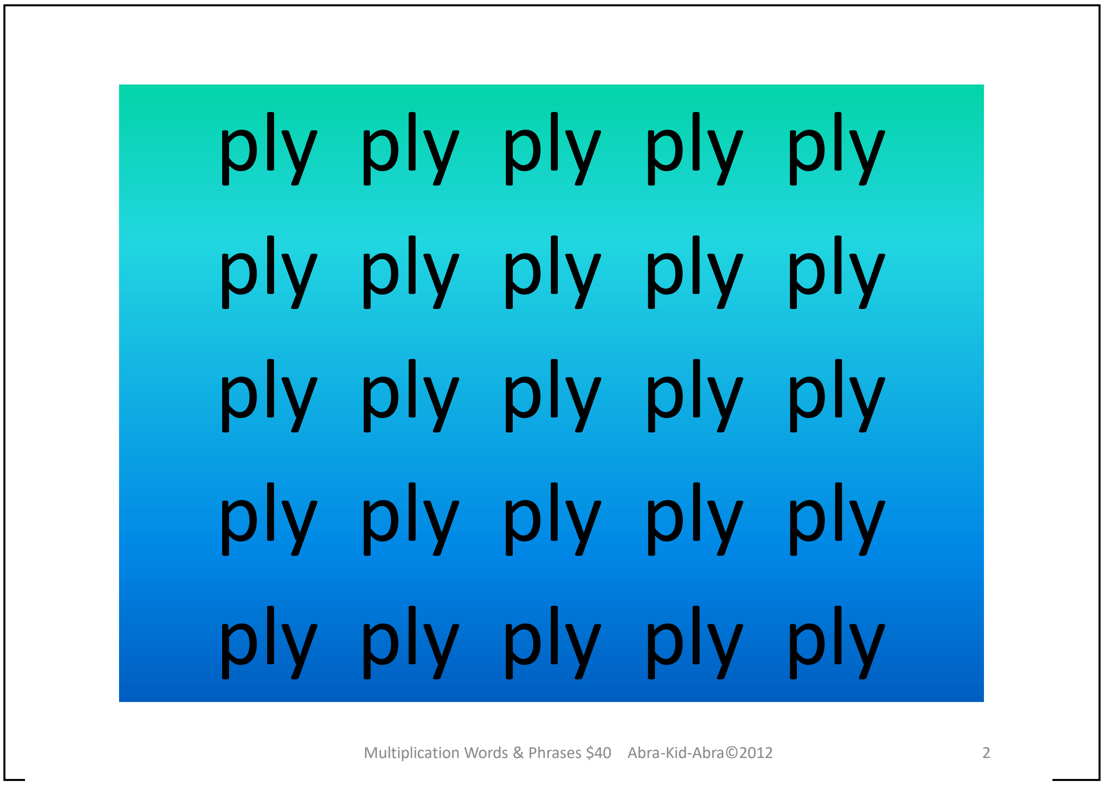
1. On the blank side of the envelope write something like “Math Secrets”.
2. Wind the washer a bunch of times until the rubber band is fairly taut. Slide the contraption (rubber band with washer on a paper clip) into the envelope.

<u>Presentation</u>: After you do a lightning calculation trick, mention that you keep the secret to the trick in your envelope (pull it out, showing it). Would they like to see your secrets? They can’t tell anybody. You might mention that this envelope used to contain rattlesnake eggs (show side that says “Rattlesnake Eggs”), but you took those all out and now you use this to hold your math secrets. Hand them the envelope. When they open it and it rattles, they’ll be startled!

Multiplication Class #2 Opener

What is the below wordle saying?   Answer: Multiply   (multi ply)

Props: Wordle 8.5x11 sheet with the below wordle on 1 side and the division wordle on the other.



Lightning Multiplication

2 Digit numbers where 1st digit is the same and 2nd digits add to 10 (e.g. 34 x 36)

Effect: You lightning calculate the answer to a variety of two 2-digit multiplication problems.

Props: 2 Digit Multiplication Worksheet, 2 Digit Multiplication Flash Cards.

Teaching Sequence:

Part 1: Squaring 2 digit multiples of 10. E.g. 10^2=100. 20^2=400. 90^2=8100.

a. Square the 1st #. Then tack on two 0's.
b. Activity: Do Part 1 of the worksheet, or do it all together.

Part 2: Squaring 2 digit #s ending in 5.

a. What is 25 x 25? 625. How do you know? A) 25 is between 20 and 30. Multiply 2 x 3 = 6. That's the first part. B) Multiply the 2 last digits together. 5x5=25. That's the last part. 625.
b. How about 45 x 45=? 4x5=20. 5x5=25. Put them together: 2025. (Note: 4x5 is really 40 x 50 = 2000, + 25 = 2025)
c. Activity: Complete part 2 of the worksheet.

Part 3: Multiplying, e.g. 32 x 38. 2 digit #s with the same first digit, and last digits add to 10.

a. What is 32 x 38? Use the same approach. 3x4=12. 2x8=16. Put them together: 1216.
b. 73 x 77 = ? 7x8=56. 3x7=21. 5621.
c. 51 x 59 = ? 5x6=30. 1x9=9. 309? No, 3009. If multiply the 2nd digits & get a 1 digit number, e.g. 9, make it 09.
d. Activity: Complete Part 3 of the worksheet to hone your skills.

Part 4: Multiplying 2 #s equi distant from a multiple of 10. E.g. 9x11. 19x21. 18x22.

a. What is 4x4? 16. If we multiply the numbers on either side of 4—3 & 5, what do we get? 15. How many less is 3x5 vs. 4x4? 1 less.
    1. Let's try this with some others. 10x10=? 100. 9x11=? 99. How many less? 1.
    2. Have a student name a number. E.g. 35. 35x35=1225. 34x36=? 1224. How many less? 1.
b. Algebra: Suppose A^2=X. (A-1) x (A+1) =(X-1). How can we use this?
c. Examples:
    a. 29x31 looks like a tough problem, right? But we know the answer is 1 less than 30x30. What's 30x30? 900. So what is 29x31? 899.
    b. 49x51=? 50x50=? 2500. Then 49x51=? 2499.
d. Let's go a step farther. 4x4=16. 3x5=15, which is 1 less. What is 2x6? 12. How many less is it? 4.
    a. 10x10=? 100. 9x11=? 99. 1 less. 8x12=? 96. How many less? 4.
    b. So if numbers are 2 away from the square, how many less will the total be? 4.
    c. 30x30=? 900. 29x31=? 899. 28x32=? 4 less than 900 =? 896.
e. What is 62 x 58? 60 x 60 = 3600. Less 4 =? 3596.
f. Make sure you have it by doing part 4 in your worksheet.

Summary-Lightning Multiplication Tricks

We have learned several tricks in lightning calculate certain types of 2 digit multiplication problems.

What are they?

1. Squaring 2 digit #s ending in 0.
    a. E.g. $35^{2=?}$ 1225.
    b. What's the secret? 3x4=12. 5x5=25. 1225.
2. Squaring 2 digit #s ending in 5.
    a. E.g. what is 45^2? 2025.
    b. What's the secret? Multiply 1st # x 1 higher. That's the first part. Multiply 5x5=25, which is the last part. E.g. 4x5=20. 5x5=25. 2025.
3. Multiplying 2 #s with same 1st digit, and last digits add to 10.
    a. E.g. what is 44 x 46? 4x5=20. 4x6=24. 2024.
    b. What's the secret? Same as 2 digit #s ending in 5.
4. 1 higher and 1 lower than a multiple of 10.
    a. E.g. 39 x 41? 40^2=1600. 39x41 is 1 less, or 1599.
    b. Secret: square the 10s multiple in the middle and subtract 1. Always ends in 99.
5. 2 higher and 2 lower than a multiple of 10.
    a. E.g. 38 x 42? 40^2=1600. 38x42 is 4 less, or 1596.
    b. Secret: square the 10s multiple in the middle and subtract 4. Always ends in 96.

