Literal Equations Breakout

Lesson Overview

In this lesson, students will solve literal equations on paper using the solutions to locate breakout boxes and their combinations.

SC Standards Addressed

A1.ACE.4 Solve literal equations and formulas for a specified variable including equations and formulas that arise in a variety of disciplines.

Computational Thinking

Tool:
Breakouts (physical)

Cornerstone(s) Addressed:

- Decomposition: Isolating variables with multivariable equations
- Pattern Recognition: Students will recognize the variable being solved for will indicate their breakout box.
- Abstraction:
    - Students will give more attention to the variable being isolated in the given equation.
    - Students decompose the paragraph provided to decide what values are relevant and the proper way to use the values in deciding the combination code to the lock.
- Algorithmic Thinking: Students will use the steps for solving multistep linear equations to solve the literal equation.

Lesson Plan

Time required: Two 50-minute periods

Focus Question(s): How do the solutions to a single variable equation and a multivariable equation differ?
Materials needed:

- *4 Boxes with 4 locks*
- *Agree/Disagree Handouts – one per student*
- *Equation handouts – one per group*
- *Set of four envelopes with "inoculation sequence" parts – one set per group*

Preparation:

- You will need four boxes with four locks, each programed with one of the 4-digit lock codes (*see the attached Key to the equations*) NOTE: How to program the locks may vary depending on the lock manufacturer. Instructions should come with the locks you purchase. There are also videos on programing combination locks. Search YouTube if you don't have instructions. If you use letter locks, assign a number-to-letter code, i.e., 1 = A, 2 = B, etc. If you have 3 number locks, you will need to rewrite the equations and lock codes for the student sheet.
- Make copies of the inoculation sequence (*see attached*) you will need a copy for each group.
- Cut the sequences into 4 parts and place one part in an envelope. You will have a set of four envelopes for each group.
- In each box place the envelopes containing one part of the inoculation sequence (*they need to be the same part*). Each box will contain one envelop for each group (*if you have six groups then each box will contain six envelopes*) and each envelope in the box will contain the same part of the inoculation sequence.

Engage

Create groups of 4 or 5 students.

Read the following scenario or something similar:

> Zombies have invaded! There is an inoculation for the zombie virus, but security protocols have been compromised and the sequence has been separated and locked in different boxes. Alpha team has retrieved the boxes and placed them in the safe room. You and your team are being escorted to the safe room and will need to solve the literal equations to determine the codes and order to unlock the boxes. Once you have unlocked the boxes remove the parts from the envelopes and arrange them to complete the inoculation sequence.

Explore

- Each student will receive the agree/disagree handout. Each group will be given a sheet with literal equations to solve (*see attached*).
- As groups solve their equations, they use the information about the locks (*located at the bottom of the sheet*) to determine what parts of the solutions need to break the code and unlock the room.
- The correct order of the information must also be determined.
- Once they open the box, they remove one of the envelopes. They must collect all four envelopes to complete the inoculation sequence.

Explain

- Start and PROJECT/ display the timer (30 minutes). You can find timers online to use as embedded video or PPT slides.
- While the group works to solve the literal equations (**Hint- divide and conquer if they want to be successful*), individuals should pay attention to dialogue and discussion about how the equations are solved, and record any useful information on their Agree/Disagree statement handouts.

Elaborate

- Allow students time to complete the Agree/Disagree statement sheets.
- Have groups use the Agree/Disagree statements to discuss the process and methods used to solve the literal equations. If it is the first-time students have used agree/disagree statements model it using the example provided on the sheet (see attached) or another example.
- Follow the implementation instructions for the IQMS strategy Agree & Disagree Statements (see the link above). *Modification – the dialogue happens in small group. Be sure to move around from group to group and assist when necessary, but remember productive struggle is a good thing.*

Evaluate

Students complete an exit ticket (*see link to disciplinary literacy strategies above*) and submit it upon leaving the classroom.

> Exit Ticket: “Write one thing you learned today”. OR, “Write one question you still have about solving literal equations.” *Provide students with both prompts and let them choose one.*

Assessment Notes:

A formative assessment is the successful opening of the lockboxes, assembly of the inoculation sequence, and productive dialogue around the Agree/Disagree statements.

Teacher Biographical Information

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Algebra **NAME**_____
Solving Literal Equations

Solve each equation for the indicated variable. Please use a separate sheet of paper to show your group's work.

