September 3rd Puzzle

Math History-Mystery Puzzle

Birthday of Louis Sullivan, Architect

BY DAVID B. SPANGLER
AND KAREN S. CORDELL

Print & Digital

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September 3rd Puzzle

Math History-Mystery Puzzle

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ActiveMath, Inc.
2720 Dundee Road, PMB 146
Northbrook, IL 60062

Activemath39@yahoo.com
(847) 722–8690

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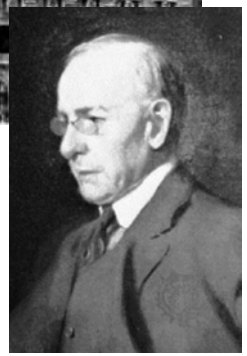
September 3: Birthday of Louis Sullivan, Architect

September 3 of the *Mystery Year* is the birthday of **Louis Sullivan,** American architect known as the *father of modern skyscrapers*. Sullivan and his partner, Dankmar Adler, collaborated on over 100 projects, including the Auditorium Building (shown at right) and the Wainwright Building in St. Louis.

With the evolution of affordable steel frames for load-bearing walls in buildings, Sullivan realized buildings could go much higher and with much larger windows. He was known for his ornate embellishments, his trademark semi-circular arches, and his "form follows function" style.



Louis Sullivan designed the Auditorium Building in Chicago.

Mystery Year

Use the clues on the next page to find the *Mystery Year*.

Thousands	Hundreds	Tens	Ones

September 3 CLUES

Use these clues, along with data in the table, to find the *Mystery Year* when Louis Sullivan was born.

World's Tallest Buildings* (as of 2021)	Code Letter	Height (meters)	Height (feet)	Number of Floors
#1: **Burj Khalifa** (Dubai, United Arab Emirates)	**B**	828	2,717	_____
#3: **Abraj Al-Bait Clock Tower** (Mecca, Saudi Arabia)	**A**	601	1,971	120
#6: **One World Trade Center** (NYC, U.S.)	**W**	541.3	_____	104

- **How tall is One World Trade Center to the nearest foot? The ones digit of the height is the ones digit of the *Mystery Year.*** (1 m ≈ 3.281 ft)
- **How much taller, *in meters,* is Abraj Al-Bait Clock Tower than One World Trade Center? The tens digit of that difference is the tens digit of the *Mystery Year.***
- **The number of floors in Burj Khalifa is a *prime* number greater than 161 and less than 167. Two less than the sum of the digits in that number is the hundreds digit of the *Mystery Year.***
- **The Code Letters in the table stand for their respective heights of the buildings *in feet.* When you replace the Code Letters in expression below with their heights and simplify, you will have the *Mystery Year.***

$$0.5(B + A) - (0.25W + 44)$$

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$$0.5(B + A) - (0.25W + 44)$$

_____	_____	_____	_____
Thousands	Hundreds	Tens	Ones

* The #2 tallest building in the world is Shanghai Tower in Shanghai, China, #4 is Ping An Finance Center in Shenzhen, China, and #5 is Little World Tower in Seoul, South Korea.

How to Use

Math History-Mystery Puzzles

Warm-up Activities for Middle School

Each puzzle begins with historical information about a particular person or event. The topics selected reflect the diverse nature of our society. Students use the clues that follow to determine the *Mystery Year* when the event occurred. In some cases, data needed to solve a clue is contained within the historical information. This reinforces what students experience in the real world: The data needed to solve a problem may not all appear in the same place.

The math content of the warm-ups is based on a ***spiral review of skills***. During the early months of the school year, they provide important math review skills drawn from Grades 5 and 6. As the year progresses, the skills advance to those of Grades 6 and 7 — with an abundance of real-world connections related to the contexts of the events. Towards the end of the school year, math skills from Grade 8 are included that can also be handled intuitively by students in earlier grades. It should be noted that many **high-school teachers** are using the puzzles with success to provide students with important skills review in context.

