CSI: ALGEBRA

UNIT 7
Systems of Equations

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## Project Title: CSI Algebra: Systems of Equations

### Standard Focus:
Patterns, Algebra and Functions

### Time Range:
1-3 days

### Supplies:
Pencil and Paper

### Topics of Focus:
- Solving & Graphing Systems of Equations
- Systems of Inequalities

This particular was mapped to the curriculum in Glencoe Algebra 1 Chapter 7 and can be used as an enrichment or review activity.

<table>
<thead>
<tr>
<th>Expressions and Equations</th>
<th>8.EE</th>
<th>8a. Understand that solutions to a system of two linear equations in two variables correspond to points of intersection of their graphs, because points of intersection satisfy both equations simultaneously.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Expressions and Equations</td>
<td>8.EE</td>
<td>8b. Solve systems of two linear equations in two variables algebraically, and estimate solutions by graphing the equations. Solve simple cases by inspection.</td>
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<tr>
<td>Expressions and Equations</td>
<td>8.EE</td>
<td>8c. Solve real-world and mathematical problems leading to two linear equations in two variables.</td>
</tr>
<tr>
<td>Reasoning with Equations and Inequalities</td>
<td>A-REI</td>
<td>5. Prove that, given a system of two equations in two variables, replacing one equation by the sum of that equation and a multiple of the other produces a system with the same solutions.</td>
</tr>
<tr>
<td>Reasoning with Equations and Inequalities</td>
<td>A-REI</td>
<td>6. Solve systems of linear equations exactly and approximately (e.g., with graphs), focusing on pairs of linear equations in two variables.</td>
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<td>Reasoning with Equations and Inequalities</td>
<td>A-REI</td>
<td>10. Understand that the graph of an equation in two variables is the set of all its solutions plotted in the coordinate plane, often forming a curve (which could be a line).</td>
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</table>

### Procedures:

A.) Student will be given a letter from Chief Harris, the possible suspects, and crime scene puzzles.

B.) Students will work in pairs or individually to solve the crime.

C.) Students will determine which suspect should be arrested.

D.) Students will create a portfolio of evidence proving that they have arrested the right person and will demonstrate their understanding of their mathematical content present in the problem.
*E.) Students can present their evidence to the class as an oral presentation.

*Extensions
CSI Algebra: Systems

Detectives,

What’s another month without a series of high profile robberies at the hands of the Mathemagicians? The evil genius terrorist group has pulled off another elaborate crime spree that has left the continent of Africa in disarray. As the Mathemagicians work to build their world conquering device, our investigators are trying to piece together the thefts by an anonymous associate, Hakuna Math Ata.

Cocky as always, the Mathemagicians have left behind a trail of mathematical puzzles and a cryptic text message that must be solved. After solving the puzzles, you can decode the message, which will lead to Hakuna’s favorite number. So far there are six suspects that police have questioned. It is hoped that someone with a relatively strong number sense can crack some of the puzzles that have puzzled the detectives on the case so far.

Your job is to bring Hakuna Math Ata to justice and save the planet. You need to be prepared to state your case and demonstrate an understanding of the following skills that appear to be used in the notes:

- Solving Systems with Elimination and Substitution
- Graphing Systems of Equations
- Solving & Graphing Systems of Inequalities

Be sure to include:

- Other examples of the concepts
- Definitions
- Any other relevant information.

This is no time for sloppy work. The slightest miscalculation or illegible footnote could result in a not guilty verdict. Oh, did I mention that use of a calculator might prematurely set off his world conquering device? Good luck to you, gumshoe.

Chief Harris
CSI: THE EVIDENCE

NAME: _________________________________

1. _____________

2. _____________

3. _____________
Who is Hakuna Math Ata?

Name: Marcy
Occupation: Computer Scientist
Favorite Number: 1

Name: Bella
Occupation: Fashion Designer
Favorite Number: -315

Name: Ted
Occupation: Mechanical Engineer
Favorite Number: i

Name: Pat
Occupation: eBusiness Entrepreneur
Favorite Number: 44

Name: Osbert
Occupation: Executive Assistant
Favorite Number: 2

Name: Jebediah Wolfhead
Occupation: Poet / Scholar
Favorite Number: -9
Scene #1  Nairobi National Park -- Nairobi, Kenya

Last night, Hakuna Math Ata snuck into the National Park and left with five baby black rhinos. Investigators believe the baby rhino DNA may be a super serum for the world conquering device.

