Teacher Notebook:

AlgebRock

National Center for Research
on Evaluation, Standards, & Student Testing

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Document No. 2014-02-04-SE4.2

The research reported here was supported by the Institute of Education Sciences, U.S. Department of Education, through Grant R305C080015 to the National Center for Research on Evaluation, Standards, and Student Testing (CRESST). The opinions expressed are those of the authors and do not represent views of the Institute or the U.S. Department of Education.

Overview of the Notebook

The goal of this notebook is to provide you with the necessary information to use this game with your students. In this notebook, you will find:

1) **Overview of the Game**: This section provides a brief introduction about the game including how to play and the math topics covered by the game.

2) **The Screen**: This section of the notebook shows an example of a typical screen and points out elements of the game that will help your students play such as help menus, game resources, and screen features that may be important to know about as your students play the game.

3) **Suggested Topics for Classroom Instruction**: This list provides an overview of the math topics related to this game. Depending on your purpose for using the game (e.g., review, introduction, etc.), the math topics can be used as preview topics to the game or something to go over with students after they have played the game. You might teach the lesson to the whole class, a small group, or an individual student who is having difficulty.

4) **Common Errors Students Might Make in the Game**: This is a list of the most common errors students might make in this game. Review this list and watch carefully for these errors in the game. In many cases, the mistakes students make in the game provide hints to you about their deeper understanding and misconceptions about solving equations.

5) **Sample Lesson Plan**: This section provides a sample lesson that could be used as a guide for classroom instruction.

6) **FAQ**: This section provides you with frequently asked questions about this game.

7) **Standards Assessed**: This list provides an overview of the Common Core State Standards for Mathematics addressed in this game. Both middle school and elementary school standards may be listed.

Overview of the Game

Topic(s) covered in the game: solving equations.

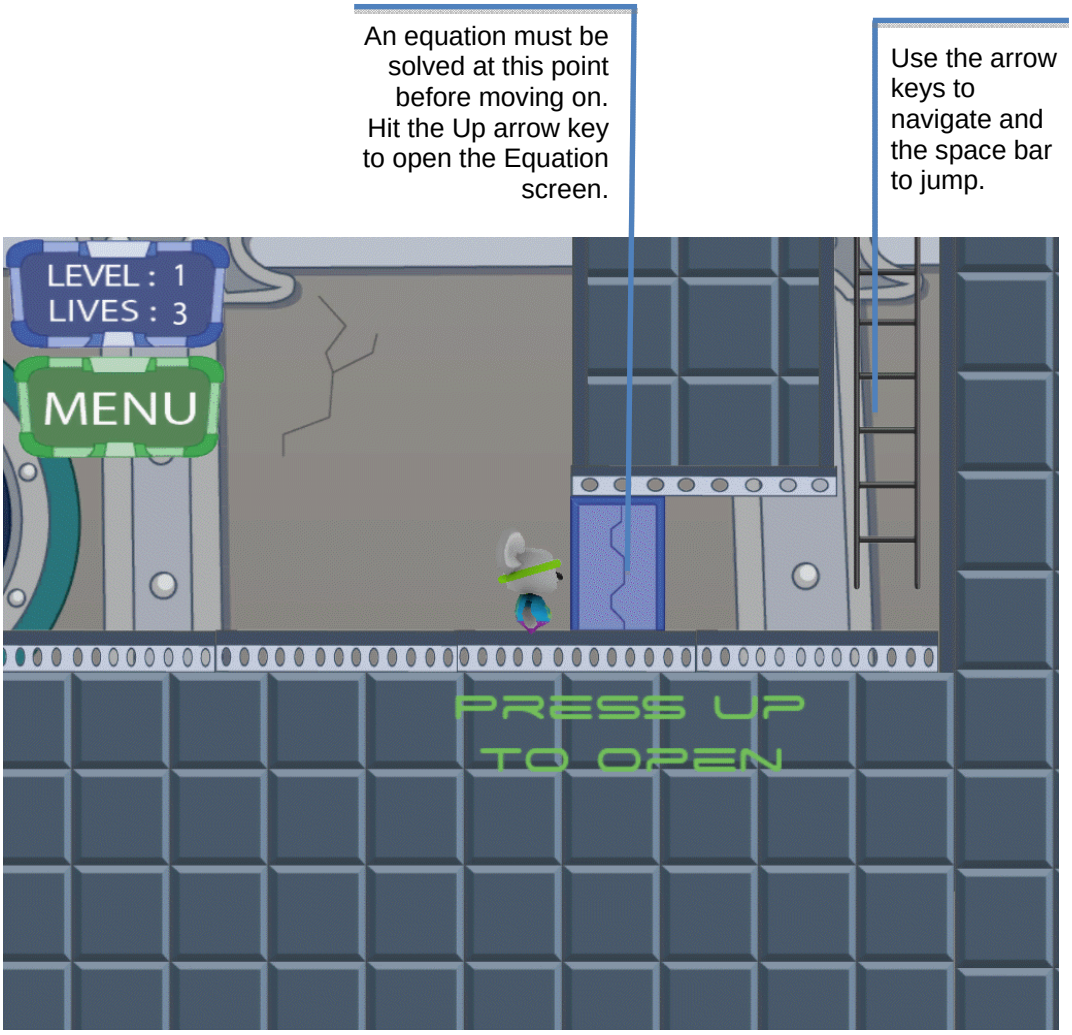
AlgebRock is a platform game in the domain of solving equations. As players encounter barriers or treasure chests, they are required to correctly solve an equation before proceeding.

