MATH EXHIBITS EXPLAINER GUIDE

A STEP-BY-STEP GUIDE FOR STUDENT OR CHAPERONE EXPLAINERS.

MONEY

This exhibit, **"On the Money,"** teaches students how to use money to buy items.

STEP #1: Hold each piece of money, starting with a penny, and explain how much it's worth. (For example: "This is a penny. It's worth 1 cent. This is a nickel. It's worth 5 cents."

STEP #2: Have the students select one of the food items from the display card.

STEP #3: Have the students place the amount of money on the board that adds up to the price of the item using the fewest amount of coins.

STEP #4: Continue to allow the students to purchase items either as a group or by taking turns.

STEP #5: Before they go, pick up the **Big Allowance** display card and read it to them. Point to the total allowance the girl received: 10 million, 737 thousand, 418 dollars, and 23 cents. Show how the money increases each day.

PLACE VALUE

The idea of this exhibit, "One in a Million," is to show how much a million is.

STEP #1: Explain that there are **1 million** beads in the tube.

STEP #2: Point out the chart on the display card, which shows many of each color bead is in the tube.

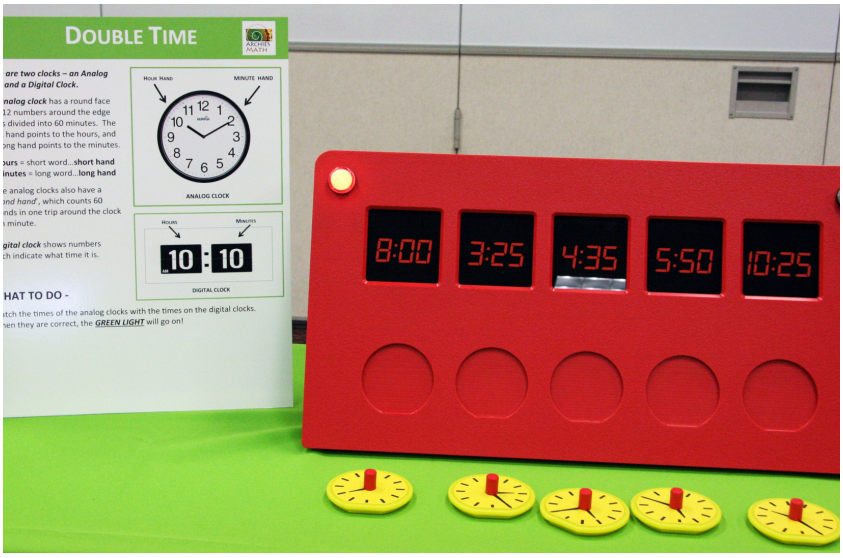
STEP #3: Point to the white bead on the chart and ask how many there are in the tube. (One Thousand)

STEP #4: Point to the red bead and ask how many red beads there are in the tube. (Ten Thousand)

STEP #5: Next ask the students to find **the black bead**... it's on in a million!

STEP #6: Before they leave the exhibit, ask the students a question: "If you drive a car 60 miles per hour (which is very fast) how long will it take you to drive 1 million miles?" Let the students take a guess. The answer is **two years**! That's a long drive!

TIME



This exhibit, called **"Double Time,"** explains that there are two different types of clocks - Analog and Digital.

STEP #1: Explain that an analog clock is divided into 12 hours and each hour has 60 minutes. Point to the minute marks on the clock.

STEP #2: Explain that the short hand points to the hour and the long hand points to the minutes

STEP #3: Explain that a digital clock tells you the hours and the minutes. The digital clock on the display card tells us it's 10 minutes after 10.

STEP #4: Point out that both clocks on the display card are showing the **same time.**

STEP #5: Have the students match the yellow analog clock pieces with the digital times show in the black squares on the exhibit. If their answers are right, the green light will go on. Make sure everyone in the group has a turn.

MEASUREMENT

This exhibit is called **"How Many Miles."** It can be complicated, so explain all of the parts carefully so the students understand what they are doing.

STEP #1: The map of the Lancaster area has a number of destinations marked with a peg. Below the map is a measurement scale showing miles.

STEP #2: Students will use the red string to measure the distances of the road trips listed on the license plate display card.

STEP #3: Have the student choose one of the road trips and follow the **What To Do** directions on the display card. You may need to help them keep their string as they move it from the peg to the ruler.

STEP #4: There is an answer key to check their measurement on the display card. After completing each trip, you can prompt students to try alternate routes and multiple destinations.

STEP #5: There is also a set of cards that are time problems. Students may need a pencil and paper to solve them. Answers are also on the display card.

