**Prerequisite Skills:**

* Understand that a variable represents an unknown number/quantity.
* Understand integer arithmetic.

**Learning Goals:**

* Evaluate equations that are more than one step.
* Recognize that solving an equation is like maintaining a balanced scale.
* Utilize inverse operations to work backwards in order to identify an unknown value.

**Common Core Standards:**

7.EE.B. Expressions & Equations: Solve real-life and mathematical problems using numerical and algebraic expressions and equations.

**Mathematical Practices:**

MP1. Make sense of problems and persevere in solving them.

MP2. Reason abstractly and quantitatively.

MP5. Use appropriate tools strategically.

MP6. Attend to precision.

**Materials:**

* Phet *Equality Explorer* simulation:
* <https://phet.colorado.edu/sims/html/equality-explorer/latest/equality-explorer_en.html?screens=2,3,4> (link to Basics, Numbers, Variables, Operations screens)
* <https://phet.colorado.edu/sims/html/equality-explorer/latest/equality-explorer_en.html?screens=5> (link to Solve It! screen)
* Computers/Chromebooks/iPads/Tablets for each student or pair of students
* Solving Equations Activity Sheet (1 per student)

**Estimated Time:**

Approximately 80 minutes or two 40 minute classes

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| Balancing Act |
| **Warm Up** | **5 minutes** |
| Use this problem to explore an informal situation implementing pouches and coins to get students starting to think algebraically:Ask students to consider this picture. Then ask them to determine how many coins should be in each pouch and to explain their reasoning.  |

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| **Simulation Introduction** | **5-10 minutes** |
| *Teacher will...* | *Students will...* |
| * Wait to distribute activity sheet until after students have had their 5-10 minutes of exploration
* Encourage students to take a few minutes to explore the Equality Explorer simulation
* Circulate the room and ask students about what they are working on or any interesting discoveries they made
 | * Explore the simulation however they choose
* Respond to teacher’s informal questioning
* Jot down three discoveries on the activity sheet
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| **Guided Exploration** | **30-40 minutes** |
| *Teacher will...* | *Students will...* |
| * Prior to allowing students to work through the activity sheet facilitate a discussion around interesting discoveries students made about the functionality of the sim. Make sure key components of the sim are discussed such as: snapshot tool, how to change the value of *x*, lock button, how to use the operators within the operations screen, creating zero pairs
* Encourage students to begin working on #2-8 in pairs or individually. Try to give students at least 5 minutes where the teacher is silent before probing/aiding.
* Circulate the room to be available for questions and ask probing/pushing questions.
 | * Complete #2-8 on the activity sheet.
* Respond to teacher questions.
* Ask questions or ask for help as needed.
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| **Discussion and Summary** | **10-15 minutes** |
| *Teacher will...* | *Students will...* |
| * Ask for student volunteers to share their solutions, processes, and reasoning to solving the equations from #7.
* Model how to setup and record work.
 | * Answer questions and question answers: students should be able to determine if they agree/disagree with others’ claims and justify their own responses.
* Some students may go to the board to share findings, then summarize and record main ideas.
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| **Informal Assessment** | **5-10 minutes** |
|  | *Students will...* |
| **Exit Ticket:**On an index card, determine the value for *x* that will make each equation true. Additionally, include the mathematical steps taken to reach each solution:

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| --- |
| **Front of Index Card** |
| $$5x-2=18$$ | $$-6x+3=33$$ |
| **Back of Index Card** |
| $$3x+2=17$$ | $$-2x-7=-21$$ |

 | * Complete exit ticket
 |
| ***Going Forward...*** |
| * Teachers can refer to the Equality Explorer sim to introduce solving equations with fractional coefficients, then asking how you get rid of a fractional coefficient?
* While not possible in the Equality Explorer sim, teachers should discuss whether or not expressions like $1-x$ are the same as $-x+1$
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