Presentation:

1. You have a packet of 2 digit multiplication flash cards. There are several different colors of cards, each corresponding to a different type of problem above. 1 side has the problem, which can be shown to the student. The other side contains the answer.
2. To practice, have the kids stand shoulder to shoulder on stage. Randomly hold up cards, reading the problem. Each child gets read a different card and tries to lightning calculate the answer. They can write it on the board if they need to.
3. In the show:
    a. The lightning calculators stand shoulder to shoulder on stage.
    b. Explain that we have here a series of math wizards. They are going to demonstrate their mathematical prowess by trying to lightning calculate in their heads the answer to a series of 2 digit multiplication problems.
    c. Show that you have a stack of cards with a variety of multiplication problems on them. One side has the problem, the other side, the answer. Have members of the audience select approximately 20 cards (4 or so from each of the 5 groups).
    d. One at a time, audience members will hold up their card, and read out loud their math problem. The next lightning calculator whose turn it is will try to lightning calculate it.
    e. Depending on how many students you have, each should get ~2-4 turns.

Two Digit Multiplication Worksheet

Part 1, Squaring 10's:

20^2 =____ 30^2 =____ 40^2 =____ 50^2 =____ 60^2 =____ 70^2 =____ 80^2 =____ 90^2 =____

Part 2, Squaring 5's:

15 x 15 = ____ 25 x 25 = ____ 35 x 35 = _____ 45 x 45 = _____ 55 x 55 = _____

65 x 65 = ______ 75 x 75 = ______ 85 x 85 = ______ 95 x 95 = ______

Part 3, Around _5s:

22 x 28 = _____ 23 x 27 = _____ 24 x 26 = _____ 21 x 29 = _____ 20 x 30 = _____

38 x 32 = _____ 47 x 43 = _____ 56 x 54 = _____ 69 x 61 = _____ 70 x 80 = _____

71 x 79 = _____ 83 x 87 = _____ 94 x 96 = _____ 98 x 92 = _____ 37 x 33 = _____

Part 4, Around _0's:

19 x 21 = _____ 29 x 31 = _____ 51 x 49 = _____ 71 x 69 = _____ 89 x 91 = _____

28 x 32 = _____ 48 x 52 = _____ 22 x 18 = _____ 92 x 88 = _____ 58 x 62 = _____

41 x 39 = _____ 38 x 42 = _____ 59 x 61 = _____ 68 x 72 = _____ 81 x 79 = _____

Answers--Two Digit Multiplication Worksheet

Part 1, Squaring 10's:

20^2 =400 30^2 =900 40^2 =1600 50^2 =2500 60^2 =3600 70^2 =4900 80^2 =6400 90^2 =8100

Part 2, Squaring 5's:

15 x 15 = 225 25 x 25 = 625 35 x 35 = 1225 45 x 45 = 2025 55 x 55 = 3025

65 x 65 = 4225 75 x 75 = 5625 85 x 85 = 7225 95 x 95 = 9025

Part 3, Around _5s:

22 x 28 = 616 23 x 27 = 621 24 x 26 = 624 21 x 29 = 609 20 x 30 = 600

38 x 32 = 1216 47 x 43 = 2021 56 x 54 = 3024 69 x 61 = 4209 70 x 80 = 5600

71 x 79 = 5609 83 x 87 = 7221 94 x 96 = 9024 98 x 92 = 9016 37 x 33 = 1221

Part 4, Around _0's:

19 x 21 = 399 29 x 31 = 899 51 x 49 = 2499 71 x 69 = 4899 89 x 91 = 8099

28 x 32 = 896 48 x 52 = 2496 22 x 18 = 396 92 x 88 = 8096 58 x 62 = 3596

41 x 39 = 1599 38 x 42 = 1596 59 x 61 = 3599 68 x 72 = 4896 81 x 79 = 6399

5x5 Matrix

Effect: You draw a 5x5 table, and ask a spectator to name any 2-digit number. Suppose they say 12. You put 12 in the upper left corner square, and fill in the table with consecutive numbers (figure 1).

You explain that while you are not looking, you want them to circle any number (demonstrate by circling one with your finger), then cross out the numbers in that row and in that column (again, demonstrate by crossing them out with your finger—figure 2 shows this with a drawn circle & lines). Do this until 5 numbers are circled. Let you know when they are done. (In a show, they are at the blackboard. You are in front of them, facing the audience, back to blackboard.)

You then ask them to total the 5 circled numbers, and let you know when they've done so. You then turn around, glance at the 5 circled numbers, total them in your head, and instantly give the correct total (in this case, 120)!

12	13	14	15	16
17	18	19	20	21
22	23	24	25	26
27	28	29	30	31
32	33	34	35	36

Figure 1

12	~~13~~	14	15	16
~~17~~	(18)	~~19~~	~~20~~	~~21~~
22	~~23~~	24	25	26
27	~~28~~	29	30	31
32	~~33~~	34	35	36

Figure 2

~~12~~	~~13~~	~~14~~	(15)	~~16~~
~~17~~	(18)	~~19~~	~~20~~	~~21~~
~~22~~	~~23~~	~~24~~	~~25~~	(26)
~~27~~	~~28~~	(29)	~~30~~	~~31~~
(32)	~~33~~	~~34~~	~~35~~	~~36~~

Figure 3

Props: Pencil & paper

Secret: The simple answer: Total = the average number in the table x the number of numbers circled. In this case, 24 is the middle number x 5 numbers circled = 120. Use the x5 trick learned earlier to help deduce your total.

More detailed answer: This grid is an arithmetic series. I.e. each of the numbers is the same distance apart (in this instance, 1). The middle number in the table is both the mean (average) and median number, technically. When you circle numbers and cross off others in its row & column, you are getting an average sampling throughout the table, which will always add to the same total.

Teaching This: There is a lot you can teach with this.

1. After you demo it, ask what if different numbers had been selected. What would the total be? Let them try it. They get the same total. Hmm.
2. Try it with different numbers. E.g. 1-25. What is the total this time? (65)
3. Is there a way to know what the total will be when you see the grid?
    a. Adding a diagonal. Why does that work? It meets the condition of the trick, so it adds to the total.
4. Find the middle number in the table (which happens to be the average). Multiply it by 5 to get the total. How to quickly multiply by 5? Mutliply by 10, then take half.
5. What if we use a 3x3 matrix? How many numbers would be chosen? (3) Does it work then? (yes) How do you get the total? Middle # x 3.
6. What if the numbers go up by something other than 1—e.g. by 2, by 3, or by 5? Will it work then? (yes) Try it.
7. Does is work with a 4x4 table? (yes) What's the challenge here? There is an even number of numbers, so no clear middle number. E.g. in a 1-16 table, total = 8.5x4=34. What else can you do? Add the 2 corners, multiply that x 2. Or 8x4=32. .5x4=2. 32+2=34.

Scalability: Depending on the student's skill level, they can choose: a) table—3x3,4x4,5x5 (bigger gets long). b) How big is the starting #--e.g. 1,2,or 3 digits, 1-50,… c) Do the numbers increase by 1, or some higher number like 2,3,5,…? You decide whether you want to keep everyone on the same page, doing the same parameters, or whether to permit variation based on skill level.

Performing Notes:

1. As you are filling in the table, start figuring out what the total will be. You have additional time if needed while the spectator is circling their numbers. Try to have the answer by the time the spectator has circled the last number.
2. As an alternative to quickly looking at the circled numbers, you can ask them to tell you the 5 numbers, immediately add them in your head, and give your lightning added answer.

Math Learning: a) multiplying in their head various numbers by 3, 4, or 5. Use shortcut by 5s multiplication. b) familiarity with average. c) adding. If your total doesn't match the spectator's, you may need to check their addition.

Multiplication Swami

Effect: You introduce The Great Swami, who has great mental powers. She goes out of the room, and you ask the audience to name 2 1-digit numbers (e.g. 5 & 3). You jot them on a slip of paper, multiply them, and jot the product on the paper also (15). To be sure Swami doesn't see it, you fold the paper twice and set it on the table. You call the Swami in. She gazes at the people who called out the numbers, then she reveals the total, and the numbers!

Props: paper & pencil.

Secret: Where you set the paper & pencil on the table communicates to the swami the 2 numbers that get multiplied together. Swami multiplies them mentally to deduce the total.

1	2	3
4	5	6
7	8	9

You and Swami agree in advance to divide the table into 9 squares (see diagram). Where you put the paper determines one number, and where you put the pencil, the other. E.g. for 3 and 5 in the above example, you would put the folded paper in the 3 square and the pencil in the 5 square.

$$\begin{array}{r} 3 \\ \underline{x5} \\ 15 \end{array}$$

Note: If a 0 is chosen, hold onto an item. (Though if you ask for 1-digit numbers, you'll usually get 1-9.)

