

## Math Exhibit Guide

Exhibit Group 1: Primary Concepts
Recommended for grades 1 - 3
Money
Place Value
Time
Measurement
Geometric Shapes
Volume Sandbox
Tiling (Tessellation)
Fractions

Exhibit Group 2: Elementary
Geometry
Recommended for grades 4-6
Geometric Shapes
Volume Sandbox
Tiling (Tessellation)
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Volume: Cubes
Tangrams
Pyramid Puzzle

Exhibit Group 3: Elementary Concepts
Recommended for grades 4-6
Probability
Pi - Circumference
Binary
Magic Squares
Hanoi Puzzle
Pythagorean Theorem
Fibonacci Sequence


## MONEY

PA Standards

- Solve problems and make change involving money using a combination of coins and bills. CC.2.4.3.A. 3
- Key Words:

$$
\begin{array}{ll}
\text { Penny }=1 \text { cent } & \text { Quarter }=25 \text { cents } \\
\text { Nickel }=5 \text { cents } & \text { Dollar }=100 \text { cents } \\
\text { Dime }=10 \text { cents } &
\end{array}
$$

- Materials: Bar fractions: $18^{\prime \prime} \times 34^{\prime \prime}$ magnetic board. Magnetic currency: BILLS: 10 ones, 4 fives, 2 tens, 1 twenty. COINS: 20 pennies, 20 nickels, 20 dimes, 10 quarters. 3 display cards


## Display Card

In the United States the official money is dollars and cents.

## Penny



1 cent

One Hundred Pennies make a dollar. One cent can be written as $1 \nmid$ or $\$ 0.01$

## Nickel

## Dime

## Quarter



5 cents

10 cents

25 Four Quarters makes a dollar. One quarter can be written as $25 \not \subset$ or $\$ 0.25$

## Dollar



One Dollar equals 100 pennies and is written as $\$ 1.00$


## PLACE VALUE (1 MILLION)

PA Standard

- Students generalize their understanding of place value to 1 million. CC.2.1.4.B.1 (MO4.A.T.1.1.1)
- Apply place value concepts to show an understanding of multi-digit whole numbers. CC.2.1.4.B.1
Key Words:

One = 1
Ten = 10
Ten Thousand $=10,000$

One Hundred = 100 One Million = 1,000,000
One Thousand = 1,000
Materials: 6" X 24" clear plastic tube on base. 1 Display card.

## Display Card

The bottle contains one million beads. 1,000,000. Here is a list of how many beads there are of each color. Can you find the black bead?????

| BEAD <br> COLOR |  |  |  |  | NUMBER OF <br> BEADS IN BOTTLE | PERCENTAGE OF <br> TOTAL BEADS |
| :--- | :---: | :---: | :---: | :---: | :---: | :---: |
|  | Black | 1 |  |  |  |  |
|  | Green | 10 |  |  |  |  |
|  | Pink | 100 |  |  |  |  |
|  | White | 1,000 |  |  |  |  |
|  | Red | 10,000 |  |  |  |  |
|  | Yellow | 100,000 |  |  |  |  |

## DID YOU KNOW???

Every time you add a zero to a number, it gets 10 times as big. If you add a zero to one million $(1,000,000)$ it becomes ten million $(10,000,000)$. And if you add three zeros to one million, it is a thousand times bigger and becomes one billion $(1,000,000,000)$.

, If you drive a car one million miles at 60 miles an hour, without stopping for gas or food, it will take you about two years...that's a long drive!!


## TIME

## PA Standard

- Tell and write time to the nearest five minutes using both digital and analog clocks. CC.2.4.2.A. 2


## Key Words:

Time, Hours, Minutes, Seconds Analog Clock, Digital Clock
Materials: $12^{\prime \prime} \times 24^{\prime \prime}$ exhibit with 5 clock faces. NOTE: Electricity required.
1 Display card.

## Display Card

There are two clocks - an Analog Clock and a Digital Clock.

The analog clock has a round face with 12 numbers around the edge and is divided into 60 minutes. The short hand points to the hours, and the long hand points to the minutes.

Hours = short word...short hand Minutes = long word...long hand

Some analog clocks also have a 'second hand', which counts 60 seconds in one trip around the clock each minute.

A digital clock shows numbers which indicate what time it is.