Jambo Westerners! Since I've been employed to steal a variety of things across African, I figure I'll try to enjoy interesting things along the way. No worries, eh? Hakuna Matata as Hakuna Math Ata likes to say. You can try to catch me, but I'm gonna throw some algebra systems in your way. Here's your first...

In the jungle, the mighty jungle, the mommy rhino sleeps tonight. And then I stole her babies. She mad.

I left behind with the safari receipts for two families. If you can figure out how much a Child ticket costs, you'll know the answer to the next puzzle.

\[ C = \____ \]

Scene #2  Regional Centre for Renewable Energy -- Praia, Cape Verde

One of the foremost research labs in sustainable energy discovered last night that a prototype for their solar powered monster truck was stolen. In its place, they found this note.

Animals live, graze, get turned into hotdogs, cooked, eaten by people who then artificially inseminate more animals -- It's the Circle of Life. We're not going to cook these dogs on a grill or in a pot, but on a solar oven. Let the sun do the work.

**SOLAR OVEN B:**

The chef starts her oven at \( t = 0 \) and her oven heats an average of 4 degrees per minute.

**SOLAR OVEN A:**

The chef started four minutes later and heats an average of 8 degrees per minute.

What will the temperature be when the ovens are the same? This temperature will be \( T \). (I'd solve it instead of trust a graph).

\[ T = \____ \]
Scene #3  Ngorongoro Conservation Area -- Serengeti Plains, Tanzania

A park ranger was astonished to find large excavation markings in the famous Ngorongoro Crater, a massive, unflooded volcanic caldera (kind of like a big bowl). Some estimate the crater to be 2 million years old. At this time, investigators are unclear how this factors in the plans of the Mathemagicians.

It’s unclear how the volcanic caldera will factor in the plans of the Mathemagicians, but I love it! I think it can turn some vagabonds to kings! Can you feel the love tonight? Onto our problem...

A pair of confused math friends have different pieces to one system of equation, but they’re not sure how to find their answer.

<table>
<thead>
<tr>
<th>(1, 3)</th>
<th>$m = 3$</th>
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<tbody>
<tr>
<td>(-4, 0)</td>
<td>$s = 20$</td>
</tr>
<tr>
<td><strong>No Solutions</strong></td>
<td>$u = 21$</td>
</tr>
<tr>
<td><strong>Infinite Solutions</strong></td>
<td>$b = 26$</td>
</tr>
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Scene #4  Lake Tanganyika -- Central Africa

A ferry boat captain for the Heart of Peacefulness and Delight cruise line was alarmed when a patron jumped overboard. The figure had stolen a ceremonial African Biombo mask. The staff later found this note in a bed.

There’s a lost African treasure somewhere around here! Some think it is the riches of a Zulu king hid it during the age of Imperialism. Supposedly it’s at one of these six points and it’s in the solution to this system of inequalities. I just can’t wait to be king!

$$y < -2x + 3$$

$$x - 4y > 12$$

**Which of the points is in the solution set?**

**=-300**
Scene #5  Namib Desert - Namibia

This morning it was discovered that thousands of Namib Desert beetles were taken by Hakuna Math Ata. These beetles have developed a unique technique to survive by obtaining water from early morning fogs. It is believed this power may be used in the world conquering device somehow.

It’s almost getting to the time for the strange old baboon to hold up a brand-spanking new baby lion. That means our story is coming to an end. Match the number of the question to the letter of the answer choice and put them on the row along the bottom.