Mechanics:

- After you jot the #s & total, set the pen down in its square. Show the paper to the audience, fold it, & set it in its square. (Setting pen and paper down separately arouses less suspicion then together in different spots.
- Be sure you & Swami agree on the orientation and boundaries of the 3x3 matrix in advance. E.g. are you using the whole table top, or a portion of it? Is 1 in the upper left corner from the magician's perspective, or the audience's?

Presentation:

"Ladies and gentleman, I'd like to introduce the Great Swami. A round of applause for her, please. She has great mathematical powers, particularly in the area of multiplication. She will now demonstrate. Swami, please leave the room. (Pick up paper & pencil.) Can someone please name a 1 digit number. (e.g. 3. Jot it on your paper.) And can someone else name 1 more 1 digit number please. (e.g. 5. Jot it on your paper.) Let's multiply them together and we get ___ (15. Jot product on your paper so it now looks something like the below.) To make sure Swami doesn't see this, I will fold it in half a couple times. (Do so and set folded paper & pencil in the appropriate places on the table—in this case, in squares 3 & 5.)

I will now summon the Swami. Swami! A round of applause for the Great Swami, please. Swami, these 2 people have selected numbers. Would you gaze into their eyes deeply. Can you tell us, when you multiply them together, what total do you get? (Swami concentrates, then says, e.g. "I'm getting a 15. The numbers uses could be 1 and 15, but I don't think so. I think the numbers were 3 and 5".) Ladies and gentleman, a round of applause for the Great Swami!"

Scaling for Younger Students: Have each number be 1-5. Or make this an addition trick instead of a multiplication one, having Swami add the 2 #s instead of multiplying.

Math Learning: Multiplying 1 digit x 1 digit numbers. Note that both the magician and the Swami each must correctly do this for the selected numbers.

Super Spy Pen

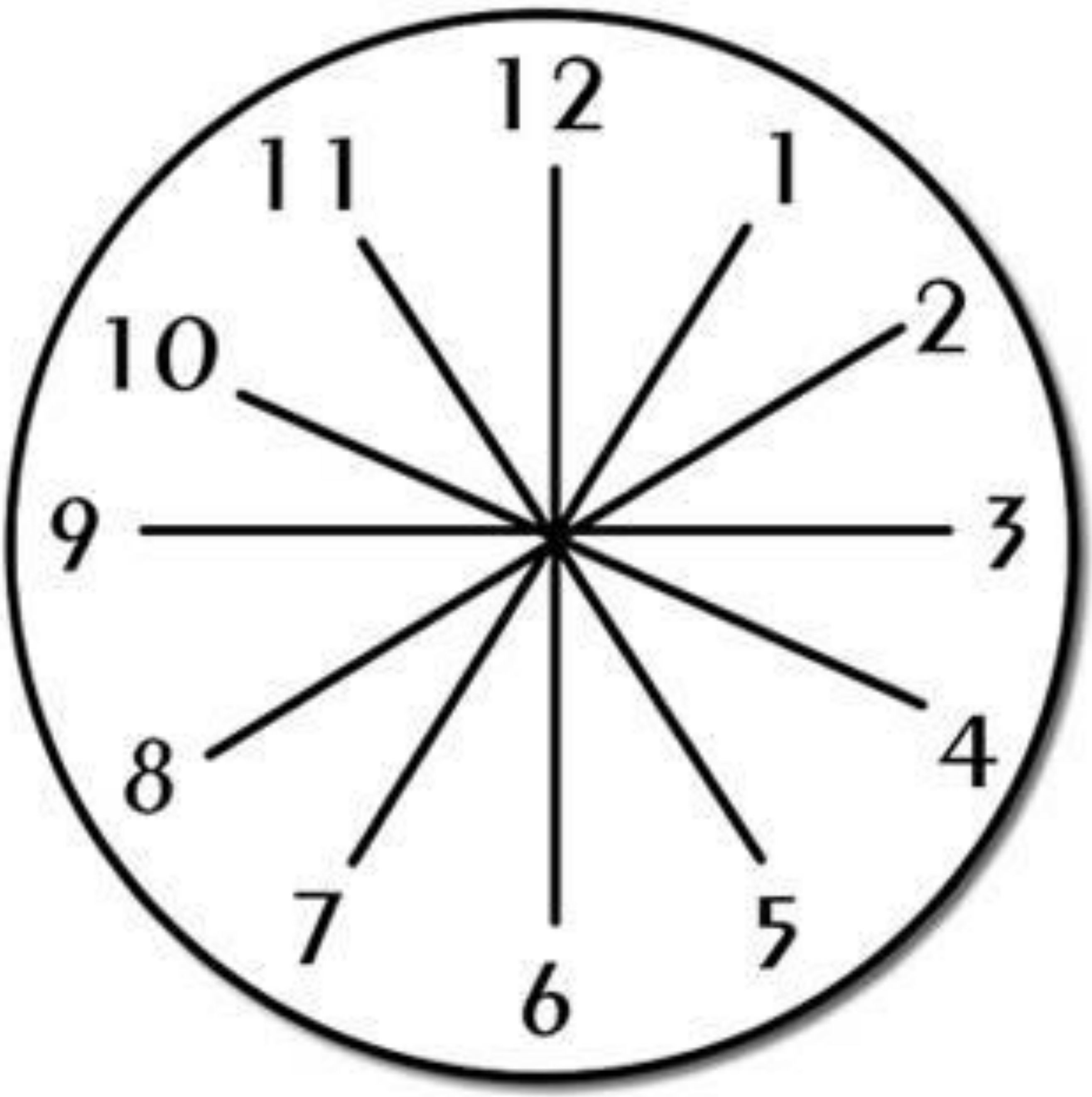
Effect: Write a message with 1 pen. It's invisible! Write over it with the other pen and your secret message appears!

Props: Super spy pen

Note: This is a fun take-home item to reward a hard day's work. Encourage the students to think of a way to use it in their math tricks.

Subtraction Opener

- Call up an assistant. You'll also need a clock—in the room, or use the picture below.
- Look away & ask your asst to point to any number 1-12 on the clock so the audience sees.
- Now have him point to the # directly across from it. (E.g. if he pointed to 9, now he points to 3.)
- Subtract 1 number from the other. You arrive at a total. Concentrate. Is the total…6?
- See if anyone knows the secret. Secret: the answer is always 6. Clock numbers directly across from each other are always 6 apart!



Lightning Subtraction: 2 Tricks—Altering & Distance from 100

Altering –Adding to both sides of the Equation for Easier Subtraction

Effect: The audience holds up various flash cards with subtraction problems. You announce the correct answers with lightning speed!

Props: Flash cards-math wiz, worksheet of subtraction problems, and pencil.

Secret: 62-26 is a tough problem. To make it easier, what would you need to add to 26 to make it a multiple of 10? 4. Add 4 to both sides (which keeps the answer the same): 66-30. This is a much easier problem: 36. A 2nd example: 176-49=? Add 1 to both sides to make 49 a multiple of 10. 177-50=27. Note, by the way, that all of these problems (before you alter them) involve borrowing. The number you're subtracting ends generally in 7, 8, or 9. The altered problem eliminates the borrowing.

Why Does This Work? Adding the same amount to both sides of the minus doesn't affect the answer. E.g. 5-3=2. Add 4 to both sides of the minus to get 9-7, which also = 2. Alter the problem to make it easier, enabling you to solve a tough problem quickly.

Worksheet: Have students fill out rows 1-3 of the Subtraction worksheet.

Scaling This To Younger Vs. Older Kids: Less digits and smaller numbers are easier. E.g. 2 digit minus 1 digit, and keeping the numbers lower is easier.

When the Numbers Straddle 100, Add the Distances from 100.

Effect: The audience holds up various flash cards with subtraction problems such as 131-72. You announce the correct answers with lightning speed!

Props: Flash cards, worksheet of subtraction problems, and pencil.

Secret: Convert these tough problems into easier problems by adding the distances from 100. E.g. 131-72=? 31 (131 is 31 from 100) + 28 (72 is 28 from 100) =59, which is the answer! This also works for multiples of 100. E.g. 724-685=? 24+15=39.

Why Does This Work? This technique alters the problem to make it easier. 131-72= 131-100+100-72 =(131-100)+(100-72).

Worksheet: Have students fill out row 4 of the Subtraction worksheet.

Scaling This To Younger Vs. Older Kids: Keep the numbers close to 100 for an easier problem.