GEOMETRIC SHAPES

If there are more than three students in the group, divide them into groups of 2 or 3.

STEP #1: Point out and describe each of the shapes on the display card and name each one. (Use the caption if you need to.) As the students to find each shape on the table.

STEP #2: Have the students build the **three-dimensional ball using 12 pentagons.** Help them if they get stuck.

STEP #3: Next, have the students build the geodesic sphere. Have them start by collecting **20 hexagons** and **12 pentagons**. Make sure they follow each step on the display card. The key is that **pentagons should never touch another pentagon.** They may need help fitting the pieces together.

STEP #4: After they have completed both shapes, share that geometric shapes are used to build bridges and structures. Tell them that the bridge is made with triangles because they are strong and keep their shape.

STEP #5: Students are free to build with the shapes until it's time to move to the next exhibits.

VOLUME SANDBOX

If there are more than three students in the group, divide them into groups of 2 or 3. NOTE: take care to keep the sand in the box and off of the ground!

STEP #1: Point out and name the shapes on the display card: **cylinder, cone, and sphere.**

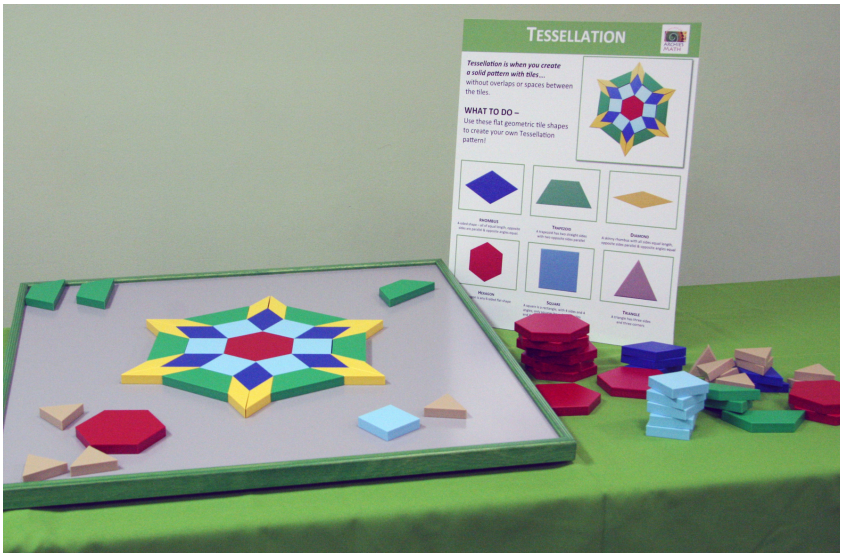
STEP #2: Ask what the word "volume" means and wait for answers. After they answer say the definition (on the display card) and wait for them to agree.

STEP #3: Hold up a cone and a cylinder. Ask the students how many cones it will take to fill the cylinder and wait for them to guess. Have the students carefully fill the cone and then pour it into the cylinder. Repeat until filled (3 times.)

STEP #4: Repeat these steps with the cone and the sphere. (Two times)

STEP #5: Students are free to experiment with other shapes. You can do the same activity with the square cone and square cube (three cones). Or have them guess several shapes at a time.

TESSELATION (TILING)



Students will learn the names of several shapes and use them to recreate a design and pattern.

STEP #1: Have the students try and name each shape on the display card. After they (or you) name the shape, describe it. **For example: "A hexagon is any 6-sided shape."**

STEP #2: Next, have the students start to assemble the shape shown on the display card using the magnetic board. Divide larger groups of students into separate groups to work on their own board.

STEP #3: Make sure the pieces do not overlap and that there are no spaces between them. Help the students as needed.

STEP #4: After they complete the design on the card they can use the pieces to create their own designs.

FRACTIONS

This exhibit helps students understand what a fraction is and how to add and subtract fractions.