1. Solve $6 = mx - b$ for x _____
2. Solve $2(a + 3c) = 4a$ for a _____
3. Solve $3x - 2a = 7a$ for x _____
4. Solve $-3x + 3y = 12$ for y _____
5. Solve $6f + 3q = 16f - 2q$ for q _____
6. Solve $\frac{d}{r} = t$ for d _____
7. Solve $\frac{x - 8a}{6} = 3a - 2x$ for x _____
8. Solve $\frac{2x + 3b}{9} = \frac{x - b}{2}$ for b _____
9. Solve $ax + d = a(x + y)$ for y _____
10. Solve $A = P + Prt$ for t _____

Lock 1 = the coefficients and/or constants in the solutions for 1 – 2. Try a different order if your first attempt fails.

Lock 2 = the coefficients and/or constants in the solutions for 3 – 5. Try a different order if your first attempt fails.

Lock 3 = the coefficients and/or constants in solutions for 6 - 8. Try a different order if your first attempt fails.

Lock 4 = the positive coefficients and/or constants in solutions for 9 - 10. Try a different order if your first attempt fails.

KEY:

1. x = (6 + b)/m Code Digit(s) = 6, 1, and 1
2. a = 3c Code Digit(s) = 3

LOCK 1 combination is 3116

3. x = 3a Code Digit(s) = 3
4. y = 4 + x Code Digit(s) = 4 and 1
5. q = 2f Code Digit(s) = 2

LOCK 2 combination is 4321

6. d = rt Code Digit(s) = 1
7. x = 2a Code Digit(s) = 2
8. b = x/3 Code Digit(s) = 1 and 3

Lock 3 combination is 1312

9. y = d/a Code Digit(s) = 1 and 1
10. t = (A – P)/Pr Code Digit(s) = 1 and 1 (NOTE: the negative 1 does not factor in since the clue says positive coefficients or constants)

Lock 4 combination is 1111

NOTE: you can rearrange the combinations numbers to suit your needs.

Inoculation Sequences

Each Zombie	Gene Is	Destroyed By
My Cleverness	Each Zombie	Gene Is
Destroyed By	My Cleverness	Each Zombie
Gene Is	Destroyed By	My Cleverness
Each Zombie	Gene Is	Destroyed By
My Cleverness	Each Zombie	Gene Is
Destroyed By	My Cleverness	Each Zombie
Gene Is	Destroyed By	My Cleverness

Agree & Disagree Statements **Name:** _____ **Date:** _____

Statement	How Can You Find Out?	Explanation
Example: The goal of eating 12 hotdogs is to get fat. ____agree _X_ disagree _____ it depends on ____not sure My thoughts: *I think it is to win a contest and get an award.*	*I need more information about where and when- to determine the why of eating 12 hotdogs.*	*The statement itself is not enough – My initial thinking was that it was a timed contest to see how many hotdogs one might eat in that given time period. It might be that the person hasn't eaten in days. Or, it could be that the person is already fat and that is how many hotdogs it takes to satisfy them.*
1. The goal of solving literal equations is to get a numerical answer. ____agree _____ disagree _____ it depends on _____ not sure My thoughts:		
2. x = (6 + b)/m is the solution to first literal equation. ____ agree _____ disagree _____ it depends on ____ not sure My thoughts:		

3. A strategy for solving 2(a + 3c) = 4a…. for *a,* is to first apply the distributive property to multiply. ____ agree _____ disagree _____ it depends on ____ not sure My thoughts:		
4. Solve A = b…. for b. Isolate b by factoring. ____ agree _____ disagree _____ it depends on ____ not sure My thoughts:		
5. To solve *Q* = 3*a* + 5*ac*…. for a, factor, then isolate. ____ agree _____ disagree _____ it depends on ____ not sure My thoughts:		

Key to Agree/Disagree:

1. It is an incorrect answer because, more often the equation will have multiple variables, making it impossible to get a numerical answer.
2. This is a true statement – it is in its simplest form.
3. This statement is also true - to isolate, you follow the order of operations: multiply first then subtract.
4. This is not true – there is nothing to factor. Everything is already simplified. All you must do is divide both sides by *h*.
5. This statement is true – to have like terms you must factor out *a* – this will isolate *a*