Students focus on a number of different math skills and concepts in the same warm-up. The spiral review is intended to help students keep their skills sharp. Also, the clues are intended to provide day-to-day mathematical variety. So, while students may be studying in unit, on, say, percent, they may be solving clues that review fractions or measurement.

Each clue produces a *digit* of the *Mystery Year.* As the clue is solved, students record the digit in the box to the right of the clue and into the place-value chart for the *Mystery Year* at the bottom of the first page of the puzzle. **The final clue with each puzzle provides a "check" for determining the correct *Mystery Year.***

Provided with each puzzle are extensive **Teacher Notes with Sample Solution Strategies** that include valuable teacher information that address the following:

- The specific **Common Core State Standards for Mathematical Content** that are addressed in the clues. When a clue employs skills that are not directly addressed by a Standard for Mathematical Content, one or more **Standards for Mathematical Practice** are cited.
- **Step-by-step solutions** designed so thoroughly that parents working with students at home are equipped to help their child. *Alternative solution strategies* are detailed to illustrate various paths to the solution.
- **Math Notes** that provide additional **mathematical background** for the teacher. This includes various pedagogical insights that include an analysis of related ***common student misconceptions*** **with** ***intervention suggestions.***
- **Extensions** that allow advanced students to take the content to the next level.
- **Multicultural Notes** to bring to light the contributions from various cultures related to the discovery / development of the content of the puzzle.
- **Historical Notes** to provide further context for the theme of the puzzle. Often these notes delve into **social justice issues** related to the theme of the puzzle. Included are links to **video clips** and uplifting **quotes**.

Even though we do not provide a separate puzzle for each day of a given week, we view the puzzles as being ***daily puzzles*** because of the extensive activities and extensions that are provided with the Teacher Notes that may be used during the other days of the week.

To download a FREE, more extensive document describing **How to Use** the puzzles, go to https://www.teacherspayteachers.com/Product/FREE-How-to-Use-Math-History-Mystery-Puzzles-for-Middle-School-manual-7037642

Teacher Notes and Sample Solution Strategies for September 3

September 3 Birthday of Louis Sullivan, Architect (Father of Modern Skyscrapers)

CCSS: 6.NS.3, 5.NBT.7, 4.OA.3, 6.NS.4, 6.EE.2.c.

Mystery Year: **1856**

- One World Trade Center's height is 541.3 meters. One way to convert this to feet is to use the conversion rate given (1 m ≈ 3.281 ft):

$$541.3 \text{ m} \cdot \frac{3.281 \text{ ft}}{1 \text{ m}} \approx 1{,}776.0053 \text{ ft}$$

To the nearest foot, the height is 1,776 ft. The ones digit of 1,776 is 6, so the ones digit of the *Mystery Year* is 6.

Math Note: For students who may not know where to start, or if they do not know if they should multiply or divide, the following line of questioning can support their reasoning:

If a box is 1 meter tall, how many feet is that? (3.281 ft, because 1 m ≈ 3.281 ft)

So, if a box is twice that height, or 2 meters tall, how tall in feet would that be? (twice 3.281, or 6.562 ft)

Now, what about a box that is 10 meters tall? What could you do to figure out how tall that box is in feet? (Multiply 3.281 by 10 to obtain 32.81 ft.)

Finally, for a building that is 541.3 m tall, what can you do to determine how tall it is in feet? (Multiply 3.281 by 541.3 to obtain ≈ 1776.0053 ft.)

Historical Notes: One World Trade Center (completed in 2014) is also known as *Freedom Tower*. It was built on the same site as the original World Trade Center that was destroyed on September 11, 2001 (9/11) by terrorist attacks. The original World Trade Center was a complex of seven buildings that featured the *Twin Towers*. When built, the *Twin Towers* were the tallest buildings in the world, standing at 1,368 and 1,362 feet, respectively. One World Trade Center was built to be 1,776 feet tall — in honor of the year 1776 when the Declaration of Independence was signed. (The approximate height obtained in this clue, ≈ 1,776.0053 ft, resulted because the approximate conversion factor, 1 m ≈ 3.281 ft, was used.)

