April 21st Puzzle

Math History-Mystery Puzzle

Birthday of Queen Elizabeth II

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Print & Digital

Contents

The student page is also included as a separate file with answer fields for ease of use as a digital assignment.

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April 21st Puzzle

Math History-Mystery Puzzle

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Credits

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COVER DESIGN: Angie Seltzer

Name _____

April 21 Puzzle

Birthday of Queen Elizabeth II

Queen Elizabeth II

On **April 21** of the *Mystery Year,* **Elizabeth II was born.** She is Queen of the United Kingdom and the other 15 Commonwealth realms (including Canada, Australia, and New Zealand). Queen Elizabeth II is the longest-reigning British monarch of all time. She became Queen when her father, King George VI, passed away.

The Queen celebrates two birthdays: her real birthday on April 21, and a second one on a Saturday in June "when the weather is nicer."

During the coronavirus pandemic, the Queen provided comfort and support to the world in a speech where she made reference to the British song from World War II, "We'll Meet Again." That song had offered hope to those on the front lines.

Use these clues to find the *Mystery Year:*

1. Elizabeth II has been Queen during the terms of x U.S. Presidents. To find the value of x, find the volume of a cube — in *cubic inches* — that measures 0.2 *feet* on a side. Round the volume to the nearest cubic inch. You will now have the value of x.

When you subtract 8 from *x*, you will have the ones digit of the *Mystery Year.*

2. A "nice" temperature in the United Kingdom in June is 22°C. Convert that temperature to degrees Fahrenheit, and round to the nearest degree. Use $F = 1.8C + 32$.

The ones digit of the temperature in degrees Fahrenheit is the tens digit of the *Mystery Year.*

3. As of April 2022, Queen Elizabeth II has x children, $2x$ grandchildren, and $3x$ great-grandchildren. If the total of all three groups is 24, how many grandchildren does she have?

Increase that number by 1 and you will have the hundreds digit of the *Mystery Year.*

4. *Use this clue as a check on the other clues:* Queen Elizabeth II is well known for her hats, crowns, and tiaras. In fact, it is estimated that she has worn ***at least*** 5,000 pieces of headgear since her rule began. Solve this inequality:

$$x + 3{,}074.9 \geq 5{,}000$$

The *least integer* that satisfies the inequality is the *Mystery Year.*

What is the *Mystery Year* when Queen Elizabeth II was born?

_____ _____ _____ _____
Thousands Hundreds Tens Ones

Teacher Notes provide helpful tips for enhancing or extending the activity.

- solution strategies
- common errors
- optional extensions
- related links
- historical information

Complete Solutions, Teacher Notes, & Extensions

Birthday of Queen Elizabeth II — **April 21 Puzzle**

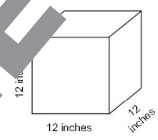
***Mystery Year:* 1926**

CCSS: 6.G.2, 6.RP.3.d, 7.EE.3, 6.EE.5, MP6 (Attend to Precision).

Topics: volume of a cube, convert a Celsius reading to Fahrenheit, solve a two-step equation, solve a one-step inequality.

Clue 1 Solution The volume of a cube that measures 0.2 feet on a side is 0.2 × 0.2 × 0.2 = 0.008 cubic feet. Because there are 12 inches in 1 foot, there are 12 × 12 × 12 = 1,728 cubic inches in 1 cubic foot. So, the volume of the given cube in cubic inches is 1,728 • 0.008 = 13.824 cubic inches. (An alternate solution is to first change 0.2 foot to inches, then find the volume of the result.) When 13.824 cubic inches is rounded to the nearest cubic inch, the result is 14 cubic inches. Thus, Queen Elizabeth II has lived during the administrations of 14 U.S. Presidents! When 8 is subtracted from 14, the result is 6. So, the ones digit

