

Introduction screen

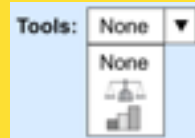
Three unbalanced equations with small coefficients help familiarize students with what needs to be balanced and what can be varied to generate a balanced chemical equation.

VARY coefficients in the equation (from 0-3) until

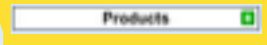


CHOOSE from 3 unbalanced equations

CHOOSE scales or bar charts to show if equations balance



HIDE molecules



Game screen

The **Game** challenges students to balance 5 randomized equations per level, with coefficients from 1-7. Students can submit up to 2 attempts per question for feedback, but there are no scales or bar charts.

Level 1: Equations with 3 coefficients. (i.e. combination or decomposition)

Control game sounds or enable a timer before starting a level.

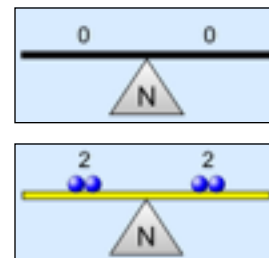
Levels 2 and 3: Equations with 4 coefficients. Those at Level 3 are more challenging and have larger coefficients.

Stars keep track of the highest previous score.

Model Simplifications

Scale analogy

Note that the balance scales appear level when all coefficients are zero, even though the equation is not balanced. This limitation of the analogy doesn't affect student usage or interpretation of the scales. Also, when the equation is balanced, all scales are level *and* turn yellow to highlight the difference.



Insights into Student Use

Scales and Bar charts

Students first learning to balance equations may at first rely solely on the balance scales or bar charts for balancing. This gives them a great working definition of a balanced equation, but it is typically the *Game* which helps them to move beyond these tools to more general strategies for balancing, and focuses their attention on the symbols and molecules.

Game Feedback

- We expect least coefficients, even though this isn't stated up front. When the equation is balanced but not with the lowest coefficients (e.g., $2A + 2B \rightarrow 2AB$), we count the answer as incorrect, but ask them to try again with the prompt shown at the right:
- When students submit an unbalanced equation on their first attempt, they have the option to "Show Why." This feature uses a different representation for each level: Level 1 uses balance scales, Level 3 uses bar charts, and Level 2 uses a mix of both representations.



Suggestions for use

- **Hide the molecules** and ask students to balance an equation and draw the molecules represented. *This can reinforce differences between subscripts and coefficients, and get students comfortable switching between both symbols and molecular-scale pictures.*
- **Compare strategies:** Ask student groups to compare how they arrived at a balanced equation in the Game, and brainstorm all of the different strategies that groups used for balancing, especially for the more challenging equations in Level 3.
- **Discuss coefficients and subscripts:** Ask students why they think the simulation uses only whole number coefficients, and why changing coefficients is allowed while changing subscripts isn't.

See all published activities for Balancing Chemical Equations [here](#).

For more tips on using PhET sims with your students, see [Tips for Using PhET](#).