**Standardized test are as follows:**

**A. Number sense** (e.g. understanding of numbers, their magnitude, and relationships)

1. Compare the fractions and choose the correct symbol in the blank.

27/30 \_\_\_\_\_\_\_ 72/80

a. > b. < c. = d. ≤

2. Write 68/0.00001 as an ordinary number.

a. 0.00068 b. 680 c. 6,800 d. 6,800,000

3. A room measures 21 feet by 38 feet. Round the dimensions to the nearest ten and estimate the area of the room.

a. 600 sq ft b. 800 sq ft c. 900 sq ft d. 1000 sq ft

3. Pablo drove 452 miles a day for three days. Estimate how far he drove in all and round to the nearest hundred.

a. 1,000 mi b. 1,100 mi c. 1,200 mi d. 1,500 mi

4. What is the greatest common factor (GCF) of 15 and 45?

a. 9 b. 10 c. 15 d. 18

5. Which is the smallest number?

a. 5 squared (52)

b. the square root of 484

c. the cube root of 8,000

d. 3 cubed (33)

6. Divide 115 into two parts so that one will be 130 percent of the other. What is the largest number?

a. 55 b. 65 c. 75 d. 85

7. What is the largest sum of two integers such that their product is 787?

a. 777 b. 788 c. 789 d. 897

8. Which number has the greatest number of divisors?

a. 120 b. 180 c. 192 d. 200

9. Choose some of the two-digit numbers below so that they add up to exactly 100. How many numbers do you use?

Do not use any number more than once.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| 10 | 12 | 19 | 22 | 24 |
| 32 | 41 | 45 | 49 | 53 |

a. 3 b. 4 c. 5 d. 6

10. If 120 is divided into three parts proportional to 7, 8 and 9, then the largest number is –

a. 40 b. 44 c. 45 d. 48

11. How many times larger than 105 is 510? Find the best approximation.

a. 10 b. 100 c. 200 d. 1000

12. Four counters in a supermarket are shown below. The numbers are estimations of the items in the shopper’s basket. It takes 2 seconds to count one item and 30 seconds for a customer to pay. Which counter do you choose?

Counter A - 15 5 5 10 5

Counter B - 20 10 10 10

Counter C - 25 15 10

Counter D - 5 10 5 10

a. Counter A b. Counter B c. Counter C d. Counter D

13. What is the largest digit in the product of 11111 x 11111 ?

a. 1 b. 3 c. 5 d. 6

Solution:

11111 x 11111 = 123454321

The largest digit in the product is 5.

14. Which row contains both the square of a positive integer and the cube of a different positive integer?

a. 2,4,6,8,10,12 b. 3,5,7,9,11,13 c. 3,6,9,12,17,27 d. 7,8,9,10,11,12

Solution:

32 = 9, and 23 = 9

The line 7,8,9,10,11,12 contains both the square of a square of a positive integer and the cube of a different positive integer.

15. Anna (A), Boyet (B), Carla (C), and Danilo (D) work on a project.

1.) Together, A, B, and C can complete it in 100 days.

2.) Together, B, C, and D can complete it in 101 days.

3.) Together, C, D, and A can complete it in 102 days.

4.) Together, D, A, and B can complete it in 103 days.

Rank them from the best to the worst performer.

a. D>B>A>C b. C>A>B>D c. C>B>A>D d. D>A>B>C

Solution:

Comparing 1) and 2): A is better than D;

Comparing 2) and 3): B is better than A;

Comparing 3) and 4): C is better than B;

Therefore: C is better than B, B is better than A, and A is better than D.