The goal of this game is to collect your band's musical instruments that have been hidden by evil robots. Players run and jump through levels using the keyboard. As players complete the levels, they amass the instruments needed for the band. Players solve algebraic equations to pass blockades and secure treasures.

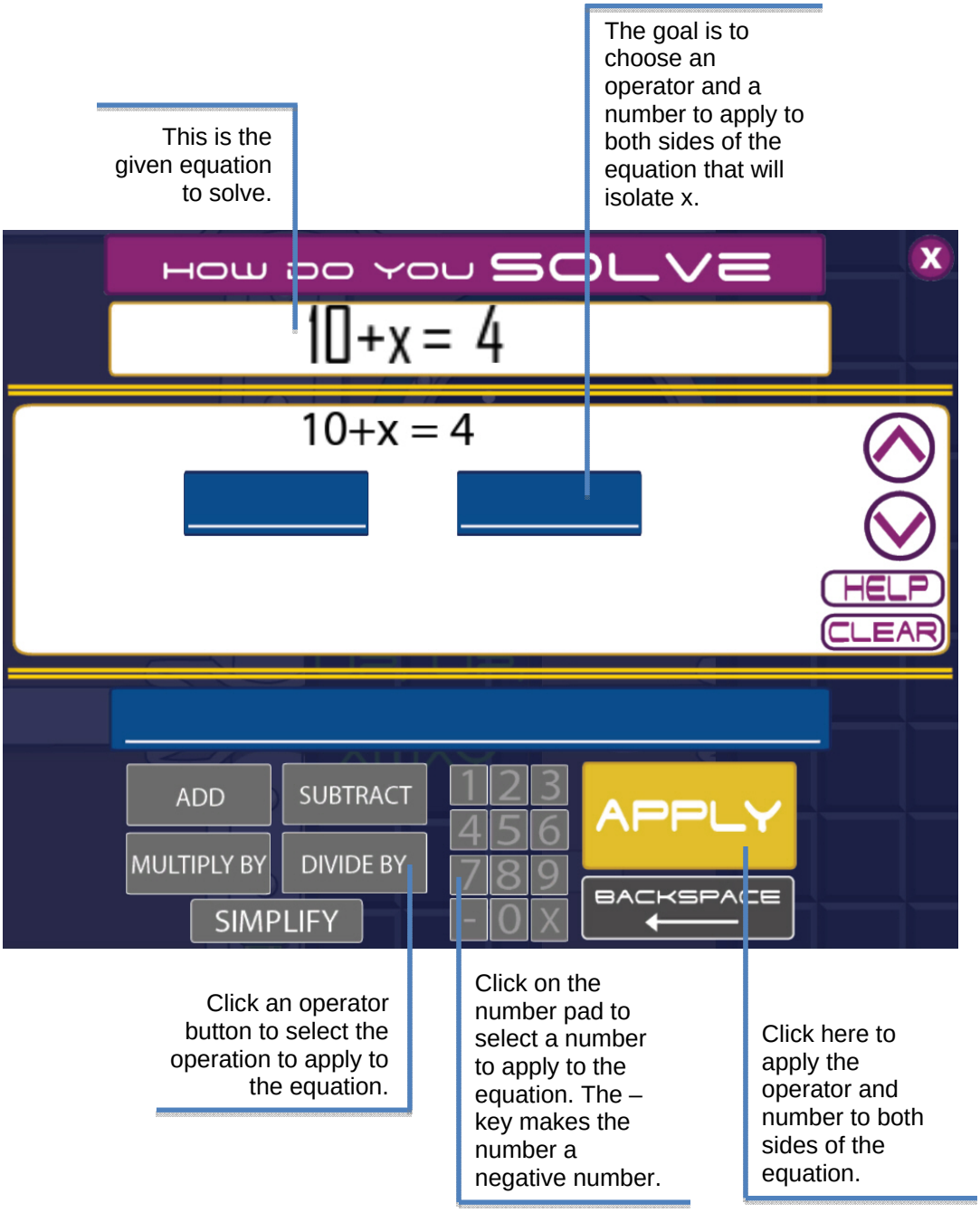
Players use the arrow keys to run and the space bar to jump. To solve equations, players must supply the next steps of the equation to correctly isolate *x.*