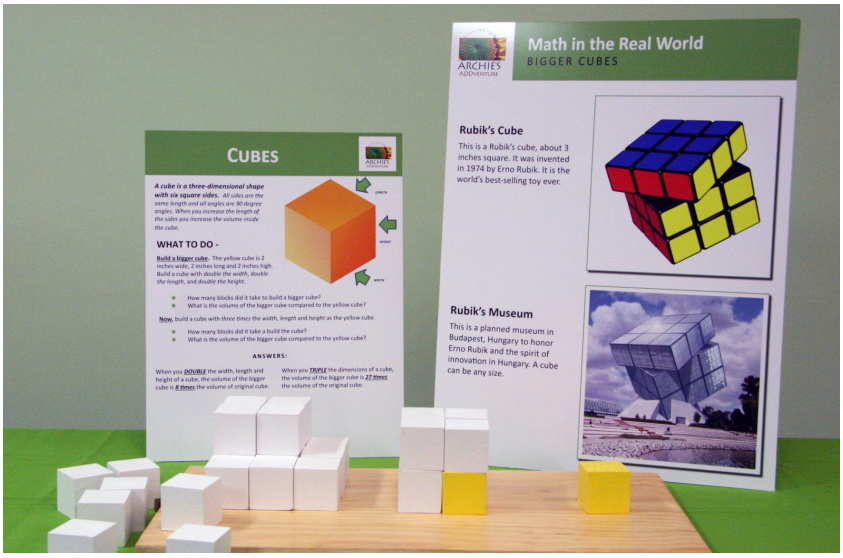
STEP #1: To start, explain what a fraction is using the definition on the display card (pizza example). Make sure all students understand that 1/3 equals one-third of the pizza.

STEP #2: Explain that a fraction is written as a top number (numerator) over a bottom number (denominator). Point to the example on the display card. Show that the top number shows how many parts you have and the bottom number shows how many parts in the whole.

STEP #3: Divide the group into two parts. One group will work on the pie fractions and the other will work on the bar fractions. For small groups do one activity at a time.

STEP #4: Have the students follow the directions under "what to do" on the display card.

VOLUME: CUBES



If there are more than three students in the group, divide them into groups of 2 or 3. Each group will be doing the same activity.

STEP #1: Hold up the yellow cube and explain that all of the sides are squares of the same size and that all of the angles are the same.

STEP #2: Ask the students if they know what volume means. After they have answered correctly give them the definition, **"Volume is the space inside an object or shape, like a bottle, a basketball, or a cube."**

STEP #3: Tell the students that they are now going to build a bigger cube. It should be **two times as wide, two times as long,** and **two times as tall** as the yellow cube. Ask them if the new cube will be **twice as big, four times as big, eight or ten times as big**? Let them give some answers.

STEP #4: Using the white cubes, have the group build the cube to test their answers. Help them if they get stuck. Once finished, have them compare the bigger cube to the yellow cube and have them answer the question again. **(It took 8 white cubes to build the bigger cube, so that means it's 8 times bigger than the yellow cube.)** Explain that this means it has 8 times more volume.

STEP #5: For older students, you can explain that 8 is 2 cubed, 2 times as wide, long, and as high. 2x2 = 4x2= 8 times as big.

TANGRAMS

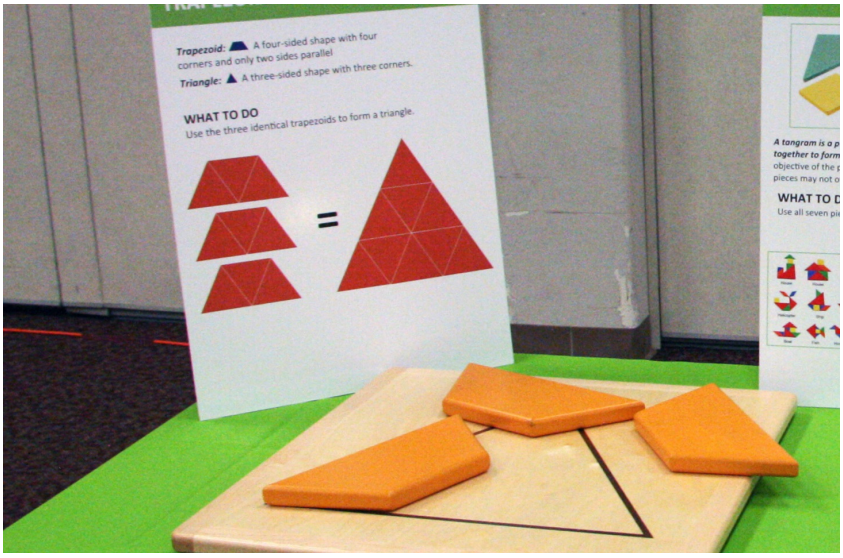
A tangram is a puzzle with seven pieces in three different shapes: **squares, triangles, and a parallelogram.**

STEP #1: Begin by holding up each shape and have students identify them. Explain that **a parallelogram is a four-sided shape with opposite but equal sides.**

STEP #2: Have the students complete the puzzle. All pieces must fit exactly in the lines on the exhibit board. If they can't get it after a few minutes you can provide hints or show them the answer.