C>B>A>D

**B. Memorization of arithmetic facts** (e.g. having memorized the times tables or math formulas such as area)

1. Simplify:    20 + 43 + (-8)

a. 4        b. ‐4      c. 12        d. ‐10.5

2. Evaluate the expression: 4a2 – 4ab + b2, when *a = 2* and *b = 5*

a. -14 b. 1 c. 66 d. 81

3.  Express in scientific notation: 0.0000056

a. 5.6 x 10-6       b. 5.6 x 106   c. 5.6 x 10-5      d. 5.6 x 10-7

4. Expand:  1.20 x 105

a. 12000000 b. 1200000    c. 120000      d. 12000

5. Solve:  8(x – 2) – 5(x + 4) = 20 + x

a. x = 9 b. x = 28 c. x = ‐8 d. x = ‐18

6. Solve:  (¼x) – (5/8) = 3/8

a. x = 4 b. x = 2 c. x= ½ d. x = ¼

7. Solve for *m*:  F = mv2

r

a. m = F/rv2 b. m = Frv2 c. m = Fv2/r d. m = Fr/v2

8. Solve P:  *A = P + Prt*

a. *P = A – rt* b. *P = (A-rt)/*2 c. *P = A/1+rt* d. *P = A/2rt*

9. Which regular shape cannot be used to tile a floor with no gaps between tiles?

a. hexagon b. pentagon c. square d. triangle

10. What is the approximate area of a circle with a radius of 21 feet?

a. 380 sq ft b. 836 sq ft c. 1,386 sq ft d. 1,400 sq ft

11. What is the approximate circumference of a circle with a radius of 21 feet?

a. 132 ft b. 140 ft c. 152 ft d. 160 ft

12. Two heights in a triangle are both not less than either of two of its sides. Find the largest angle?

a. 60° b. 90° c. 120° d. 150°

13. A rectangular has width of 0.3x and a length of 0.4x. Which formula is the correct one to calculate the perimeter (P) in terms of x?

a. P=0.7x b. P=0.12x2 c. P=1.4x d. P=0.49x2

Solution:

Did you remember to include all 4 sides?

P = 0.4x + 0.3x + 0.4x + 0.3x = 1.4x

14. Fred is four feet tall. How many inches tall is Fred?

a. 48 inches b. 50 inches c. 52 inches d. 60 inches

15. Marina is making a square pillow that measures 14 inches on a side. How many inches of hem will she need to go around the edges of the pillow?

a. 36 inches b. 42 inches c. 52 inches d. 56 inches

**C. Accurate calculation** (e.g. the knowledge of and ability to carry out the procedural aspects of mathematics such as adding two numbers together, fractions, long division, trigonometry)

1. Change 7¾ to an improper fraction.

a. 21/4 b. 31/4 c. 28/21 d. 28/3

2. What is the quotient of 57,624 and 84?

a. 580 b. 616 c. 656 d. 686

3. Change 3/20 into a decimal.

a. 0.15 b. 0.3 c. 0.5 d. 1.5

4. If 2x – 3y + 4x – 7y = 0, then what is the value of y/x?

a. -3/5 b. 3/5 c. 5/3 d. 5/11

5. x2 + 4x + 3 = 0 then x equals

a. 2 or 3 b. -1 or -3 c. 1 or 3 d. -2 or 3

How many squares can be placed inside the circle without intersection?

a. 5 b. 6 c. 7 d. 8

4. What is the result when the largest two-digit number is multiplied by the second smallest three-digit number?

a. 1,100 b. 9,900 c. 9,999 d. 10,000

5. A circle of radius 3 is drawn centered at the origin. How many squares of side length 1 and integer coordinate vertices are inside the circle or intersect it?

a. 24 b. 28 c. 32 d. 36

6. Ricky stacked colored cubes in a square pyramid. The top layer had 1 cube, the second layer had 4 cubes, the third has 9 cubes, and so on. If the pyramid were 16 layers high, how many cubes would be in the sixteenth layer?

a. 225 b. 256 c. 316 d. 512

7.

8. Given an isosceles triangle with base length 32 cm and altitude 12 cm, find the length of the congruent sides.

a. 24 cm b. 22 cm    c. 20 cm      d. 18 cm

9. The minute hand of a clock is 6 cm long. How far does the minute hand travel in 15 minutes?

a. 12 cm      b.  9 cm    c. 6 cm      d. 3 cm

10. Solve 4cos + 6 = 5(cos + 1), 0 ≤ < 360

a. 0 b. 90 c. 180 d. 270

11. How much does the maximum value of 2- 2sin(x) exceed the maximum value of

2-(2-x)2?

a. infinity b. 0 c. 1 d. 2

Solution:

The maximum value of 2- 2sin(x) is 2 -(-2) = 4

The maximum value of 2-(2-x)2 is 2 –(2 -2)2 = 2

4 – 2 = 2

D. **Fluent calculation** (e.g. the speed at which one is able to perform simple mathematical computations such as adding, subtracting, and multiplication),

1. Solve. 27 – 18 + (-4) -6 =

a. -1 b. 1 c. 2 d. -2

2. Evaluate. (3 – 5)2 ÷ 4 + (8 – 3)2 =

a. -20 b. 20 c. -26 d. 26

3. Solve the equation for x. 3x – 6 = 18

a. 3 b. -6 c. 8 d. -8

4. Find the expression that is INCORRECT.

a. 127 – 25/0.2 = 2

b. x10 \* x-8 \* x-2 > 0

c. (1/9 + 9/1)/3 = 3.5

d. (999 + 99 – 9)/ 11/ 9 /11 > 0.1

5. Y2 + 4 = 20, the Y equals

a. -4 b. 4 or -4 c. 4 d. 6 or -6

6. The sum of three consecutive even numbers is 222. Find the numbers.

a. 73,74,75 b. 74,74,74 c. 70,72, 74 d.72,74,76

7. Danilo and Norman share P 4,550 in the ratio 2:3 respectively. How much money does Norman get?

a. P 910 b. P 1,750 c. P2,000 d. P 2,730

Rodrigo buys a pair of shoes with a price tag of P 1,650. If the tax is 3%, what is the total cost of his shoes?