Level 1: 3 equations
Level 2: 5 equations
Level 3: 4 equations
Level 4: 4 equations
Level 5: 5 equations
Level 6: 5 equations
Level 7: 4 equations
Level 8: 4 equations

The Screen


An equation must be solved at this point before moving on. Hit the Up arrow key to open the Equation screen.
Use the arrow keys to navigate and the space bar to jump.
LEVEL : 1
LIVES : 3
MENU
PRESS UP
TO OPEN

The Equation Screen



Suggested Topics for Classroom Instruction

Below are the topics associated with this game. If students are having a particular type of trouble with a game, you might want to address that topic with the whole class or individual students.

Equality

The equation displays for students to solve. The equality sign signifies that the problem is an equation, and not just an expression. After choosing an operator and a number, students "apply" these to the equation. The operation is automatically applied to both sides of the equal sign. It is important that students understand why the operation is applied to both sides of the equal sign. For example, with the equation $2x + 2 = 14$, when the "subtract" operator and "2" are selected and the "apply" button is clicked, students will automatically see that 2 is being subtracted on both sides of the equal sign. This built-in feature reinforces the concept that performing the same operation on both sides of the equal sign keeps the equation balanced. To complete the problem and solve for *x*, students can choose the "divide" operator and "2" and click "apply." The automated feature will show that 2 is being divided on both sides of the equal sign.

Operators

Students choose the operations (adding, subtracting, multiplying, and dividing) to perform on the equation. Students will automatically see the effects of the order in which these operations are chosen. For example, dividing $3x + 3 = 9$ by 3 will display each component as being divided by 3 rather than just the $3x$.

Inverse Operations

The game uses inverse operations of addition, subtraction, multiplication, and division facts to emphasize the inverse relationship of the operations. For instance, $24 \div 8 = 3$ because $3 \times 8 = 24$; $20 - 5 = 15$ because $15 + 5 = 20$. The two pairs of statements are inextricably related.

Opposite Effects of Inverse Operations

Adding by 3 can be "undone" by subtracting by 3. Multiplying by 8 can be "undone" by dividing by 8. For example, the equation $5x + 10 = 15$ can be solved several ways. One of the ways is to choose the subtract operator and 10. Since the operation in the given equation is to add 10, to undo the addition of 10 (and work your way toward solving for *x*), the inverse operation would be to subtract 10. The game's built-in feature that reinforces the concept of equality will display 10 being subtracted on both sides of the equal sign.