Worksheet Subtraction - Altering, Above and Below 100

14	17	15	23	26	27
- 9	- 8	- 9	- 7	- 9	- 8

42	37	73	44	55	68
-17	-18	-19	-27	-28	-29

141	117	133	164	142	176	125	193	185
- 7	- 8	- 9	-27	-19	-49	-107	-168	-159

103	104	110	123	442	1035
-96	-85	-76	-68	-384	-967

$10.00	$10.00	$20.00	$20.00	1000	1000
-5.25	-7.67	-13.24	-7.49	-1725	-333

Row 1: alter 2x1
Row 2: alter 2x2
Row 3: alter 3x_
Row 4: over 100, under 100
Row 5: making change

Answers--Worksheet Subtraction - Altering, Above and Below 100

14	17	15	23	26	27
- 9	- 8	- 9	- 7	- 9	- 8
5	9	6	16	17	19

42	37	73	44	55	68
-17	-18	-19	-27	-28	-29
25	19	54	17	27	39

141	117	133	164	142	176	125	193	185
- 7	- 8	- 9	-27	-19	-49	-107	-168	-159
134	109	124	137	123	127	18	25	26

103	104	110	123	442	1035
-96	-85	-76	-68	-384	-967
7	19	34	55	56	68

$10.00	$10.00	$20.00	$20.00	1000	1000
-5.25	-7.67	-13.24	-7.49	-725	-333
4.75	2.33	6.76	12.51	275	667

Nein

Effect: A spectator names any 3-5 digit number, which you write. Then the spectator rearranges the numbers, creating a 2nd number which, again, she names and you write. With you not looking, she subtracts 1 number from the other, writing a total, as you subtract the 2 in your mind. You ask her how many digits the total has, and to circle one of them (not a 0). She names the uncircled digits. You then name the digit she circled!

Props: Pencil and paper, or a blackboard & marker.

Secret/Mechanics:

1. Ask spectator to name any 3-5 digit number. Write it down. (e.g. 572)
2. Have spectator rearrange the digits to create a 2nd number, which she announces. You write it down (e.g. 257).
3. Look away. Have spectator subtract the smaller number from the larger, writing the difference (e.g. 315). You, meanwhile supposedly subtract the 2 #s in your head.
4. Spectator circles any digit in the total (not a 0). E.g. suppose 5.
5. Spectator reads you the uncircled numbers. E.g. 3 & 1.
6. You announce the circled number: 5.

572
-257
315

What you do: Add the uncircled digits together, subtract the total from 9, and that is the circled number! In this instance, 3+1=4. 9-4=5.

What if the total is greater than 9? Keep adding the digits together until you get a single digit number. E.g.

$$\begin{array}{r} 321 \\ -\underline{123} \\ 198 \end{array}$$

If spectator circles 1, and reads 9 & 8, that totals 17. 1+7=8. 9-8=1!

Why Does this Work/Teaching the Math Behind This:

- When you have a multi digit number where the digits are different, you make a 2nd number reordering the same digits, and subtract, the result is always a multiple of 9.
- With a multiple of 9, the digits always add to a multiple of 9.
- Therefore, if you hear all the digits except one, if you total these and subtract from 9, you get the missing digit! (Note: If the total you get is greater than 9, you can subtract it from the next highest multiple of 9 to get the missing digit. Or you can total the digits until you get an answer less than 9 and subtract that from 9. E.g. If the spectator says the total of the 2 digits she didn't circle in the 3-digit answer is 17, 18-1=1. Or 1+7=8. 9-8=1.)

Notes:

- It should seem like you do a difficult mental subtraction problem in your head. Actually you just add the numbers and subtract from 9!
- This is a good trick to hone adding and subtracting in your head, as the numbers are different each time.

Scaling for Younger Kids: Use 2 digit numbers instead of 3. The digits of the difference will add to 9. Have them circle 1 digit, and you mind read the other.

Lightning 5

Effect: You add 5 numbers in your head faster than someone can do it on a calculator! (Numbers are called out by spectator, you, spectator, you, then spectator.)

Younger adders do this with 1-digit numbers. Older adders do it with 4-digit numbers.

Props: Pen or pencil, pad of paper.

Secret: The number you call out, added to the spectator's previous number, brings the total to 9s. To get the total, you take the last number, append a 2 to the front, and subtract 2 from it. Let's look at some examples:

1 Digit # Example	
Spectator's #	5
You say (to make it add to 9)	4
Spectator's #	3
You say (to make it add to 9)	6
Spectator's #	7
Total	25
How you know total: Last # = 7. Append 2 in front & subtract 2 = 27.	

2 Digit # Example	
Spectator's #	27
You say (to make it add to 9s)	72
Spectator's #	43
You say (to make it add to 9s)	56
Spectator's #	82
Total	280
How you know total: Last # = 82. Append 2 in front & subtract 2 = 280.	

4 Digit # Example	
Spectator's #	2967
You say (to make it add to 9)	7032
Spectator's #	9258
You say (to make it add to 9)	741
Spectator's #	7621
Total	27619
How you know total: Last # = 7621. Append 2 in front & subtract 2 = 27619.	

In the last (i.e. 4 digit) example, the spectator's second number had a first digit of 9. Therefore your first digit is 0, which is omitted since it's the first digit of your number.

Also in the last example, when you subtract 2 from the spectator's last number, you have to borrow. So instead of subtracting 2 from 1, subtract it from 21, making the last 2 digits of your answer 19.

Presentation: "I'm going to try to add some numbers very quickly. Can someone call out any 4 digit number. (2967. Jot this on the board, or on paper if doing it for a small group.) To make things a little harder, I'll add another number. (Write 7032 in this case, bringing the first number to 9s.) Can someone call out another number, please. (9258. Write it.) Oh, boy, you're not making it easy on me, are you? I'll add another. (741) Can I get one more 4 digit number, please. (7621) (Draw a totaling line beneath the last number, as you mentally come up with the total.) I think I have added these numbers. I'll put my answer over here. (Jot your total on the side of the board—27619 in this instance.)

Let's see how I did. (Add up the 5 numbers out loud. The total should match yours.) That's the number I had—which is lucky, because this trick works 1 out of a thousand times!"

Notes:

- This can be presented as a 2-person trick. One is the emcee, and the other is the lightning calculator. In this presentation, the emcee would carry on about what a mathematical genius the other person is.
- When you write your total, if you prefer, you can not reveal it until after you have totaled the 5 numbers.
- If you do this on a sheet of paper, hold it so both you and the audience can see the numbers. Don't make the numbers upside down to them.

Stretching Their Thinking: If you just used 3 numbers, what would you do to the last number to add them? (append 1 on the front, subtract 1 from the end. Like adding 10,000 less 1.) 7 numbers? (append 3 on front, subtract 3. Like adding 30,000 less 3.)

Disappearing Ink Gag

Effect: Squirt disappearing Ink on a spectator's shirt! It makes a blue stain, but it disappears after a short while.

Props: Disappearing ink bottle.