Math Note: A **common student misconception** is to multiply by 12 when converting from cubic feet to cubic inches (because there are 12 inches in 1 foot). Some students multiply by 27 because they recall that there are 27 cubic feet in 1 cubic yard. To help students visualize the correct result, provide an image of 1 cubic foot modeled as shown at right. Ask: *How many cubes, each 1 inch on a side, are in the bottom layer of the large cube?* (12 × 12, or 144 small cubes) *So, if each layer holds 144 cubic inches, how many cubic inches are in the entire cube?* (12 × 144, or 1,728 cubic inches)



Historical Note: Princess Elizabeth became Queen Elizabeth II on February 6, 1952 when her father, King George VI died. **She has lived during the terms of the 14 U.S. Presidents listed below.** The dates given are the years the presidents served in office (not the years when they were elected).

Harry S. Truman (1945–1953), Dwight D. Eisenhower (1953–1961), John F. Kennedy (1961–1963), Lyndon B. Johnson (1963–1969), Richard Nixon (1969–1974), Gerald R. Ford (1974–1977), Jimmy Carter (1977–1981), Ronald Reagan (1981–1989), George H.W. Bush (1989–1993), Bill Clinton (1993–2001), George W. Bush (2001–2009), Barack Obama (2009–2017), Donald J. Trump (2017–2021), Joe Biden

Extension: Pose the following question to students:

What if the dimensions of the cube in the clue were each increased by 0.1 foot: Would the resulting volume in cubic inches be $(0.1)^3$ greater than the original volume? Answer Yes *or* No, *and explain your reasoning.*

Solution: No. *Explanation:* $(0.1)^3 = 0.001$. The volume of the new cube is $12^3 \cdot (0.3)^3 = 1{,}728 \cdot 0.027$, or 46.656 cubic inches. The volume of the original cube is 13.824 cubic inches. The volume of the new cube is much more than just 0.001 cubic inch more than the original cube. In fact, only the 0.3^3 needs to be compared with 0.2^3, resulting in a 27 to 8 ratio in volume — and NOT an increase of 0.001.

Clue 2 Solution When 22 is substituted for C in the formula, $F = 1.8C + 32$, the formula becomes $F = (1.8 \cdot 22) + 32$. When the product, $1.8 \cdot 22$, is added to 32, the result is $39.6 + 32$, or 71.6. Thus, 22°C = 71.6°F. When 71.6°F is rounded to the nearest degree, the result is 72°F. The digit in the ones place of 72 is 2, so the tens digit of the *Mystery Year* is 2.

Extension: For advanced students and students in 8th grade/Algebra 1, have them solve this *literal equation*, $F = 1.8C + 32$, for C. (A *literal equation* is an equation that has several variables that represent specific unknowns that are easily recognizable. In this case, F represents degrees Fahrenheit and C represents degrees Celsius.) Remind students that solving a literal equation for one of the variables is really the same process as solving an equation with one variable. In each case, the goal is to *isolate* a particular variable by using inverse operations!

$F = 1.8C + 32$	
$F - 32 = 1.8C$	Subtract 32 from each side of the equation.
$(F - 32) \div 1.8 = C$	Divide each side of the equation by 2.

Once students solve the literal equation for C, **(a)** have them explain its meaning and then **(b)** have them confirm its equivalence to the original formula by replacing C with 22° and solve for F.

Sample response for **(a)**: The Celsius temperature can be determined by subtracting 32 from the Fahrenheit temperature, and then dividing by 1.8.

Sample steps for **(b)**:

$(F - 32) \div 1.8 = C$	
$(F - 32) \div 1.8 = 22$	Replace C with 22.
$F - 32 = 22 \cdot 1.8$	Multiply each side of the equation by 1.8.
$F - 32 = 39.6$	Simplify the multiplication on the right.
$F = 39.6 + 32$	Add 32 to each side of the equation.
$F = 71.6$	Simplify the addition on the right side.