STEP #3: Take the puzzle apart and have them solve it again or build more of the designs from the display card.

PYRAMID PUZZLE



This exhibit, **"Trapezoids and Triangles,"** teaches students how to solve an easy puzzle that creates a triangle from three trapezoids.

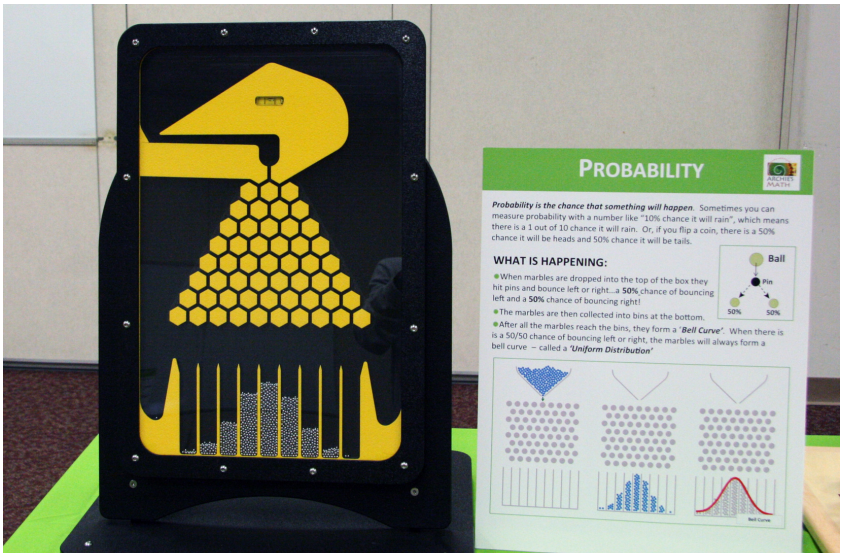
STEP #1: Begin by holding the trapezoid shape. Ask the students if they know what it's called. Explain that **a trapezoid is a four-sided shape with two opposite but parallel sides.**

STEP #2: Have the students complete the puzzle. All pieces must fit exactly in the lines on the exhibit board. If they can't get it after a few minutes you can provide hints or show them the answer.

STEP #3: After the students have completed the puzzle, use the display card to point out that each trapezoid is made up of **3 triangles.** Ask them how many small triangles make up the big completed triangle. **(9 triangles)**

STEP #4: Finish up by explaining that the big triangle they created is an **equilateral triangle**, meaning all of the sides are the same length. They are all equal.

PROBABILITY



STEP #1: Begin by reading aloud the definition of probability on the display card. After you read it, ask the students what the probability of flipping a coin and landing on heads. **(50%)**

STEP #2: Next read the "What's Happening" section of the display card. Make sure the students understand that there is a **50/50 chance** that the beads will bounce left or right. Then point out the bell curve on the display card.

STEP #3: Turn the exhibit so it clicks into place and the beads fall (you may need to nudge it if the beads get stuck). Wait for the beads to fall, then ask the students "why are there more beads in the center slots than the end slots?" Wait for their answers.

STEP #4: Explain that for a bead to get to the outside left slot the bead has to bounce left every time. That's eight times in a row. (L-L-L-L-L-L-L-L) **The odds of that happening is 1 in 128 which is very low.** It's less than 1% probability.

STEP #5: Explain that the odds for a bead to get to the center slots are much greater. This is because there are a lot of ways the bead can travel for it to get there creating a much higher probability.

PI (CIRCUMFERENCE)

For this exhibit, it is important that the students learn the parts of the circle and the word "Pi."

STEP #1: First, point out the parts of the circle on the display card and explain what each one means. **Circumference, Diameter, and Radius.**

STEP #2: Next, read the display card to the students which explains how Archimedes figured out how to calculate the circumference of a circle.

STEP #3: Point out that the diameter of the yellow circle on the exhibit board is 10 inches**. Tell the students that we will now calculate its circumference.**

STEP #4: Have the students follow the "What to do" directions to calculate the circumference **(Steps 1 and 2).**

STEP #5: When the students measure the string and it's 31.4 inches, ask them why 31.4 inches. **(Pi times the diameter 3.14 x 10 - 31.4).**

STEP #6: Ask them the questions at the bottom of the display card and make sure they know the parts of the circle before completing this exhibit.

BINARY

This exhibit explains what the Binary Number System is and how it works.

STEP #1: Start by reading the information on the display card starting with "When we count."

STEP #2: Next, explain how the machine works. Show how the switches go from **NO (0) to YES (1)**. Create the binary number 5 (00101) and how the number is also shown as a base number in the box on the right.