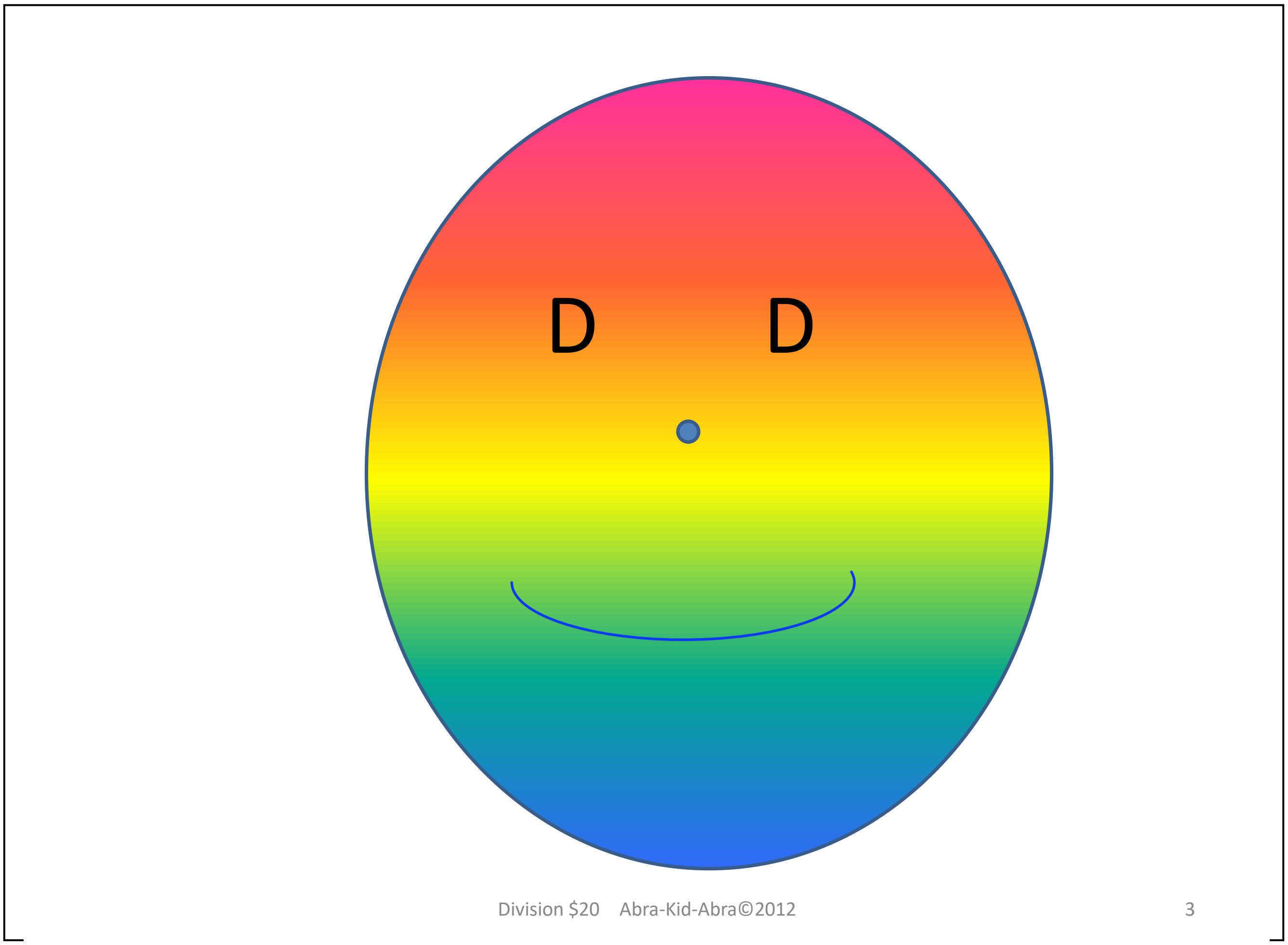
Presentation: Remark that someone hs a very nice shirt—but, wait a minute, there is a spot on it! No problem. You happen to have with you a bottle of spot remover. You intend to squirt out a small dab but uh oh—you squirt a big blotch that makes a large blue stain on his shirt! No worry. In a few minutes, it disappears and the shirt is back as good as new!

Comment: This is a gag (not a trick).

Division Opener

What is the below wordle saying? Answer: Division (D vision)

Prop: 8.5x11 sheet with this wordle on 1 side and multiplication wordle on the other.



3 Lightning Division Tricks: Dividing Evens, Dividing by 4, & Dividing Fractions

Each of these tricks uses flash cards. The audience holds them up and you lightning calculate the answer mentally. Props for each include: flash cards, a worksheet covering the division tricks on this page, and a pencil.

Dividing When You Have 2 Even Numbers

Effect: You lightning divide flash card problems dividing an even number by an even number.

Secret: When both numbers are even, divide them by 2. Keep doing this until you get an odd number an can't any more. Then solve the problem. E.g. 84/14 = 42/7 = 6.

Why Does This Work? You can divide (or multiply) both sides of a division problem by the same number and not affect the answer. E.g. 2/4 = ½ (2/2=1, 4/2=2). Dividing by 2 when you can simplifies the problem!

Worksheet: Have students complete rows 1 & 2 of the division worksheet.

Scaling This To Younger Vs. Older Kids: Lower numbers are, of course, simpler.

Dividing By 4

Effect: You lightning calculation flash card division problems that entail dividing by 4.

Secret: To divide a number by 4, halve it, then halve it again. E.g. 128/4=? Half of 128 is 64. Half of 64 is 32, which is the answer! This is most easily done with even numbers.

Why Does This Work? Halving it twice is dividing by 2, then dividing by 2 again, which is equivalent to dividing by 4.

Worksheet: Have students complete rows 3 & 4 of the division worksheet.

Scaling This To Younger Vs. Older Kids: Smaller numbers are, of course, easier to divide.

Extension: You can also divide by 40 using this same approach. However, with 40, ignore the 0 and treat it like 4. We'll deal with the 0 at the end. E.g. 640/40=? Half of 640 = 320. Half of 320 = 160. Then adjust for the 0 (40 instead of 4) as follows. 160 doesn't look right. That would be 640/4. How can we adjust 160 to be right? Make it 16. That looks right. 16.

Dividing By a Fraction

Effect: You lightning divide fractions on a flash card! E.g. 28/3.5=? 8.

Secret: We've seen in the first 2 tricks that you can divide both sides of the equation by the same number and not affect the answer. The same is true with multiplying. When you are dividing something by a half, double both sides, which often yields an easier problem. In this case, e.g. 28x2=56. 3.5x2=7. 56/7=8.

Why Does This Work? In division, you can multiply or divide both side of the equation by the same number and not affect the answer. E.g. ½ = 3/6. (3/6 is obtained by multiplying top & bottom by 3.) When you multiply a fraction by 1 (e.g. 2/2), it equals itself.

Worksheet: Have students complete rows 5 & 6 of the division worksheet.

Scaling This To Younger Vs. Older Kids: Smaller numbers, of course, makes for an easier problem.

Division Worksheet—Evens, 4s, and Fractions

288÷36=	70÷14=	78÷26=
198÷22=	168÷24=	328÷82=
64÷4=	80÷4=	100÷4=
216÷4=	412÷4=	888÷4=
9÷1.5=	30÷7.5=	36÷4.5=
75÷2.5=	150÷12.5=	130÷6.5=

Row 1 & 2: dividing even #s
Row 3 & 4: dividing by 4
Row 5 & 6: dividing by _.5

Answers--Division Worksheet
Evens, 4s, and Fractions

288÷36= 8	70÷14= 5	78÷26= 3
198÷22= 9	168÷24= 7	328÷82= 4
64÷4= 16	80÷4= 20	100÷4= 25
216÷4= 54	412÷4= 103	888÷4= 222
9÷1.5= 6	30÷7.5= 4	36÷4.5= 8
75÷2.5= 30	150÷12.5= 12	130÷6.5= 20

Divisible by __?

Effect: You hand 4 spectators each a list of numbers. The first spectator's list is all numbers divisible by 3 (up to 600). The 2nd spectator's list is all numbers divisible by 6 (up to 1200). The 3rd spectator's list is all numbers divisible by 9 (up to 2000). The 4th spectator's list is all numbers divisible by 4 (up to 1000). Start with the first spectator. He calls out several numbers which can be from his sheet--in which case, they are divisible by 3--or not from his sheet, in which case they are not divisible by 3. After each, you correctly say whether or not the number is divisible by 3. You then do the same with numbers divisible by 6, 9, and then 4!

Props: Divisible by sheet (2-sided). It contains Divisible by tables for: 3,6,9, & 4.

Secret:

Divisible by 3: Add the digits. If the sum is a multiple of 3, the number IS divisible by 3. If not, it is not. The highest total you'll get for 3 digit numbers is 27 (9+9+9). So if the digits total 3, 6, 9, 12, 15, 18, 21, 24, or 27, the number IS divisible by 3. If they total anything else, the number IS NOT divisible by 3. Why does this work? A property of multiples of 3 is that the sum of their digits is a multiple of 3. This is not the case with non multiples of 3.

Divisible by 6: Must be divisible by 3 AND by 2. I.e. Divisible by 3, as above, and be even. If it is odd, or not divisible by 3, it's not divisible by 6.

Divisible by 9: Add the digits. If the sum is a multiple of 9, the number IS divisible by 9. If not, it is not. The highest multiple of 9 you'll get is 999, or a total of 27. So if the digits total 9, 18, or 27, it IS a multiple of 9. Otherwise, it isn't. Why does this work? A property of multiples of 9 is that the digits add to a multiple of 9. Non multiples of 9 don't.