## WHAT TO DO -



Match the times of the analog clocks with the times on the digital clocks. When they are correct, the GREEN LIGHT will go on!


## MEASUREMENT

PA Standards

- Measure and estimate lengths in standard units using appropriate tools. CC.2.4.2.A.1
- Solve problems calculating time intervals. CC.2.4.3.A. 2

Key Words Unit of Measure, Distance, Mile.
Materials: 24" X 22" map board. 2 strings. 1
Display card. 5 "Trip" cards. 1 Display card

## Display Card

Miles are a unit of measure. A mile equals 5,280 feet. We use miles to measure large distances.

## WHAT TO DO-

Use the string to measure distances from one place to another.

Step 1: Choose a place where you want to start your trip.

Step 2: Put the loop of the string around the post where you start.

Step 3: Stretch the string to the place you want to go - until the string hits the peg.

Step 4: Keep holding the string and move the string down to the ruler.
Step 5: Measure how many miles you traveled.


## Did You Know???

灣The earth is about 25,000 miles around its circumference.

* It would take a commercial airplane around 51 hours to fly around the earth.絭The distance from the earth to the moon is 238,900 miles. It took the astronauts 3 days, 3 hours, and 49 minutes to get there!




## GEOMETRIC SHAPES

PA Standards

- Identify and describe two- and threedimensional shapes. CC.2.3.K.A. 1
- Identify, compare and classify shapes and their attributes. CC.2.3.3.A.1
- Compose and distinguish between two and three dimensional shapes. CC.2.3.1.A.1
- All Standards 2.3 Geometry.

Key words: Square, Triangle, Pentagon, Hexagon Two-dimensional shape. Three-dimensional shape. Materials: 72 each: Triangles, Squares, Pentagons, Hexagons, Trapezoids, Rhombus. 4 Display Cards.

## - Display Card

## Use your imagination to create unique combinations \& designs.



TRIANGLE
A triangle has three sides and three corners.


HEXAGON
A hexagon is any six-sided flat shape


SQUARE
A square is a rectangle. All rectangles have 4 sides \& 4 right angles, but only squares have 4 equal sides \& 4 right angles.


TRAPEZOID
A trapezoid has 4 straight sides with 2 opposite sides parallel


PENTAGON
A Pentagon is any five-sided flat shape


## RHOMBUS

A 4-sided shape where all have equal length, the opposite sides parallel \& the opposite angles are equal


## VOLUME SANDBOX

PA Standards

- Describe and compare attributes of length, area, weight and capacity of everyday objects. CC.2.4.K.A. 1
- Solve problems involving measurement of temperature, liquid volume, mass and length. CC.2.4.3.A.1
- Apply the concepts of volume of cylinders, cones and spheres to solve everyday problems. CC.2.3.8.A.1
Key words: Cylinder, Cone, Sphere, Volume, Capacity.
Materials: $24^{\prime \prime} \times 18^{\prime \prime}$ Sandbox with cone, cylinder, sphere, cube, square cylinder, half-cube, scoop. Two sets available. 2 display cards.


## Display Card

## Volume is the amount of space inside an object or shape, like a bottle or a basketball.

## WHAT TO DO:

Compare the volumes of a cylinder, a cone and a sphere by pouring sand from one shape to another.


CYLINDER


CONE


## SPHERE

## Do You Know????

. How many cones does it take to fill the cylinder?

* How many cones does it take to fill the sphere?
. Does the sand in a sphere fill the cylinder?



## TILING (TESSELLATION)

## PA Standards

- Identify and describe two- and three-dimensional shapes. CC.2.3.K.A. 1
- Identify, compare and classify shapes and their attributes. CC.2.3.3.A. 1
- Compose and distinguish between two and three dimensional shapes. CC.2.3.1.A.1
- All Standards 2.3 Geometry

Key words: Hexagon, Pentagon, Square, Triangle, Trapezoid, Diamond, Tiling, Tessellation
Materials: 24" X 24 " Magnetic board. 12 each of: Rhombus, Trapezoid, Hexagon, Square, Triangle, Diamond. Two sets available. 1 display card.

Tessellation is when you create a solid pattern with tiles.... without overlaps or spaces between the tiles.

## WHAT TO DO -

Use these flat geometric tile shapes to create your own Tessellation pattern!