a. P 1,600.50 b. P 1,699.50 c. P 2,050 d. P 2,145

6. Belinda ordered books from a catalog. The prices of the books added up to P2,280. She had to pay a 6% tax and 8% for shipping. What was the total cost of her order?

a. P 2,350 b. P 2,380.50 c. P 2,599.20 d. P 3,200

7. How many generations forward must you go in order to have more than five hundred ancestors?

a. 7 b. 8 c. 10 d. 11

8. I have three types of carrots of lengths 10 cm, 15 cm and 17 cm. What is the least number of carrots I can use to mark out a distance of 126 cm?

a. 6 b. 7 c. 9 d. 10

9. Three papayas were weighed in pairs and the weights were 400, 404, and 408 grams.

a. 196 b. 198 c. 201 d. 204

10. Mrs. Bautista has two sons who played football, four sons who played basketball, two of these sons played two sports, and one son who smokes and does not play any sports.

a. 4 b. 5 c. 6 d. 7

11. A popular mathematical puzzle online site is observed that some of the problems, although instructive, may be too boring. So, students may instead watch funny cat & dog videos. If more than 20% of the problems are boring, too many students will be lost. Assuming that there are 80 interesting problems available, how many “boring problems” can we resolve to make all the problems interesting to students?

a. 5 b. 10 c. 20 d. none

12. The number of strawberry cones sold at an ice cream store was 1 more than 3 times the number of vanilla cones sold. A total of 301 cones were sold.

How many vanilla cones were sold?

a. 51 b. 65 c. 75 d. 76

13. Sixty percent of the STEM students did vote for the student government election and forty percent did not vote. While forty percent of the HUMSS students did vote and sixty percent did not vote. HUMSS student voters are sixty percent more than those of STEM students. If there are 780 student voters, how many HUMSS students did vote in the student government election?

a. 180 b. 192 c. 200 d. 208

Solution:

60% more means 100% + 60% = 160%

If the number of STEM students who did vote is = S then

S (100/100+160/100) = 780 student voters

S = 780/2.6 = 300

STEM students = S (60/100) = .6S

HUMSS: S (160/100)x(40/100)= 1.6 x 0.4 x S = 0.64 S

Therefore:

0.60 x300 = 180 STEM students who did vote

0.64 x 300 = 192 HUMSS students who did vote

14. The edges of a large cube are 3 times longer than the edges of a small cube. How many times greater is the volume of the large cube than the small cube?

a. 3 b. 9 c. 27 d. 81

Solution:

Volume = Height x width x length

If a is the edge of the small cube, its volume is (a x a x a) = a3

The edge of the large cube is 3a; its volume = 3a x 3a x 3a = (3x3x3)a3 = 27a3

15. À runway numbered 09 points east (90°), runway 18 is south (180°), runway 27 points west (270°) and runway 36 points to the north (360° rather than 0°). There are two numbers at different ends of a runway. There is number 13 at an end of a runway. What is the number at the other end?

a. 0 b. 3 c. 23 d. 31

Solution:

The difference between two opposite directions is 180°.

The difference between two the numbers is 18.

13 + 18 = 31

E. **Accurate math reasoning and application** (e.g. the ability to tell time, convert currencies, extract information from a chart or diagram, complete word problems, and calculate statistics).

1. Fifteen minutes ago it was 7:15. What time is it now?

a. 6:15 b. 7:00 c. 7: 30 d. 7:45

2. I go to bed at 8:30, but tonight I get to stay up an hour later. What time do I have to go to bed?

a. 7:30 b. 8:30 c. 9:00 d. 9:30

3. Twenty minutes from now it will be 12:00. What time is it now?

a. 11:40 b. 12:00 c. 12:20 d. 12:30

4. Change 36 km/hr to meters/sec.

a. 5 b. 10 c. 20 d. none

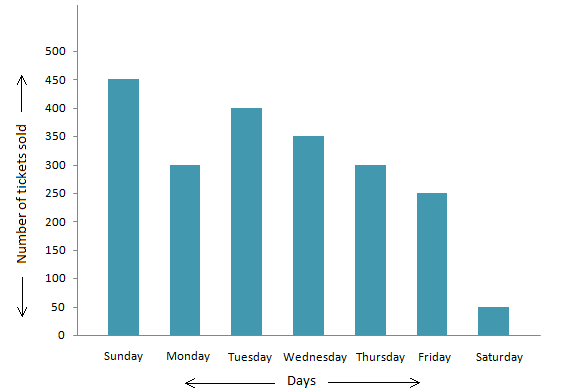
5. Carlo is rolling two dice and adding the numbers on the top faces. What sum is Carlo most likely to roll?