Divisible by 4: If the last 2 digits are divisible by 4, then the number is divisible by 4. Quick way to check: 20, 40, 60, 80, & 100 are all divisible by 4. Start with 1 of them and count by 4s to see if the # in question is divisible by 4. E.g. is 117 divisible by 4? No, it's odd. To be divisible by 4, it must be even. How about 134? We know 120 is divisible by 4. 120-124-128-132-136. No, 134 is not divisible by 4. Why does this work? 100 is divisible by 4. So, therefore, is 200, 300, 1000, etc. Hence, just as these are divisible by 4—08, 12,16, etc.—so are these—108, 112, 116, etc. For completeness, here is a list of all 2 digit #s divisible by 4: 04, 08, 12, 16, 20, 24, 28, 32, 36, 40, 44, 48, 52, 56, 60, 64, 68, 72, 76, 80, 84, 88, 92, 96, 00.

Show Performance:

1. You are the emcee. Have 12 students on stage standing shoulder to shoulder in a row. (Use 6 or 3 if you don't have 12.) Have 5 Divisible by sheets available—4 for the audience and 1 for yourself.
2. "We have with us today 12 of the greatest lightning calculators in the world. A round of applause for them, please.
3. May I have 4 adult volunteers from the audience please, who are willing to help us from their seats. (Pass out a Divisible By sheet to each.) Thanks for your help.
4. Knowing whether a number is divisible by 2, or by 10, or by 5 is easy. However, knowing whether a number is evenly divisible by 3, or by 6, or by 9, or by 4 is much more challenging.
5. Let's start with divisible by 3. You, sir (indicate 1 of the spectators with a divisible by sheet). Do you see the section on your sheet that says divisible by 3? Beneath it is a box containing all the numbers from 1-600 that are divisible by 3. I would like you to call out any number from 1-100, and our lightning calculators will attempt to tell you whether or not it is divisible by 3. If it is in the divisible by 3 table, it is divisible by 3. If not, then it isn't. The number you call out can be in the table or not—your choice. When they give their answer, I'll ask you to say 'correct' or 'wrong'. Do you have any questions? Do you understand the activity? Alright, would you call out any number from 1-100. (e.g. 37) Lightning Calculator #1 (1st one in line): is 37 divisible by 3? (No) Is he correct? (Yes, correct) Well done. Now, would you name a higher number between, say, 100-300. (142) Lightning Calculator #2, is 142 divisible by 3? (Yes) (Spectator says 'correct'). Well done. Finally, would you name a number between 300-600. (448) You are really putting them to the test! Lightning Calculator #3, is 448 divisible by 3? (No) (Spectator: 'correct'). A round of applause for our 1st 3 lightning calculators.
6. Repeat this procedure for 6s, 9s, & 4s. Note: if you have 12 kids, each will get 1 turn. If 6, each gets 2 turns, etc.

Tip: When the number is a challenge to the student, you or they can jot it on the board. This provides more time & lets them see it.

3.5 of Clubs

<u>Effect</u>: Magician places a prediction card face down on the table. Spectator selects a card. Magician declares that whatever the card is, the magician's card will be ½. Spectator says that half would be the 3.5 of clubs—which is what the magician turns over!

<u>Props</u>: 3.5 of clubs, deck of cards.

<u>Secret/Preparation</u>: While spectator thinks that have a free selection, magician actually forces the 7 of clubs. Before you start, place the 7 of clubs as the 10th card from the top.

<u>Presentation</u>: Have the 3.5 of clubs face down on the table, off to the side. Invite a spectator up from the audience. Have him come around to the same side of the table as you, facing the audience. Ask him to name any number from 10-20, then deal (from the top of the deck) that # of cards into a (face down) pile.

Then ask spectator to pick up the pile he just dealt, add the digits of his number, & deal that many. E.g. if spectator picks 15, he deals 15 in a pile. Then from that pile, he deals 6 cards (1+5) onto the table. The last card (the 6th one in this example) is his card—have him set it aside on the table and reassemble the rest of the deck. Pick up the 3.5 of clubs (don't let them see its face, of course). "I have taken the liberty of making a prediction. This (hold up 3.5 of clubs, back facing audience & spectator) is my prediction card. Whatever card you picked, mine will be half. For example, if you have the 2 of hearts, mine will be the ace of hearts. If you picked the 10 of spades, mine will be the 5 of spades. Would you look at your card and tell me—when you divide it by 2, what do you get? (3.5 of clubs) This is no time for jokes. I am trying to conduct a performance. The card that you're holding, what do you get when you divide it by 2? (3.5) May we see the card please. (He shows it's the 7 of clubs. Pick up the deck and spread through the cards face up, looking through it.) I must have given you the wrong card. Shall we start over from the beginning?

Would you turn over the card, let's see how close I was. (Hold up the 3.5 of clubs so everyone can see it.) Thank you. Let's give our assistant a round of applause.

<u>Teaching Points</u>:

- If they don't know how to divide 7 by 2, have them show it to the audience and get help. You might also act like you think it's a picture card and say, "if it's a queen, that's worth 12, so the queen divided by 2 is 6".
- Act like you messed up. Then you show that you really did get it right.

<u>Teaching Math with This</u>:
Spectator deals any number of cards from 10-20.

10	1+0=? (1)	10-1=? (9)
11	1+1=? (2)	11-2=? (9)
15	1+5=? (6)	15-6=? (9)

The point: Many different equations = the same number. No matter how many cards the spectator deals, it always = your card!

Question: These equations = 9. Why is it the 10th card, not the 9th? Answer: When you deal the 2nd pile, you start counting with the first card, which, in effect, gets double counted. If you dealt 10 cards on the table in a row, then started on the last card and counted 1 as the next card, it would be 9th from the top.

Pencil Through Finger Gag

Effect: It looks like a pencil is going right through your finger! Oh, the hazards of being a math magician.

Props: pencil through finger gag

Secret: It goes around your finger, worn like a ring.

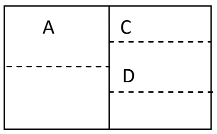
Note: This gag makes a fun take-home item. Ask the kids to think about how they can use it in their math magic tricks.

Impossible Paper

Effect: You show a folded sheet of paper sitting on a table. You ask a spectator to take a blank sheet of paper and fold it to replicate your sheet—without touching your sheet. As the spectator tries to do this, he realizes that your folded sheet looks impossible!

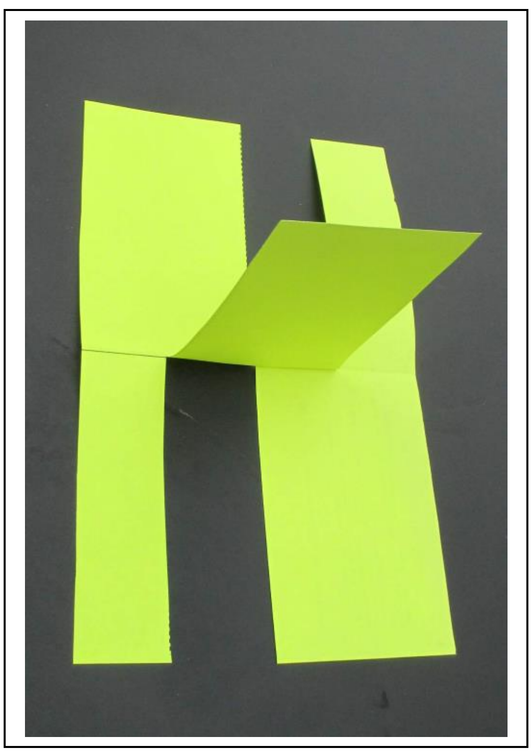
Props: Impossible paper sheet for each student, and a kids scissors.

Secret: The instructions are printed on the sheet, which are as follows:



1. Fold this paper in half along this (solid vertical) line, then unfold.
2. With a scissors make 3 cuts along the 3 dotted lines, each cut halfway through the paper.
3. Fold section D so it points up.
4. Rotate A & C 180 degrees (i.e. they swap places). These instructions will now be on the bottom, facing the table, not visible.
5. You've done it! The shape now looks impossible! Ask a spectator to take a blank sheet of paper and fold it so it replicates this. No touching this sheet.

It is amazing that some simple cuts and a fold can make a paper look impossible!



1. Just One Line

5+5+5+5 = 555

Can you draw just 1 line to make this equation correct? (You can't change equals to no equals.)

2. Five 6's = 19

Can you make five 6's equal 19?

You may use any combination of +, -, x, and / signs.

3. 5678

5678

Can you insert into 5678 above an equals sign and any combination of +, -, x, and/or / to make a true equation? Keep 5678 in their same order.