RHOMBUS
4-sided shape - all of equal length, opposite sides are parallel \& opposite angles equal.


Hexagon A Hexagon is any 6-sided flat shape


Trapezoid
A trapezoid has two straight sides with two opposite sides parallel


Square
A square is a rectangle, with 4 sides and 4 angles, only squares have 4 equal sides and 4 equal right angles.


DIAMOND
A skinny rhombus with all sides equal length, opposite sides parallel \& opposite angles equal


Triangle
A triangle has three sides and three corners


## FRACTIONS

PA Standard

- Explore and develop an understanding of fractions as numbers. CC.2.1.3.C. 1
- Develop an understanding of fraction equivalence, addition and subtraction of fractions with like denominators.
CC.2.1.4.C. 2

Key Words: Fraction, Numerator, Denominator Materials: Bar fractions: 18" X 24" Fraction board, 18" X 8" fraction holder with fraction pieces. Pie fractions: $18^{\prime \prime} \times 34^{\prime \prime}$ Fraction board, $18{ }^{\prime \prime}$ X 6 " fractions holder with fraction pieces. 1 Display Card.

## Display Card

Fractions are parts of a whole. For example, say you have a whole pizza and you divide it into three equal parts, each part represents one-third of the whole pie. If you have one part, you have $1 / 3^{\text {rd }}$ of the whole pizza.


Whole Pizza


Whole divided into thirds


1/3 of the Whole Pizza

In this fraction - the top number is called the numerator and the bottom number is called the denominator

## WHAT TO DO:

## NUMERATOR

 (the number of parts you have)

DENOMINATOR (total parts in the whole)
*Make a pie shape using 4 equal parts.
黄Make a pie shape using at least three different fractions
Make a complete bar using 6 equal parts.
黄 Make a complete bar using $1 / 8$ s and $1 / 4 \mathrm{~s}$
Make a complete bar using at least three different fractions.


## VOLUME CUBES

## PA Standards

- Describe and compare attributes of length, area, weight and capacity of everyday objects. CC.2.4.K.A. 1
- Solve problems involving measurement of temperature, liquid volume, mass and length. CC.2.4.3.A.1
Key Words:
Cube, Volume, Capacity
Length, Width, Height, Three-dimensional shape
Materials: $24^{\prime \prime} \times 14^{\prime \prime}$ board. All cubes 2 " square. 2 yellow cubes, 29 white cubes. 2 display cards.


## Display Card

A cube is a three-dimensional shape with six square sides. All sides are the same length and all angles are 90 degree angles. When you increase the length of the sides you increase the volume inside the cube.

## WHAT TO DO -

Build a bigger cube. The yellow cube is 2 inches wide, 2 inches long and 2 inches high. Build a cube with double the width, double the length, and double the height.


黄 How many blocks did it take to build a bigger cube?

* What is the volume of the bigger cube compared to the yellow cube?

Now, build a cube with three times the width, length and height as the yellow cube.
. How many blocks did it take a build the cube?

* What is the volume of the bigger cube compared to the yellow cube?


## ANSWERS:

When you DOUBLE the width, length and height of a cube, the volume of the bigger cube is 8 times the volume of original cube.

When you TRIPLE the dimensions of a cube, the volume of the bigger cube is $\mathbf{2 7}$ times the volume of the original cube.


## TANGRAMS

PA Standards

- Identify and describe two- and three- dimensional shapes. CC.2.3.K.A. 1
- Analyze, compare, create, and compose shapes. CC.2.3.3.A. 1
- Make sense of problems and persevere in solving them. Standards for Mathematical Practice \#1.


## Key Words

Triangle, Square, Diamond
Materials: $24^{\prime \prime} \times 24$ " board, 7 Tangrams shapes.
1 display card.


A tangram is a puzzle consisting of seven flat pieces called tans, which are put together to form a shape. Tangrams originated in China in 700 AD. The objective of the puzzle is to form a specific shape using all seven pieces - the pieces may not overlap.

## WHAT TO DO -

Use all seven pieces to fill the square $\longrightarrow$



## GROUP 2

## TRAPEZOIDS AND TRIANGLES

## PA Standards

- and describe shapes. CC.2.3.PreK.A. 1
- Analyze, compare, create, and compose shapes. CC.2.3.PreK.A. 2
- Make sense of problems and persevere in solving them. Standards for Mathematical Practice \#1.