a. 5 b. 6 c. 8 d. 7

6. How many times do the two hands of a clock point in the same direction between 6:00 am and 9:00 pm?

a. 11 b. 12 c. 14 d. 24

Examine the bar graph representing the number of students, interested in different games, in a school and answer the following questions.



<https://www.math-only-math.com/worksheet-on-representing-data-on-bar-graph.html>

7.  On which day were the maximum tickets sold and how many?

a. Monday b. Tuesday c. Wednesday d. Sunday

8. On which day were the minimum tickets sold and how many?

a. Monday b. Friday c. Saturday d. Sunday

9. On which day were 350 tickets sold?

a. Monday b. Tuesday c. Wednesday d. Sunday

Mr. Cabrera collected the following information about the number of books in different subjects in his school library as shown in the table below.

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Subjects | English | History | Science | Maths | Computer | General |
| No. of books | 550 | 425 | 325 | 350 | 450 | 525 |

10. In which subject has the maximum number of books?

a. English b. History c. Computer d. General

11. How many computer books are there in the library?

a. 550 b. 425 c. 450 d. 525

12. What is the total number of books in the library?

a. 2,200 b. 2,625 c. 2,825 d. 3025

13. Seven soldiers have lined up in order of height, tallest to shortest. They have to be lined up from small to tall. How many interchanges are needed?

a. 12 b. 14 c. 18 d. 21

14. Gilda and Ricky borrow P30,000 to pay for new furniture. They will pay back the loan by making 12 monthly payments of P 3,333. Compare the loan with the original price of the furniture. How much does the loan Cost?

a. 13.32% b. 23.32% c. 33.32% d. 43.32

15. Gabriel said: “I always give 200% to my job. 80% on Monday, 50% on Tuesday, 40% on Wednesday, 20% on Thursday, and 10% on Friday.” What is the real percent of Gabriel’s job engagement?

a. 40% b. 80% c. 100% d. 200%

16. There is a 6% sales tax in purchasing a car. How much tax did I pay for a car, if the check was Php795,000 in total?

a. Php 25,000 b. Php 30,000 c. Php 35,000 d. Php 45,000

17. How many different ways can P1,000 be used using only P50 and P100 bills?

a. 10 b. 11 c. 15 d. 20

18. In a survey of customers, 2/3 of the female clients preferred using netbook computers over laptop computers. Women make up 36% of the clients in the region. What percent of the clients prefer to use netbook computers?

a. 68% b. 70% c. 72% d. 74%

19. A store sells many nice things and all prices end in 99 pesos (P 99, P 199, P 299, etc.). Paula ends up spending P 9,889. How many items did she purchase?

a. 11 items b. 15 items c. 51 items d. 67 items

20. If Gabriel tosses a fair coin two times, the probability of obtaining 1 head and 1 tail (in any order) is 50%. If he tosses the coins four times, what is the probability of obtaining 2 heads and 2 tails (in any order)?

a. less than 50%

b. 50%

c. greater than 50%

d. In depends on the first result.

Solution:

There 24 = 16 options.

Only 6 of 16 correspond to the case with 2 heads and 2 tails.

The probability is 6/16 = 0.375 = less than 0.5 or 50%

21. A school canteen offers the following meal choices:

First course: soup or small salad;

Main course: vegetarian, chicken, pizza, cheeseburger or fish;

Dessert: Banana cake, doughnut, fruit salad, ice cream or milkshake.

How many school meals will I have eaten before I have to choose a combination that I have already eaten?

a. 16 b. 32 c. 40 d. 50

Solution:

First course: soup, salad = 2

Main course: vegetarian, chicken, pizza, cheeseburger or fish = 5

Dessert: Banana cake, doughnut, fruit salad, ice cream or milkshake = 5

2 x 5 x 5 = 50

22. When I roll three dice, what is the total?

a. neither even nor odd

b. an even number

c. both could likely be an (even and odd) number

d. an odd number

Solution:

(1+2+3+4+5+6)/6 = 21/6 = 7/2 = 3.5

3 dice numbers is 3.5 x 3 = 10.5

Therefore: the number is exactly in the middle between an even number 10 and an odd number 11.