- To find how much *taller* Abraj Al-Bait Clock Tower is than One World Trade Center, subtract the smaller height from the larger to determine the difference:

601 meters – 541.3 meters = 59.7 meters

The tens digit of 59.7 is 5, so the tens digit of the *Mystery Year* is 5.

Math Note: A **common student error** (when not using a calculator) is to simply "drop down" the 3 into the tenths place of solution — and then just subtract the whole numbers, 601 and 541. This results in the incorrect answer of 60.3. Should you observe students making that error, you might use play money and have students act out the amount of change they should get back if they buy something for $1.30 and give the clerk $2. Ask: *How can you determine the amount of change you should get back? Does it make sense to receive $1.30 in change?* (Students may "count up" to determine that they should get 70 cents in change.) Relate that to how they should find $2 – $1.30, and ultimately, 601 – 541.3.

- Students may start solving this clue by listing all the possible whole numbers between 161 and 167, which are 162, 163, 164, 165, and 166. From this list, they should be able to quickly eliminate 162, 164, 165, and 166 (knowing all even numbers other than 2 are composite and that 165 is divisible by 5 because it ends in 5). The only remaining number is 163. After testing, students should be able to determine that 163 is prime. To complete the clue, students must find "two less than the sum of the digits," so they need to add the digits in 163 and then subtract 2: (1 + 6 + 3) – 2 = 8, so the hundreds digit of the *Mystery Year* is 8.

  Math Note: Students who do not carefully read the clue may end up spending much time testing the numbers 161 and 167. For those students, emphasize that "greater than 161" does not include 161; "less than 167" does not include 167.

- Attention to precision is called for in this final clue. Students need to tune in to using data *in feet*, replacing the **Code Letters** accurately, and then following the order of operations to evaluate the expression.

$0.5(\boldsymbol{B} + \boldsymbol{A}) - (0.25\boldsymbol{W} + 44) =$	
$0.5(\mathbf{2{,}717} + \mathbf{1{,}971}) - (0.25 \bullet \mathbf{1{,}776} + 44) =$	Replace the Code Letters with their respective values.
$0.5(4{,}688) - (444 + 44) =$	Simplify within parentheses.
$0.5(4{,}688) - (488) =$	Add.
$2{,}344 - 488 =$	Multiply.
1856	Subtract.

  Because the digits __ 8 5 6 in the *Mystery Year* have already been determined based on the prior clues, this final check confirms the *Mystery Year* is 1856.

  Math Note: Watch for possible **student errors** when evaluating the expression. These include simplifying $0.5(B + A)$ as $0.5B + A$, simplifying $-(0.25W + 44)$ as $-0.25W + 44$, and multiplying both 1,776 *and* 44 by 0.25.

Historical Notes

- Despite some sources placing One World Trade Center as the 7th tallest building in the world, it remains at #6. The Golden Finance 117 building in China, projected to take over the #5 spot, is unfinished and unoccupied. Sources for additional information:
  https://www.skyscrapercenter.com/buildings
  https://www.emporis.com/statistics/worlds-tallest-buildings
- Sullivan had no way to know the huge heights to which buildings would ascend. Currently, the construction on the **Jeddah Tower** in Jeddah, Saudi Arabia is on hold. However, when it resumes and is completed, it is expected to be the tallest building in the world — rising up 1 km (or about 3,281 ft) into the sky!
- September 3 is known as **National Skyscraper Day** in recognition of the birthday of Louis Henry Sullivan. This unofficial holiday is designed to encourage people to learn more about the art and science of the building of skyscrapers — including building a model skyscraper or visiting a skyscraper or two.

"It is the pervading law of all things organic and inorganic, of all things physical and metaphysical, of all things human, and all things super-human, of all true manifestations of the head, of the heart, of the soul, that the life is recognizable in its expression, that form ever follows function. *This is the law*."

—Louis Sullivan, *1896, referring to his architectural core belief*