4. 3x3 Magic Square

Can you put each of the numbers 1-9 into the 3x3 grid below so that each row, column, and the 2 diagonals add to the same number?

5. Grandma's Cookies

Mom sent her son to grandma's house to deliver 9 cookies. "Don't eat them!" she exclaimed. To be sure he didn't, she wrote "IX" (roman numeral 9) on the bag so Grandma would know how many cookies were in the bag. During the walk, he got hungry and ate 3. He had a pen, but no eraser. What did he do?

6. Correct Equation?

5 x 6 = 8 x 4

How can the above equation be true?

7. Sum = Product

What is the only 2-digit number where the sum of its digits equals the product of its digits?

8. Amoeba Multiplication

Amoebas double every minute. It took 1 hour to fill half the bottle. How long will it take to fill the whole bottle?

9. Pearls

A guy bought a necklace with 9 pearls for his wife. He found out that 1 of the pearls is not real. All the pearls are the same weight, but the fake one weighs 1 oz less that the real ones.

Using a double balance scale, how can he find out, for sure, which is the fake pearl in only 2 weighings?

10. Chewed Calculator

My dog chewed up my calculator keys and the only number key that works is the 4. The +-x / and square root keys all work. Can you make the #s 1-10 using only the 4 key and those operations keys?

Solutions 1A

1. Add a line to the plus sign, changing it to a 4. 545+5+5=555.
2. 6+6+6+6/6 = 19.
3. 56=7x8
4.

2	9	4
7	5	3
6	1	8

5. Put "S" in front: "SIX".
6. 5x6=30. 8x4=thirty too.
7. 22. 2+2=4. 2x2=4.
8. 1 hour 1 minute.

Solutions 1B

9. 1st weigh 3 vs. 3. If the scales balance, these 6 are real, go to the next 3. If the scales don't balance, go to the 3 in the lighter group. 2nd, weigh 2 pearls from the appropriate group of 3. If they balance, the fake is the 3rd pearl not on the scale. If they don't balance, the lighter one is fake.

10. 1=4/4. 2=sq ft of 4. 3=4-(4/4). 4=4. 5=4+(4/4). 6=4+4+4/sq rt of 4. 7=4+4-4/4. 8=(4*4)/4. 9=44/4-sq rt of 4. 10=(44-4)/4).

11. An Alphabetical Number

What is the only number whose letters are in alphabetical order? Hint: It's less than 50.

12. Reverse Alphabetical Order

What is the only number whose letters are in reverse alphabetical order? Hint: it's less than fifty.

13. Matching Pair

Sam has a sock drawer with 6 pair of green & 6 pair of blue socks. What is the minimum number he must grab in the dark to be sure he has a matching pair?

What if these were gloves instead of socks, where he wants a right & a left glove of the same color?

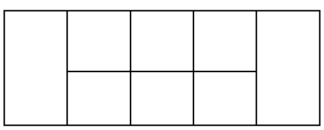
14. 4 Pint Problem

You have a 5 pint container, a 3 pint container, a sink, and a big bowl.

Challenge: Using these items, can you pour exactly 4 pints of water into the bowl? If so, how?

15. Box Score

Can you put the numbers 1-8 in the 8 boxes below so that no consecutive numbers are in adjacent boxes horizontally, vertically, or diagonally?



16. First A Number

When counting, what is the first number that contains the letter A?

17. Spelling Challenge

Can you arrange 9 letters of "extension" to spell 3 numbers, each less than 20?

You must use each letter once.

18. Triangular Problem

A triangle's sides are 4, 6, and 10 inches. What is its area in square inches?

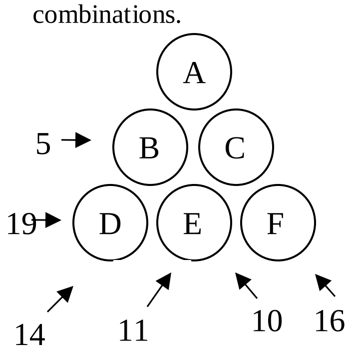
19. 2+11-1=12

Can you use the letters below to demonstrate the above equation?

TWOELEVEN

20. Detective Work

Can you figure out what 1-digit numbers the letters below represent? The numbers represent sums of various letter combinations.



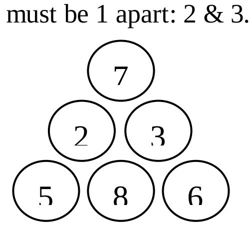
Solutions 2A

11. 40. Forty
12. 1. One
13. Socks: 3. E.g. blue, green, blue. Gloves: 13. Could get 6 right blue, 6 right green. 13th would be left.
14. Fill the 5 pint, pour it into the 3 pint, leaving 2 pints. Pour the 2 pints in the bowl. Empty the 3 pint in the sink. Repeat to yield 4 pints.
15.

<table>
<tr><td rowspan="2">7</td><td>3</td><td>1</td><td>4</td><td rowspan="2">8</td></tr>
<tr><td>5</td><td>8</td><td>6</td></tr>
</table>

Solutions 2B

16. One thousand.
17. ten, one, and six
18. 0. 4+6=10, so it's flat with 0 area (i.e. a line).
19. Cross out "one"—O, N, and the 2nd E, leaving TWELVE!
20. To start, B+C=5. They must be 2 & 3 or 4 & 1. E+C=11, E+B=10. So B& C must be 1 apart: 2 & 3.



5 Cube Addition (Art Trick)

Effect: While you look away, a spectator rolls 5 dice with different 3 digit numbers, then lines them up so the 3 digit numbers are all in a column. The spectator adds the five 3-digit numbers that she rolled. You then turn around and, within 10 seconds, add the numbers in your head, correctly announcing the sum!

Props: 3 sheets of cardstock for each child. For the group: kids scissors, glue stick, & scotch tape.

Secret: Add the last digit of each 3-digit number (suppose, e.g. 17). Subtract this number from 50 (33). Put these together to get the answer: 3317. (Note that the subtracted from 50 number goes first.)

E.g. Suppose the spectator rolls: 483 543 663 971 657	Add the last digits: 3+3+3+1+7=17 48**3** 54**3** 66**3** 97**1** 65**7**	50-17=33. Put these together for the answer: 3317	483 543 663 971 +657 3317 Correct!

Preparation:

1. Cut out the 5 dice templates.
2. Fold along lines.
3. Fold the side with 3 "Glue"s 1st. Glue end number over "Glue". Use glue stick, tape, or even blue tak.
4. Fold the other side with 4 #s & 1 Glue. Glue on 2 sides, gluing number on top of the "Glue" side.
5. Repeat until you have all 5 dice ready.

Presentation: "I have 5 dice. Each side has a different 3-digit number. When I turn away, I'd like you to roll the dice. Then put the numbers you rolled into a column like this (see diagram below) and add them. You can use a calculator or do it by hand. When you have totaled them, let me know. Any questions?

(Look away as spectator does this. Spectator lets you know she is done.) I am going to attempt to add the five 3-digit numbers in my head. When I turn around, I'd like you to start counting out loud and we'll see how long it takes me to come up with an answer. Ready? (You turn around & audience starts counting. Quickly add the last digits, then subtract from 50.) I got it! (They stop counting.) How long did it take me? (10 seconds) I believe the total was 3317. How close did I get? (On the nose) A round of applause for my assistant!"

How Works?
Can the students figure out why this works? Hints:

- Do you notice anything unusual about the numbers on each dice? Middle numbers of each dice are the same. The 3 digits on each dice add to the same number. This means that the middle numbers total will the same every time. The last column & first column, together, will total the same every time.

Here are 3 random rolls:	872	179	773	
	564	663	960	
	855	459	657	
	780	186	285	
	+345	+840	+543	
Total:	3416	2327	3218	
Middle Column Total:	30	30	30	
Last Column Total:	16	27	18	
First Column Total:	31	20	29	
First + Last Column Total:	47	47	47	Note: 47 + 3 carried from middle column = 50.

Math Learning: Mental addition and subtraction.

Answer Bag (Art Trick)

Effect: You show a bag that has magical properties. You put in any math problem—any math problem at all, no matter how difficult--and it produces the answer. You ask a spectator to name any math problem—the more difficult the better. You jot it on a slip of paper—e.g. 573 x 291—fold it, and drop it in the bag. You shake up the bag and dump out the slip of paper. You unfold it and show that it provided the answer! I.e. the slip now reads "the answer"! There is a little magic here, but it's more of a comedy gag.