Standardized test are as follows:

a. Number sense (e.g. understanding of numbers, their magnitude, and relationships)

\*\*What is Number Sense?

Number sense is an emerging construct that refers to a child’s fluidity and flexibility with numbers and what numbers mean as well as an ability to perform mental mathematics and to look at the world and make comparisons.

#### ****There may be:****

1. An awareness of the relationship between number and quantity
2. An understanding of number symbols, vocabulary and meaning
3. The ability to engage in systematic counting, including notions of cardinality and ordinality
4. An awareness of magnitude and comparisons between different magnitudes
5. An understanding of different representations of number
6. Competence with simple mathematical operations
7. An awareness of number patterns including recognising missing numbers

Number sense develops gradually over time and at different rates, through exploring numbers, visualising them in a variety of contexts, and relating them in ways that are not limited by formal written methods.

### Flexibility with Number Epitomises Number Sense.

Number sense is the ability to be flexible with numbers and to understand both how our number system works and how numbers relate to each other. Children with good number sense have a range of mathematical strategies at their disposal and they know when to use them and how to adapt them to meet different situations.

### What Does Good Number Sense Look Like?

Children with good number sense can manipulate numbers to make calculations easier and are flexible in their approach to solving problems. They can assess the reasonableness of an answer, and routinely estimate answers before calculating. They look for connections and readily spot patterns in numbers, which helps them predict future outcomes. These children have several approaches to calculating and problem solving and can use and adapt these for new situations. Children with good number sense enjoy playing with and exploring numbers and number relationships. As a result of these strategies, they can often find the most efficient solution to the problem.

### What Does Poor Number Sense Look Like?

Children with poor number sense are procedure focused and will tend to rely on methods that they feel secure with. They apply inefficient and immature strategies to  
calculations and fail to spot links and connections that could get them to the answer more quickly. They prefer to use pen and paper rather than work things out in their heads. They are reluctant to estimate an answer before working it out and will generally accept whatever answer they get, without considering whether it is reasonable or not.

This was beautifully illustrated to me by a Year 5 child, who was tackling a question that required her to estimate the sum of two 4-digit numbers before calculating the answer. She approached this task by calculating the answer and then giving an estimate. I asked her why she was doing it that way around and her reply was,

‘It is much easier to find an estimate for the answer after you have worked out what the answer is.’

You have to admire her logic – if nothing else!

Children with poor number sense do not enjoy maths and won’t spend time being creative with and exploring numbers. Ironically, they are doing a harder version of maths, that relies upon remembering and applying procedures, with little understanding of the underlying numerical concepts.

### When Does Number Sense Develop?

Psychologists, Klein and Starkey (1988) found that we are born with a sense of number. They measured the focus time of babies looking at pictures of dots and discovered that when the number of dots changed the babies’ focus time changed.

The babies had appreciated a difference in numerical quantity.

This ability to appreciate number quantity is a survival instinct. When our ancestors were out hunting and gathering they needed to be able to perceive danger. So, if one animal approached a couple of hunters, they saw this as an opportunity for a meal. However, if 10 animals approached them, they ran, or they became the meal!

So, we know that very young children can recognise the number of items in a group without having to count them. We call this subitising, and most people can subitise up to six or seven items, when they are randomly arranged.

**\*\*\*What *Number Sense* Really Means**

What people sometimes call *number sense* is really a group of skills that allow kids to work with numbers. These include the ability to:

* Understand quantities.
* Grasp concepts like *more*and *less*, or *larger*and *smaller*.
* Recognize relationships between single items and groups of items (for instance, *seven*means one group of seven items).
* Understand symbols that represent quantities (for instance, *7* means the same thing as *seven*).
* Make number comparisons (for instance, 12 is greater than 10, and 4 is half of 8).
* Understand the order of numbers in a list: 1st, 2nd, 3rd, etc.

Some people have stronger number sense than others. Kids with [dyscalculia](https://www.understood.org/en/learning-attention-issues/child-learning-disabilities/dyscalculia/understanding-dyscalculia) often struggle with these very basic skills. That can create challenges in school and in everyday life.

**Using These Skills to Learn Math**

Math requires kids to be able to manipulate quantities when they add, subtract, multiply and divide. And that requires having strong number-sense skills.

Kids who have those skills can quickly compare groups of items to know which group is larger and which is smaller. They understand what it means to increase or decrease the number of items in a group. And they recognize how to combine groups or break them into smaller parts.