Another way to solve the equation is to choose the divide operator and 5. Since the operation in the given equation is to multiply 5 and the unknown *x*, to undo the operation of multiplying 5, the inverse would be to divide by 5 on both sides of the equal sign.

Getting x by Itself

In order to get *x* by itself in an equation such as $x + 3 = 6$, a student must subtract 3 from both sides. In doing so, the student "makes a zero" with the number 3 on the left side of the equation, leaving x by itself. In multiplication or division equations, the number next to the x must be made into a one. For example, in an equation just as $2x + 2 = 6$, after students subtract 2 from both sides, students must divide each side by 2. Since any number divided by itself makes a one, students are left with $1x$ (or x) on the left side.

Components of an Equation

The operation that can be done to a number in the equation can also be done to the variable. For example, in the problem $2 – x = 3$, the variable *x* may be added to both sides. The problem then becomes $2 = 3 + x$. The variable may appear on either the right side or the left side of the equation.

Common Errors
Students Might Make in the Game

Not understanding the goal of the game

In the game, students will navigate through each level to find locations that lead them to the “How do you solve” screens. In order to move on to the next level, students will have to find the quantity of *x*, the unknown, by selecting the correct operation and numbers to apply to the equation.

Incorrect operator used

For simple equations, students will often not use an operator at all. For example, students will just choose the number 2 and click Apply to solve for *x* in $x + 3 = 5$. In order to pass this level successfully, students must select the subtraction operator and the number 3 to undo the 3 on the left side of the equal sign. Once the Apply button is clicked, students will see that subtract 3 is displayed on the left side and the right side of the equal sign. This feature reinforces the concept that the same operation (with the same number) needs to be performed on both sides of the equal sign to keep the equation balanced. In these cases, remind students to select an operation and a number.

Incorrect number added/subtracted/multiplied/divided

Students might not understand that in order to solve an equation, the variable must be isolated on one side or the other. In order to isolate the variable, students must either “make a zero” or make a one. For example, if students are given the equation $x + 3 = 5$, rather than subtract 3, they might incorrectly add 7.

Final answer

Students think that the final answer is just a number. Direct students to write a complete equation for the final answer (i.e., $x = 3$).

Sample Lesson Plan

When using *AlgebRock* with your students, the focus of your lesson could vary depending on if you wanted to use the game for review or initial instruction. Below is a sample lesson plan intended for students who have previously learned about solving equations and are now using *AlgebRock* as practice of the concepts.

The lessons below can be done on consecutive days or spaced further apart as necessary. Lessons can also be combined depending on how fast students play each level and/or how proficient students are with each topic.

Lesson 1: Quick review of one or more of the following topics: equality, operators, inverse operations, opposite effects of inverse operations, getting x by itself, components of an equation (list from Math Topics section); introduce game to students at the front of class (play first few levels together).

Lesson 2: Students play levels 1-4. Debrief trouble spots and successes with students at the end of the lesson. Have students continue to play levels 5-8. After students have completed all levels, review the topics of the game and make explicit the connection between the mathematics from the game and the mathematics learned in the classroom.

AlgebRock FAQs

Can students skip levels?

No. Students are only allowed to play the level after the last completed level. The game will automatically advance students to the next level.

Can I help students while they play the game?

Yes.

We have found that students seem to learn best when they make sense of the math in the game on their own in order to succeed at each level.

That said, you are probably in the best position to determine how to help. If students are getting frustrated or unmotivated to play, it may be best to help them through one or more levels until they better understand the goal, mechanics, and math of the game.

Standards Addressed in the Game

Common Core State Standards

Mathematics (2010)
Grade 6
Expressions and Equations

6.EE.B: Reason about and solve one-variable equations and inequalities.

6.EE.B.7: Solve real-world and mathematical problems by writing and solving equations of the form $x + p = q$ and $px = q$ for cases in which p, q and x are all nonnegative rational numbers.