Math Note: When students engage in the process above, it supports them in making sense of problems with formulas and thinking "flexibly" when given a formula and then needing to solve for one of the variables in the formula. For example, consider:

The perimeter of a rectangle is 20 in., and its length is 2 in. greater than its width.

Students may opt to start with the formula, $P = 2l + 2w$, substituting in the given information and then solving for w. Alternatively, students who think "flexibly" may opt to first solve for w — resulting in $w = (P - 2l) \div 2$ — and then substituting in the given information! Either way, the width is 2 inches. The ability to work flexibly with formulas supports building student confidence in that it affords them multiple pathways to work

Clue 3 Solution As of April 2022, Queen Elizabeth II had x children, $2x$ grandchildren, and $3x$ great-grandchildren. The total of these groups is 24. Students may solve the clue by engaging in *guess, test, and revise*, testing that are in a 1 : 2 : 3 ratio. Alternatively, students may elect to solve the clue algebraically, first translating the scenario into an equation, as shown below.

$x + 2x + 3x = 24$	Write an equation, where x = number of children.
$6x = 24$	Combine like terms on the right side.
$x = 4$	Simplify by dividing by 6.

Because $x = 4$, Queen Elizabeth has 4 children. She has 2 • 4, or 8, grandchildren, and 3 • 4 or 12, great-grandchildren. As of April 2022, When the number of grandchildren, 8, is increased by 1, the sum is 9. So, the tens digit of the *Mystery Year* is 9.

Extension: Have students apply *guess, test, and revise* and/or translate the following scenario into an equation and solve the following problem:

In a candy jar, there is a total of 120 jellybeans, consisting of only 3 colors: black, green, and orange. You are also told that the jellybeans are in this ratio: 2 black : 3 green : 5 orange. How many orange jellybeans are in the jar?

Solution:

$2x$: represents the number of black jellybeans (This author's favorite!!)

$3x$: represents the number of green jellybeans

$5x$: represents the number of orange jellybeans

So, the equation representing this scenario is: $2x + 3x + 5x = 120$. Combining like terms on the left side produces: $10x = 120$. Then, dividing by 10 on each side yields $x = 12$. Because the number of orange jellybeans is represented by the expression $5x$, substituting 12 for x yields a total of 60 orange jellybeans in the jar. As a check, the number of black jellybeans is 2 • 12, or 24, and the number of green jellybeans is 3 • 12, or 36. The total of those three groups is 120.

You can extend this problem into a simple probability problem: *What is the probability that an orange jellybean will be randomly selected on one try?* (Because there are 60 orange jellybeans out of 120 total in the jar, the $P(\text{Orange}) = 60$ out of 120, or a 50% chance.)

Clue 4 Solution To solve the inequality, $x + 3{,}074.9 \geq 5{,}000$, subtract 3,074.9 from each side of the inequality. The resulting inequality is $x \geq 1{,}925.1$. The ***least integer*** that satisfies this inequality is 1,926. The digits of the *Mystery Year* determined thus far are ___ 9 2 6. Because the only reasonable digit for the thousands place is 1, the *Mystery Year*, 1926, has been confirmed.

Math Note: Note that the wording in the clue, ***at least***, is highlighted to connect with the association of the inequality symbol, ≥. The directions for solving the clue include the words ***least integer***. A **common student misconception** associated with the concept of ***least integer*** is to round 1,925.1 down to 1,925. That misconception would lead students to think that the *Mystery Year* is 1925. Should that occur, ask students to re-read the clue and find the ***least integer*** *that satisfies the inequality is the Mystery Year.* Ask them to replace x in the original statement with their solution with 1,925:

$x \geq 1{,}925.1$

$1{,}925 \stackrel{?}{\geq} 1{,}925.1$

Ask: *Is 1,925* ***at least as great as*** *(greater than or equal to) 1,925.1?* (No). Advise students that the *least integer* of a given number is the ***integer*** that is at least as great as the given number.