<p>| | | | | | | |</p>
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</thead>
</table>
| 1 | Y = 2X  
   | 3X + 2Y = 14 | 2 | 2X - 3Y = 4  
   | -2X + 3Y = -4 |   | B = (2, 4)  
   | E = (5, -3)  
   | G = (-3, 4)  
   | T = NO SOLUTION | 4 | 3X + 6  
   | X + Y = 6 |   | T = INFINITE SOLUTIONS | 5 | Y = -X + 1  
   | 3X + 2Y = -1 |   | W = (5, 1)  
   | 2Y = -2 |   | Y = (-6, 6)  
   | 4Y = 40 |   | 7 | 2X + 3Y = 0  
   | X - 4Y = -2 |   |   |   |   |   |   |

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Scene #6    Mount Kilimanjaro -- Tanzania

Last night, it’s believed Hakuna Math Ata scaled a peak and dug up a field of indigenous African blood lilies. It’s suspected the blood lilies have some sort of value to the world conquering device. Carved into the side of the mountain they found this note and were sent a cryptic text message.

Simba lives in Kenya and he is applying for a microcredit loan to start a street food business Slimy Yet Satisfying. He is taking out a 48,000 Kenyan Shilling loan (about $570) and will have a 30,000 Kenyan Shilling monthly credit line.

Write cost and revenue equations to determine how long it will take Simba to break even.

**SLIMY YET SATISFYING**

<table>
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<tr>
<th>INITIAL COSTS</th>
<th>48,000 shillings</th>
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<tr>
<td>PROJECTED MONTHLY REVENUE</td>
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The number of months it will take to break even will be equal to $S$.

$$S = \ldots$$

**CRYPTIC PUZZLE SOLVER TEXT MESSAGE**

I’m here on Pride Rock. You have an epic coming of age journey ahead. Hakuna Math Ata.

$$c + \frac{t}{m} + \frac{mu}{s} + \frac{b}{b}$$

© 21st Century Math Projects
Thank you for being my Math Friend!

If you liked this

21st Century Math Project

You might like others. (Click the logo)

Math it Up.
Boomdiggity.
<table>
<thead>
<tr>
<th>Name</th>
<th>Occupation</th>
<th>Favorite Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lou</td>
<td>Mayor</td>
<td>1</td>
</tr>
<tr>
<td>Bella</td>
<td>Fashion Designer</td>
<td>-315</td>
</tr>
<tr>
<td>Ted</td>
<td>Mechanical Engineer</td>
<td>i</td>
</tr>
<tr>
<td>Pat</td>
<td>Homemaker</td>
<td>44</td>
</tr>
<tr>
<td>Osbert</td>
<td>Executive Assistant</td>
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\[ C = \underline{1200} \]

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**SOLAR OVEN B:**

The chef starts her oven at \( t = 0 \) and her oven heats an average of 4 degrees per minute. \( y = 4t \)

**SOLAR OVEN A:**

The chef started four minutes later and heats an average of 8 degrees per minute. \( Y = 8t - 32 \)

What will the temperature be when the ovens are the same? **This temperature will be \( T \).** (I’d solve it instead of trust a graph.)

\[ T = \underline{32} \]
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- \((-4, 0)\) \(\Rightarrow s = 20\)
- **No Solutions** \(\Rightarrow u = 21\)
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\[
\begin{align*}
y &< -2x + 3 \\
x - 4y &> 12 \\
y &< \frac{1}{4}x - 3
\end{align*}
\]

Which of the points is in the solution set?

\[
\begin{align*}
M &\quad \Rightarrow -300
\end{align*}
\]
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| 2 | $2x - 3y = 4$  
$-2x + 3y = -4$ |  |
| 3 | $x = 5y$  
$3x - 6y = 9$ |  |
| 4 | $3x + 6$  
$x + y = 6$ |  |
| 5 | $y = -x + 1$  
$3x + 2y = -1$ |  |
| 6 | $2x + 3y = 4$  
$-x - 4y = -1$ |  |
| 7 |  |

b = 20
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The number of months it takes to break even will be equal to $s$.

$$s = 8$$

**CRYPTIC PUZZLE SOLVER TEXT MESSAGE**

I’m here on Pride Rock. You have an epic coming of age journey ahead. Hakuna Math Ata.

$$c + t + \frac{mu}{m + \frac{s}{b}}$$

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