# Balancing Act

**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.
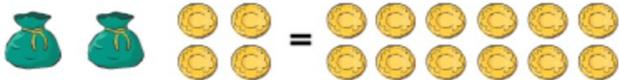MP5. Use appropriate tools strategically.
MP6. Attend to precision.

**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

| 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. | |

| Simulation Introduction | 5-10 minutes |
|---|---|
| *Teacher will...* | *Students will...* |
| <ul><li>Wait to distribute activity sheet until after students have had their 5-10 minutes of exploration</li><li>Encourage students to take a few minutes to explore the Equality Explorer simulation</li><li>Circulate the room and ask students about what they are working on or any interesting discoveries they made</li></ul> | <ul><li>Explore the simulation however they choose</li><li>Respond to teacher's informal questioning</li><li>Jot down three discoveries on the activity sheet</li></ul> |
| **Guided Exploration** | **30-40 minutes** |
| *Teacher will...* | *Students will...* |
| <ul><li>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</li><li>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.</li><li>Circulate the room to be available for questions and ask probing/pushing questions.</li></ul> | <ul><li>Complete #2-8 on the activity sheet.</li><li>Respond to teacher questions.</li><li>Ask questions or ask for help as needed.</li></ul> |
| **Discussion and Summary** | **10-15 minutes** |
| *Teacher will...* | *Students will...* |
| <ul><li>Ask for student volunteers to share their solutions, processes, and reasoning to solving the equations from #7.</li><li>Model how to setup and record work.</li></ul> | <ul><li>Answer questions and question answers: students should be able to determine if they agree/disagree with others' claims and justify their own responses.</li><li>Some students may go to the board to share findings, then summarize and record main ideas.</li></ul> |
| **Informal Assessment** | **5-10 minutes** |
| | *Students will...* |
| **Exit Ticket:**<br><br>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: | <ul><li>Complete exit ticket</li></ul> |

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

| **Back of Index Card** | |
|---|---|
| $3x + 2 = 17$ | $-2x - 7 = -21$ |

## *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 $-x + 1$