They also get that symbols (numerals) can represent real items. For example, if there’s a pile of seven beads, they can easily translate that into the numeral 7.

**Trouble With Math Operations**

If your child has weak number-sense skills, he may struggle with even basic math operations. He may not understand what it means to add to or subtract from a group of items, for instance.

Take the pile of seven beads. If you remove two of them, your child might not realize that the number of beads has shrunk. He might not recognize that subtracting the beads means the group of seven is now a group of five.

Likewise, if you add three beads to the pile, he might not realize the group of beads has grown. And he might not know that adding three to the pile of seven makes it a pile of 10.

Weak number-sense skills can also make it hard for your child to do multiplication. He may not see that it’s simpler to combine items from several groups by multiplying them rather than by adding them.

In the same way, that weakness can impact his ability to do division. It can keep your child from knowing that division is the simplest way to break up groups into their component parts.

**Trouble With Math-Related Concepts**

Math operations aren’t the only area impacted. Your child may also have trouble grasping key concepts like distance and time. That’s because these concepts rely on numerals to symbolize amounts.

He may also struggle with measurement. The task of measuring requires a good understanding of the relationships between parts and wholes.

**How the School Can Help**

Kids can develop these key skills, but it’s not a quick process. It happens slowly over time with lots of practice working in math. This makes it challenging for schools to “work on” number-sense skills the same way they work on specific reading, writing and math skills.

When a child struggles with math, schools often focus first on reteaching the specific [math skills](https://www.understood.org/en/learning-attention-issues/signs-symptoms/age-by-age-learning-skills/math-skills-what-to-expect-at-different-ages) being taught in class. The teacher might then ask the child to do extra worksheets. Or they may use computer-based activities for extra practice.

This approach often doesn’t work for kids with weak number sense, however. In that case, schools usually turn to intervention through [RTI or MTSS](https://www.understood.org/en/school-learning/special-services/rti/whats-the-difference-between-rti-and-mtss) processes. With intervention systems, kids typically:

* Work with “manipulatives” like blocks and rods to understand the relationship among amounts.
* Do exercises in which they match number symbols to quantities.
* Get a lot of practice estimating.
* Learn strategies for checking an answer to see if it’s reasonable.
* Talk with their teacher about the strategies they use to solve problems.
* Get help correcting mistakes they make along the way.

For many kids with weak number sense, intervention is enough to catch up. But kids with dyscalculia may need further support. They may need to be [evaluated for special education](https://www.understood.org/en/school-learning/evaluations/evaluation-basics/understanding-evaluations) to get the help they need.

**How You Can Help Your Child at Home**

If your child is struggling with number-sense skills, there are ways you can help him build them. It’s a good idea to start with the basics.

* **Practice counting and grouping objects.** Then add to, subtract from or divide the groups into smaller groups to practice operations. You can also combine groups to show multiplication. Try matching numerals with quantities of objects, too.
* **Work on estimating.** Build questions into everyday conversations, using phrases like “About how many” or “About how much.”
* **Talk about relationships among quantities.** Ask your child to use words like *more*and *less*to compare things.
* **Build in opportunities to discuss things like time and money.** For example, you could ask your child to keep track of how long it takes to drive or walk to the grocery store. Then compare it to how long it takes to get to his school. Ask which takes longer.

It’s important not to jam all these activities into a short period of time. It will take time for your child to develop number sense, and you don’t want him to become frustrated. Try them when it’s convenient, over a period of months. Repeat activities, but leave time in between.

Find out how [different learning and attention issues can cause trouble with math](https://www.understood.org/en/learning-attention-issues/child-learning-disabilities/math-issues/how-various-learning-and-attention-issues-can-cause-trouble-with-math). Talk to your child’s teacher about [possible supports](https://www.understood.org/en/school-learning/partnering-with-childs-school/instructional-strategies/at-a-glance-classroom-accommodations-for-dyscalculia), and [ask about the math program](https://www.understood.org/en/school-learning/partnering-with-childs-school/instructional-strategies/checklist-questions-to-ask-about-the-schools-math-instruction) used in the classroom. It can also help to learn about the [intervention systems](https://www.understood.org/en/learning-attention-issues/child-learning-disabilities/math-issues/is-there-such-a-thing-as-orton-gillingham-for-math) your child’s school uses.

[Portrait of Bob Cunningham](https://www.understood.org/en/about/authors/Bob-Cunningham)

[**Bob Cunningham, Ed.M.**](https://www.understood.org/en/about/authors/Bob-Cunningham), serves as senior advisor on learning and attention issues for Understood.