STEP #3: Have each student choose a number between 1 and 31. Then have them follow the instructions on the display card to create that number in binary on the machine.

STEP #4: Ask the students what is the largest number that can be created on this binary machine. (**31)**

STEP #5: Make sure the students know the words **Base 10 number system and binary number system.**

MAGIC SQUARES

The magic square is an ancient puzzle found in cultures all over the world.

STEP #1: Explain the rules of the puzzle. The objective is to arrange the numbers in the square grid on the exhibit board, so that each **row, column, and diagonal row** add up to the same number. This magic square must add up to **15**.

STEP #2: Next, explain that with a magic square you can only use each number once. For this magic square, we are using **numbers 1 through 9**.

STEP #3: Have the students solve the magic square on the exhibit board. The solution is :

8	**1**	**6**
3	**5**	**7**
4	**9**	**2**

STEP #4: If they are having trouble give them some help. Place the **number 5** piece in the center as a hint.

TOWERS OF HANOI

This is a very difficult puzzle. The explainer should do the puzzle for each group of students and then show them how to do it on their own if they can't.

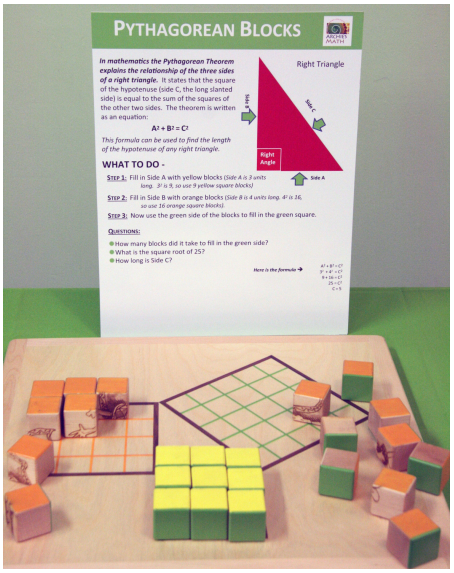
STEP #1: Explain the rules of the puzzle using the "What to do" section of the display card. Demonstrate as you explain.

STEP #2: Next, let the students try to solve the puzzle. Make sure they follow the three rules.

STEP #3: Explain that it is a **repeating pattern**. Help them solve it if they're having trouble.

STEP #4: Before they go, read the **Legend of the Big Puzzle** on the display card. It's an amazing story!

PYTHAGOREAN THEOREM



This is a very important theory in mathematics. This exhibit provides "proof" of the theory using blocks.

STEP #1: Read from the display card and explain what the Pythagorean theorem is. **(The formula used to find the length of the hypotenuse side of a right triangle.)**

STEP #2: Point to the red triangle and explain that it is a **right triangle** because one angle Is a **right angle (90 degrees)**. Point to side "c" and explain that it's the **hypotenuse, the slanted side.**

STEP #3: Point to the formula: $A^2 + B^2 = C^2$. Explain what it means to square a number **(multiply by itself)**. For example, **2 squared is 4.**

STEP #4: Point to the red triangle again and say that side **A squared plus side B squared = side C squared.**

STEP #5: Now, point to the side with 4 squares. Ask what 4 squared is. (16) Put 16 orange blocks in the 16 squares.

STEP #6: To prove the formula works, use the orange and yellow blocks to fill the 25 green squares. Ask the students for the square root of 25. **(5)** Then ask the length of the hypotenuse of this triangle. **(5)**

FIBONACCI SEQUENCE

This exhibit helps students understand **numerical sequences: Number patterns that follow a given rule.**

STEP #1: Explain that a number pattern is **a numerical pattern that follows a given rule.** Once you understand the pattern you can determine what number comes next.

STEP #2: Ask the students for examples of number patterns. If no one can think of any you can say, "How about 1, 2, 3, 4, 5, 6? Is that a number pattern?" Ask the students what the pattern is and how to get the next number. **(You keep adding one to each number.)**

STEP #3: Point to the Fibonacci numbers on the display card and ask if anyone can see the pattern. Explain the pattern: Add the two numbers before it to get the next number. **(0+1=1, 1+1=2, 1+2= 3, etc.)** Ask what the next number will be in the sequence. **(5)**

STEP #4: Point to the yellow square on the display card with the big 34. If you make squares with the sides of the square equal to the Fibonacci numbers, the squares look like a spiral. Point out the red spiral curve

STEP #5: Mix up the puzzle on the exhibit board and have the students solve it. Explain that this spiral pattern is often found in nature. This sequence is often called **"nature's numbers."**