## Key Words

Trapezoid, Triangle
Materials: 24: X 24 " board. 3 trapezoids.
1 display card.

## Display Card

Trapezoid: A four-sided shape with four corners and only two sides parallel

Triangle: A three-sided shape with three corners.

## WHAT TO DO

Use the three identical trapezoids to form a triangle.



## PROBABILITY

PA Standards
Analyze patterns and relationships. CC.2.2.4.A.4 Develop a probability model by assigning equal probability to all outcomes. CC.2.4.7.B.3 Investigate chance processes and develop, use and evaluate probability models. CC.2.4.7.B.3

## Key Words

Probability, Bell Curve, Uniform Distribution.
Materials: $18^{\prime \prime} \times 12^{\prime \prime}$ exhibit. 1 Display card.

## - Display Card

Probability is the chance that something will happen. Sometimes you can measure probability with a number like " $10 \%$ chance it will rain", which means there is a 1 out of 10 chance it will rain. Or, if you flip a coin, there is a $50 \%$ chance it will be heads and $50 \%$ chance it will be tails.

## WHAT IS HAPPENING:

*When marbles are dropped into the top of the box they hit pins and bounce left or right.... 50\%_chance of bouncing left and a $\mathbf{5 0 \%}$ chance of bouncing right!

旗The marbles are then collected into bins at the bottom.


䫀After all the marbles reach the bins, they form a 'Bell Curve'. When there is is a $50 / 50$ chance of bouncing left or right, the marbles will always form a bell curve - called a 'Uniform Distribution'



## GROUP 3

## PI (CIRCUMFERENCE)

## PA Standards.

- Solve real world and mathematical problems involving angle measurement, area, surface area, circumference and volume. CC.2.3.7.A.1


## Key Words:

Pi, Diameter, Circumference, Radius
Materials: $36^{\prime \prime} \times 18^{\prime \prime}$ board with 10 " disc and ruler. 1 string. 1 Display card.

## Display Card

Archimedes figured out how to calculate the circumference of a circle by using the number 3.14, which is also called ' Pi ' and is represented by the symbol ' $\pi$ ' .

He found that if you multiply the diameter of a circle by 3.14 you get the circumference of the circle.

Pi is also found in many other calculations in geometry for circles, ellipses and spheres.

## WHAT TO DO:


$\frac{\text { Circumference }}{\text { Diameter }}=J 己=3.14159 .$.

STEP 1: Hook the string on the peg and pull the string all the way around the yellow circle, and back to the peg.

STEP 2: Holding the length of string that went around the circle, measure the string on the ruler to find out the circumference of the circle.

## QUESTIONS:

What is the circumference of the yellow circle?
潮If you walked around a circle which has a diameter of 100 feet, how far have you walked?
. What is the radius of the yellow circle? (check diagram above)

1. The circumference of the yellow circle is 31.4 inches ( $3.14 \times 10$ inches).
2. You would walk 314 feet ( $3.14 \times 100$ feet).
3. The radius is 5 inches.


## BINARY

## PA Standards

- Generate a number or shape pattern that follows a given rule. CC.2.2.4.A. 4
- Analyze patters and relationships. CC.2.2.5.A.4

Key Words.
Binary number system, Base 10 Number System
Materials: 24" X 12" Binary machine. NOTE: Electricity required. 1 Display card.

## Display Card

When we count and do everyday calculations, like adding and multiplying, we use the Base 10 Number System: 1, 2, 3, 4.

When computers count, calculate and process words, they use the Binary Number System: 110101.

All digital technology, such a mobile phones, computers and satellite communications use binary numbers. We now live in a digital world and the most important digits are 1 and 0.

## WHAT TO DO -



There are five number cards -

##  <br> 16 <br> 8 <br>  <br> 4 <br>  <br> 2 <br> 

## Questions:

-Create your age in Binary...check the base 10 number on the right to make sure you are correct.
-Count from 1 to 31 in Binary...watch the base 10 number on the right to make sure your counting from 1 to 31 is correct.
-What is the largest number you can create? (The amazing thing about binary counting is that you can count to 31 with just five switches...you can count to 31 on one hand with just five fingers.)