<https://www.understood.org/en/learning-attention-issues/child-learning-disabilities/math-issues/number-sense-what-you-need-to-know>

b. Memorization of arithmetic facts (e.g. having memorized the times tables or math formulas such as area)

There are three instances where memorizing in math is okay:

1. Memorizing conventions, definitions, and other things with no mathematical basis.

Things like SOH CAH TOA, PEMDAS, and the word “isosceles”. These define our notation and nothing deeper. You memorize it because there’s no alternative.

2. Memorizing for simplicity, but only after it’s understood.

Things like the quadratic formula can be memorized, because the derivation is rather involved and it would be stupid to re-derive it every time. But if pressed, you should be able to prove the formula. This goes for things like area formulae in geometry and derivative rules in calculus.

3. Memorizing organically.

This is when you work with something so often you stop having to think about it (though it may be debatable whether this counts as memorization.) I never memorized sin(90º), but I can figure it less time than it takes to open my mouth to answer. For many people, this is how they know their times tables. This type of memorization must be okay, because it’s inevitable.

<https://www.quora.com/What-are-the-basic-math-facts-should-all-students-memorize/answer/Travis-Brauer>

## Memorization of Basic Facts May Help Students Master Math

August 26, 2014 / 1552 /

In educational circles, rote memorization often gets a bad rap. But there’s new research that suggests that — when it comes to mastering math — memorization of basic facts and calculations is quite helpful.

In a study conducted by Stanford University and published by [Nature Neuroscience](http://www.nature.com/neuro/journal/vaop/ncurrent/full/nn.3788.html), neuroscientists started by watching what the brains of 28 youngsters did when they worked on basic arithmetic problems inside a brain-scan MRI machine.

The children, ages 7 to 9, were given simple calculations to do (for instance, “what is four plus five?”) and instructed to hit the correct answer button. The researchers recorded not only how rapidly the subjects responded, but what areas of their brains were activated through the process.

A second observation involved watching the childrens’ faces and hands to see if they moved their lips or counted on their fingers to solve the math problems.

The bottom line? Because the children were tested more than once (about a year apart), researchers discovered that as the kids got older they relied more on memory and were quicker and more accurate with their answers. In other words, there was less brain activity in the prefrontal and parietal regions associated with counting and much more in the brain’s memory bank, the hippocampus.

The hippocampus — a kind of temporary staging area where new information enters short term memory — sends information elsewhere for long term storage and later retrieval. Hippocampal connections increased with the kids’ math performance.

“The stronger the connections, the greater each individual’s ability to retrieve facts from memory,” said Dr. Vinod Menon, a psychiatry professor at Stanford who was the study’s senior author.

Comparison testing with adults illustrated that basic math facts and calculations end up in long term storage.

That efficiency — the storage and speedy retrieval of math facts — means there’s more processing memory available to tackle more complex calculations.

“The study provides new evidence that this experience with math actually changes the hippocampal patterns, or the connections. They become more stable with skill development,” explained Kathy Mann Koepke with the National Institutes of Health, which funded the study. “So learning your addition and multiplication tables and having them in rote memory helps.”

Mann Koepke’s take is that if the child’s brain does not have to labor over simple math, there is more short-term memory space to learn new concepts, so they catch on more quickly. They have a competitive advantage because of the cognitive structure in place, and are more likely to outperform their peers.

The news flash is that those tried-and-true flash cards might actually help. It appears that children who have the basics stored in longer term memory can skip the preliminary calculations, move on to more complex mathematics problems, and learn faster and better.

<https://advancedbrain.com/neuroscience/memorization-of-basic-facts-may-help-students-master-math/>

### ****Making the Case for Math Fact Memorization****

As a software developer who has spoken to teachers all over the nation, I'm familiar with most of the typical concerns math teachers face.

First, I will build a case for math-fact memorization; then, I'll address some of teachers' concerns and offer my responses to each.

**Learning standards alignment**

NCTM, TEKS, Common Core, and The National Mathematics Advisory Panel all agree that "[curriculum must simultaneously](http://www2.ed.gov/about/bdscomm/list/mathpanel/report/final-report.pdf#page=47) [develop conceptual understanding, computational fluency, and problem-solving skills](http://www2.ed.gov/about/bdscomm/list/mathpanel/report/final-report.pdf#page=47)."

The same panel also reports that computational fluency means "[automatic (i.e., quick and effortless) recall of facts](http://www2.ed.gov/about/bdscomm/list/mathpanel/report/final-report.pdf#page=14)." In other words--memorization!

Finally, the advisory panel views arguing over math processes as "misguided" because "(such mathematical) capabilities are mutually supportive, each facilitating learning of the others."