Props: For each student: 2 paper lunch bags, pad of paper, pen or pencil to use. For group: kids scissors.

Secret: Though it looks like you have an ordinary lunch bag, there is a 2nd bag nested inside, creating 2 compartments: the inside (the middle of the inner bag), and the outside (area between the 2 bags). The slip with "The Answer" on it is folded and placed in the section between the 2 bags. The slip with the math problem is dropped in the middle. You switch slips.

Preparation: Cut ~1/2 inch off the top of 1 of the bags. Carefully slide it into the other bag, aligned the same way as the other bag (e.g. bottoms are lined up). In big letters write "The Answer" on a slip of paper. Fold it in half and drop it between the 2 bags (in what we'll call the outer compartment).

Mechanics:

- Set the bag on the table, bottom of the bag facing the audience, top of it away from audience.
- Ask the audience to name any difficult math problem. If they name an easy one, challenge them to give you a tougher one. Jot it on a slip of paper, fold the slip in half, and drop it in the inner compartment (middle of inside bag).
- Close up the bag and shake it. Have the audience say some magic words—e.g. mathemagic. Open the bag, turn it upside down and dump out the slip ("The Answer") on the table. How to make sure The Answer slip (only) falls out? As you open the bag, pull the inner bag (with the difficult problem on its slip) closed—so before you turn the bag upside down to dump out the slip, you are holding the top edge of the side toward you, along with the 2 top edges of the inner bag. This prevents the inner bag's contents from spilling out and opens the outer compartment so its slip can fall out.
- After the slip dumps on the table, put the bag away in your case, or set it bottom toward the audience. Note that the audience never sees the inside of the bag (you don't want them to see the nested bag inside).

Disarming Prediction (Art Trick)

Effect: Explain that you will ask a spectator to name a 3-digit number. You will then do some calculations with it—reversing it and subtracting, then reversing again and adding, to arrive at a total. The coffee will then reveal the number. The spectator names a number. You go through some calculations, arriving at a final number. You rub some coffee grinds on your arm, and the spectator's final number appears on your arm!

Props: For each student: pencil, paper, lip-ex (similar to chapstick), and ziplock sandwich bag. For group: Coffee tin with ground coffee.

Secret: Before the trick, write "1089" on your arm in lip-ex. The calculated total always comes out to 1089!

Mechanics:

1. Ask spectator to name any 3 digit number where all the numbers are different. (e.g. 321. See example below). Sure you don't want to change your mind?
2. Reverse the number & write the bigger number above the smaller.
3. Draw a line beneath the lower number, & subtract.
4. Reverse the total & put it below.
5. Add the 2 numbers. What total do you get? (1089)
6. Rub coffee grinds on your arm until 1089 appears. (They will stick to the chapsticked 1089.)

 321 Spectator's original number
-123 Reverse the # and subtract
 198
 +891 Reverse, then add
1089

Presentation: "Magicians attempt the impossible. I am going to try to do that for you today. I will ask you to name a 3-digit number of your choice. Then we'll perform some calculations with it—reversing it then subtracting, then reversing again and adding. We'll wind up with a final number. Then we will find your number in these coffee grinds.

Can you name any 3-digit number where all the digits are different. E.g. 123, 789, whatever. (321). (Write it on the board, or, if performing for a small audience, on a piece of paper, but make sure to position your paper so both you and the audience can read your numbers.) Any particular reason you chose that number? Let's reverse it, and we'll subtract. (Write these out, as above, and write the difference.) Now, we'll reverse the answer and add. (Do so on the board, arriving at a final total, 1089.)

Now I said we'd find the answer in these coffee grinds. How I'm supposed to do that, I'm not sure. I didn't think I'd actually get this far! First, let's make sure there is nothing up my sleeves (roll them up). We'll take these coffee grinds and rub them on my arm. Low and behold, if you look closely, you can see a number. 1089!"

Notes:

- If when you subtract, you get 99, append a 0 onto the front, making it 099. Reversed, this is 990. 990+099=1089.
- If a child cannot add or subtract 3 digit numbers, he can have an adult or older child do the calculations.

Math Learning: Adding and subtracting 3 digit numbers.

Even-Odd Numbers (extra art trick)

Effect: Magician shows a paper with #s 1-16. Spectator folds it into 16ths—any way he wants. He then cuts the edges, leaving him with a stack of 16 paper squares. He deals the face up squares in 1 pile & the face down squares in another. All the face up squares are even!

Props: 8.5x11 sheet of paper, pen or pencil, and scissors.

Secret: It just works! No matter how the paper is folded, if numbered correctly, the even #s will always be in 1 pile & the odds in the other.

Preparation: Number the sheet as in the diagram below. Note that the numbers snake around.

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

Presentation: "This sheet has 16 numbers—half are even and half are odd. Can you fold the paper along the lines, any way you want to get the packet to this size (1/16th of a page). (You might even show some examples of how it can be folded—e.g. in ¼ columns then folded down; in half 4x; etc.) Now, trim each of the 4 edges so we'll have a stack of 16 pieces of paper. Deal them the face up ones in 1 pile & the face down ones in the other. Remember, you could folded these however you liked. How did you make all the even ones (or odd ones, if that's the case) face up?"

Tips:

- Cut ~1/4-1/2 off each side. If you cut too much, you'll cut the number. If you cut too little, some of the squares won't cut all the way through, & you'll have to tear them—a pain.

Extra No Prop Math Tricks

11 Fingers

Effect: You demonstrate that you have 11 fingers.

Props/Secret: No props. The secret is in how you count.

Presentation: "How many fingers do you have? (10) Did you know that I have 11? I don't tell many people that, but let me show you. Let's count. (Hold out 1 hand & count fingers together with spectator.) 1-2-3-4-5. 5 fingers here. (Hold out the other hand & count backwards from 10.) 10-9-8-7-6. What is 6 + 5? (11) See, I told you I have 11 fingers!"

Math Learning: 6+5=11 (addition).

Number Soothsayer

Effect: You ask for 3 volunteers. You turn your back, and volunteers A & B each hold out a hand with any number of fingers showing. Volunteer C announces the total—at which point you mind read how many fingers A & B each have showing! This is repeated 2 more times.

Secret: Volunteer B is a confederate. He puts up 3 fingers the first round. In future rounds he puts up however many Volunteer A had the previous round. You, then, are able to know how many fingers each has up. E.g. Round #1 suppose A shows 2 & B 3. C announces 5. You know B has 3, so A must have 2 (5-3). Round #2, B shows 2 & suppose A shows 4. C announces 6. You know that B has 2, so A must have 6-2=4.

Math Learning: Addition and subtraction.

The Brain-Reading Swami

Effect: You introduce your assistant, who has great mental powers. You send her out of the room, and ask someone to name any number 1-10. You call your assistant back in. You sit in a chair facing the audience. Your assistant puts her 2nd and 3rd fingers on your temples, as you concentrate. Then your assistant correctly names the number!

Secret: Clench your teeth the same # of times as the chosen number. With each clench (which is invisible to the audience), your assistant feels a pulse of your temples. She counts the pulses & knows the number!

Math Learning: Counting.

The 6 Object Swami

Effect: You introduce your assistant, who has great mental powers. You send her out of the room, and ask someone to touch any of 6 different objects that you have lined up on the table, so everyone knows the selection. You call your assistant back in and after some concentration, she reveals the chosen item!

Secret: The number of words you use to call Swami back in clues her as to the item. E.g. "Ready!" means the 1st item. "Come in!" means item #2. "We are ready, come back in" denotes item #6…   Agree with Swami in advance on which end you count from. Having Swami concentrate, look at the spectator, put hands over the items, etc. adds to the fun!

Math Learning: Counting.

10-2=7 (a fingers trick)

Effect: You demonstrate with your fingers that 10-2=7 (not 8 as commonly thought)!

Mechanics: Interlace your fingers. Normally the spectator could count 10. However, you secretly put 1 of your 2nd fingers inside, secretly leaving only 9 fingers showing to the spectator. Ask what is 10-2. Spectator says 8 (Tell him this answer if he doesn't know.) Claim that 10-2 is actually 7. Say you have 10 fingers. Minus 2 (pull your thumbs down from your interlaced hands). Have the spectator count the remaining fingers. 7! Proving that 10-2=7.

Math Learning: Subtraction.