Extension: Have students make up a different inequality using Queen Elizabeth's birth year (1926), the year she assumed the throne (1952), and/or the current year are terms of the inequality, then solve and write a statement explaining the solution in context. Students could even exchange their inequalities with a classmate and explain to each other.

Example based on the year 2022:

$x + 1{,}952 \geq 2{,}022$

Solving the inequality yields $x \geq 70$, which, in context, means Queen Elizabeth II has been "on the throne" at least 70 years.

Historical Notes

On September 13, 1940, during World War II, Nazi Germany dropped 5 bombs on top of Buckingham Palace in London. King George VI and his wife Queen Elizabeth decided to remain at Buckingham Palace to show their solidarity with those living through the Blitz. Princess Elizabeth who was just 13 at the time, and her sister Princess Margaret, were moved to Windsor Castle about 20 miles away from London. To boost the morale to the thousands of children who were also separated from their families for safety, Princess Elizabeth made her first address that included these lines:

Thousands of you in this country have had to leave your homes and be separated from your fathers and mothers. My sister Margaret Rose and I feel so much for you, as we know from experience what it means to be away from those you love most of all. To you living in new surroundings, we send a message of true sympathy and at the same time we would like to thank the kind people who have welcomed you to their homes in the country.

When she turned 18 in 1944, Princess Elizabeth joined the Auxiliary Territorial Service

dubbed by newspapers as "Princess Auto

male member of the Royal family to be an

earned to tear apart, repair, and build

us military vehicles — including trucks

the accession of Elizabeth II as Queen

ilms. During her 70th Jubilee

United Kingdom, the Commonwealth,

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listed below:

uinea, Nauru, Jamaica, Solomon

Saint Vincent & the Grenadines, Antigua &

facts-about-the-queen-elizabeth-ii/

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...

ess Elizabeth on her 21st birthday

vill shown to me by people of all

the world over those years".

ccession Day, February 6, 2022.

ed the message, "Your Servant."

How to Use *Math History-Mystery Puzzles*

Warm-up Activities for Middle School

OVERVIEW

These puzzles connect mathematics to other disciplines, inspirational individuals, historical & current events, social justice issues, and pop culture — *to reflect the diverse nature of our society.* Each puzzle has brief information and questions about a specific day in history.

Mystery Year Each puzzle begins with the critical reading of a passage of historical information about a particular person or event in a *Mystery Year.* Students use math clues to determine the year when the event occurred. Each clue produces a digit of the *Mystery Year*, and the final clue provides a check on the other clues.

Bellringers The puzzles are ideal for warm-ups, sponge activities, skills-review/test prep, enrichment/challenge activities, mini-lessons — and even as activities for math clubs. Pages are ready to print or assign digitally to individuals or small groups.

Test Prep The math content of the warm-ups is based on a *daily mixed review of skills.* By revisiting a variety of important skills on a daily basis, students are likely to keep those skills sharp for the high-stakes tests that they will be taking later in the year. And the real-world contexts keep students engaged.

Common Core State Standards The skills/concepts addressed in the puzzles are drawn from the *Common Core State Standards for Mathematical Content and Mathematical Practice* from Grades 5–8. Overall, the skills increase in difficulty as the year progresses. It should be noted that many high-school teachers are using the puzzles with success to provide students with important skills review in context.

PROFESSIONAL DEVELOPMENT SUPPORT

Provided with each puzzle are extensive *Teacher Notes* with sample, step-by-step solutions and scaffolding strategies that include valuable teacher information.

- **Step-by-Step Solutions** are designed so even beginning teachers will be well-equipped to help all students. Alternative solution strategies are detailed to illustrate *various paths* to the solution.
- **Math Notes** 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** allow advanced students to take the content to the next level.

- **Multicultural Notes** bring to light the contributions from various cultures related to the discovery/development of the content of the puzzle.
- **Historical Notes** 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.

To download a FREE, more extensive document describing how to use the puzzles, go to: https://www.teacherspayteachers.com/Product/7037642