**A tool for problem solving and comprehension**

To recap so far: students need number sense, comprehension, and application.

Further, a child who enters fourth grade already automatized in core math facts has a huge advantage over students who may only know some core facts. Such a confident student can make sense of numbers and apply them in subsequent math tasks.

At Big Brainz, our research confirms that memorization accelerates comprehension and problem-solving.

Specifically, student automaticity catapults year-end math scores--not hard to do if students really know basic facts before assessment time.

After all, if you're going to chop down trees all day, you first need a few minutes to sharpen the ax.

**Pressure: the enemy to student confidence**



I heard one educator lament that the pressure students feel often impedes their working memory, such that students freeze just when they need to remember something.

This concern, while well-intentioned--misses the crux of the issue: students who are automatic in math facts don't need to use working memory. For them, math facts will come effortlessly and subconsciously, even under duress.

When core facts become trusted friends rather than distant memories, their constant presence helps diminish stress and build confidence in math generally.

**Bad Robots**

I've heard some educators express concern that rote memorization creates a 'robot' effect, therefore impeding number sense. Not true.

Phrases like "robots" and "drill and kill" sound frightening, but they imply a false principle.

Mastering core skills does not in any way inhibit or undermine higher-order thinking. Quite the opposite; such mastery liberates more advanced thinking skills.

When kids don't have to devote all their concentration to basic math facts, they can focus instead on conceptual understanding and problem-solving.

At Big Brainz, we observed students to see if they can master multiplication before learning comprehension. Unsurprisingly, kids do significantly better when they comprehend what they've been taught.

**Common Core issues**

I've heard passionate educators state that Common Core raises the priority of comprehension and application while lowering the emphasis on memorization. Sorry, but--wrong again.

Common Core significantly raises the priority for memorization, not only recommending that students memorize key facts early on, but also specifying that students should then recall those facts "from memory."

And of course, CCSS also mentions the importance of comprehension and application.

**Organic automaticity?**

Educators with a wonderful and valuable passion for number sense often express that the best way to develop automaticity is simply to use the facts regularly, combined with solid comprehension.

I really like the sound of that, and I wish it were true. But it's not. Regular math-fact use doesn't necessarily mean students have gained full automaticity.

In our experience working with thousands and thousands of students, the majority of them didn't develop automaticity of core facts simply through continued usage and exposure.

TRUE, some students will. And all students will master some facts. But at some point, most students really have to buckle down to become automatic with single-digit facts, minimum.

Programs like Big Brainz are game changers because they actually guarantee automaticity in less time than teachers would normally take on methods just described.

That may be a shocking claim, but it's still true. I've seen it time and time again.

**A reminder**

Those well-versed in CCSS and state standards may be tempted to downplay the automaticity element of math learning.

Instead, be true to the research behind such standards: "by the end of Grade 3, know from memory all products of two one-digit numbers."

Don't be tempted to undermine or change this requirement. Just because it's a concise statement doesn't mean it's not important.

Remember the National Mathematics Advisory Panel recommendation I mentioned earlier?

Their plea for algebra readiness depends on whole-number fluency, the automatic and effortless recall of core facts. Without that fluency, kids won't be ready to move on to tougher math challenges.

**Final thoughts**

If you're still a skeptic, don't worry--it's a sign that you care about what you teach your students.

Just remember, I wouldn't feel so passionate if I hadn't watched so many real students (including my own daughter) become fully fluent in their core math facts through our math-fluency solution.

If you're interested in knowing what I know, take a look Big Brainz. Then see if your views change.

**About the Author**



Ben Harrison committed himself to unlocking the massive educational potential of high-end gaming technology when his daughter started to struggle with math. In 2004, he founded Big Brainz, a company whose products dramatically impact children's core math fluency in over 200 countries.

In 2016, Ben sold Big Brainz to Imagine Learning in order to reach even more children and dramatically expand the company's high-end math development.

Prior to Big Brainz, Ben founded Argonaut CG films, where he developed content for Sony's PlayStation division.

Currently, Ben serves as Director of Product Development for Big Brainz at Imagine Learning.

<https://www.imaginelearning.com/blog/2016/06/math-teachers-hurt-memorization>

c. Accurate calculation (e.g. the knowledge of and ability to carry out the procedural aspects of mathematics such as adding two numbers together, fractions, long division, trigonometry),

d. Fluent calculation (e.g. the speed at which one is able to perform simple mathematical computations such as adding, subtracting, and multiplication),

e. Accurate math reasoning and application (e.g. the ability to tell time, convert currencies, extract information from a chart or diagram, complete word problems, and calculate statistics).