## MAGIC SQUARES

PA Standards

- Make sense of problems and persevere in solving them. Standards for Mathematical Practice. \#1


## Key Words

Magic Square
Materials: $18^{\prime \prime} \times 18^{\prime \prime}$ board, 9 number blocks.
1 Display card.

## Display Card

Magic Squares are a math puzzle. The objective is to arrange numbers in a square grid so each row, column and diagonal adds up to the same number.

When creating a Magic Square, you can only use a number once. For example, for a $3 \times 3$ magic square, you can use the numbers
1,2,3,4,5,6,7,8,9

## WHAT TO DO -

Arrange the numbers so each row, column and diagonal adds up to 15


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

Here is a magic square using $4 \times 4$ grid. You can see that each number is used only once and the Magic Sum is 34.


Magic Squares were first created in China in 650BC. In 2014 China issued a series of stamps based on magic squares and above are shown some of the magic squares that were chosen.

## TOWERS OF HANOI

## PA Standards

- Make sense of problems and persevere in solving them. Standards of Mathematical Practice \#1.
- Develop a number or shape pattern that follows a given rule. CC.2.2.4.A. 4


## Key Words

Solution, Repeating Pattern
Materials: $18^{\prime \prime}$ X $18{ }^{\prime \prime}$ board with pegs. 4 discs. 1 Display card.

## Display Card

The Towers of Hanoi game is a mathematical puzzle. The puzzle starts with circular disks in a neat stack on one post...from smallest on top to the largest
on the bottom.

## WHAT TO DO:

The object of the puzzle is to move the entire stack to another rod, obeying the following simple rules:
. Only one disk can be moved at a time

Each move consists of taking the upper disk from one stack and placing it on the top of another stack.

No disk can be placed on the top of a smaller disk.


YES NO


## Legend of the Big Puzzle

There is a legend about an Indian temple with three posts and 64 golden disks. If the legend is true, and you move disks at a rate of one per second, using the smallest number of moves, it will take $2^{64}$ seconds or roughly 585 billion years to finish!


## PYTHAGOREAN THEOREM

## PA Standards

- Understand and apply the Pythagorean Theorem to solve problems. CC.2.3.8.A. 3


## Key Words

Pythagorean Theorem, Right Triangle, Hypotenuse, Squaring a number, Formula
Materials: 18" X 18" board. 25 blocks. 1 Display card.

## - Display Card

In mathematics the Pythagorean Theorem explains the relationship of the three sides of a right triangle. It states that the square of the hypotenuse (side C, the long slanted side) is equal to the sum of the squares of the other two sides. The theorem is written as an equation:

$$
A^{2}+B^{2}=C^{2}
$$

This formula can be used to find the length of the hypotenuse of any right triangle.

## WHAT TO DO -



STEP 1: Fill in Side A with yellow blocks (Side A is 3 units long. $3^{2}$ is 9 , so use 9 yellow square blocks)


STEP 2: Fill in Side B with orange blocks (Side B is 4 units long. $4^{2}$ is 16, so use 16 orange square blocks).
STEP 3: Now use the green side of the blocks to fill in the green square.

## QUESTIONS:

How many blocks did it take to fill in the green side?
What is the square root of 25 ?
㐨How long is Side C?


## FIBONACCI SEQUENCE

## PA Standards

- Generate and analyze patterns using one rule. CC.2.2.4.A. 4
- Make sense of problems ands persevere in solving them. Standards for Mathematical Practice \#1.


## Key Words

Fibonacci Sequence, Number pattern, Fibonacci Curve.
Materials: $26^{\prime \prime} \times 20^{\prime \prime}$ board. 6 puzzle pieces.
2 Display cards.

## Display Card

## The Fibonacci Sequence

(pronounced 'fee-bow-notch-ee'). A number sequence is a list of numbers that follows a pattern. The next number in the fibonacci sequence is found by adding the two numbers before it:

## 0,1,1,2,3,5,8,13,21

| $0+1=1$ | $2+3=5$ | $8+13=21$ |
| :--- | :--- | :--- |
| $1+1=2$ | $3+5=8$ | $13+21=34$ |
| $1+2=3$ | $5+8=13$ | $21+34=55$ |

## WHAT TO DO:

Complete the puzzle to form a Fibonacci curve.


If you make squares with the sides of the square equal to the Fibonacci numbers, the squares look like this and you get a nice spiral often found in nature.

