Teacher Notebook:
Monster Line

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

UCLA | Graduate School of Education & Information Studies

National Center for Research on Evaluation, Standards, and Student Testing (CRESST)
Center for the Study of Evaluation (CSE)
Graduate School of Education & Information Studies
University of California, Los Angeles
300 Charles E. Young Drive North
GSE&IS Bldg., Box 951522
Los Angeles, CA 90095-1522
(310) 206-1532

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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 page 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 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 arithmetic operators.

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

Topics covered in the game: an unknown, positive and negative numbers, addition, subtraction, multiplication, division, expressions and equations.

In *Monster Line*, various monsters are attacking a city. Their goal is to reach and destroy the tall building which has its location on the number line denoted by a number at the bottom of the screen. In a round, the player fires one or more pie launchers at the monsters. Each pie launcher has an integer (its location on the number line) and an operation associated with it. The player can supply either a positive or negative integer for each pie launcher, with the intent that the resulting sum, difference, product, or quotient will equal the location of one of the monsters on the number line.

Every round, each monster moves a certain number of spaces along the number line. Each monster moves a different number of spaces, so some of them will advance more quickly toward the target building. Monsters can also destroy pie launchers if they are allowed to advance along the number line to the location of the launcher.

Each monster may require more than one pie to hit it before being defeated, so depending on the number of pie launchers and monsters in the level, the student may need to go through multiple rounds. Pie launchers with either division or multiplication operators may not be able to be used in every round, but pies launched by these operators will destroy a monster in one hit, so they are more powerful than the subtraction and addition pie launchers, which take three pies before a monster is destroyed.

The Screen

This is the building the monsters are trying to reach. The value below it is its location on the number line.

The value above the monster shows its current location on the number line. The number of red hearts shows how many times the monster needs to be hit before being defeated.

Click the up-and-down arrows to change the value in the selected equation or click in the box and type in a value.

Click the Fire button to fire the pies at the monsters.

The number of launchers on each level vary, as do the operations associated with each launcher. The number under each launcher is its location on the number line. Click on a launcher to open the controls in the upper right and select a value for the unknown; the result of the computation is where the pie will land. Aim the pie launcher at the location of the monsters to defeat them.

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.

An Unknown

In the game, the unknown is represented by the blank space beneath the integer in the gray box. An unknown represents one or more quantities that allow the expression to be evaluated, but the value of which is, at present, unknown. Since the unknown is a blank in this game, you can suggest to your students to use a symbol or a variable to represent the unknown quantity.

Positive and Negative Numbers

The game reinforces that positive and negative numbers are opposites by positioning the launchers, building, and monsters accordingly on the number line. In the game, most levels do not display the location of zero on the number line. To make sure students are not confused, if both positive and negative numbers are displayed, point out that the positive numbers are always positioned to the right of negative numbers on the number line. It is also important for students to see that numbers get larger as you move farther along to the right on the number line (for example, -9 is located to the right of -19 and so -9 is larger than -19). Students should not confuse the subtraction sign in each gray box with a negative sign; however, students may begin to see that subtraction and negation are related. For example, subtraction of a negative number is mathematically equivalent to adding the opposite of that number or that subtraction of a positive number is mathematically equivalent to adding the opposite of that number.

Addition and Subtraction

In the game, just like in math, addition and subtraction are operators. They should not be confused with positive and negative numbers. While subtraction will produce the same value as adding the opposite, subtraction is not the same as negation.

Division

Division can be interpreted as partitive (how many groups should be made) or measurement (how many items should be put into each group). It may be easier for students to conceptualize different meanings in different situations. For example, in the division $-12 \div -3$, students may find it easier to think about forming groups of -3 (measurement division) rather than forming -3 groups (partitive).

Multiplication

Multiplication can be thought of as the number of groups of a quantity of things. For example, (2)(5) can be thought of as two groups of five. Because multiplication is commutative, this expression can also be seen as five groups of two. It can, at times, be easier for students to see one interpretation more easily than the other.

Expressions and Equations

Simple expressions can be represented using diagrams, number lines, symbols, manipulatives, words, or in other concrete ways. If students are having trouble seeing that the integer, operator, and blank space inside each gray box represent an expression, suggest that they write it another way that makes sense to them (perhaps horizontally). You may also want to point out that the integer for each monster is an expression in itself. For example, the expressions for the screen shot below are -21 – blank; 3 – blank; and 48. Have students rewrite the expressions using variables for the blanks.

This game also gives students the opportunity to learn about equations. For the screen shot below, in order to launch the pie at the monster currently located at 48 on the number line, the student must identify an integer (which is at present unknown) to be subtracted from -21 and/or 3. When the correct unknown quantity has been identified, the result should be 48. To help students see this more clearly, ask them to write an equation (i.e., $-21 - x = 48$ or $3 - x = 48$). So that this experience is cyclical and complete, ask students to check to make sure that the expressions on each side of the equation are equal (i.e., 3 – -45 = 48; 48 = 48).

The Importance of WHY!

Students often have trouble connecting the symbolism of equations (school) to what the equations mean or represent (their use in the world). While the game is one means to help them do so, it is vital that they begin to understand why equations can be transformed from one truthful statement of equality into an equally truthful statement of equality and why numbers and mathematical operators behave like they do, especially for positive and negative numbers. A “why” question is an appropriate question to ask in instruction and when helping them in game play.

Common Errors
Students Might Make in the Game

Not understanding the goal of the game

Some students may not understand the goal of the game. If this occurs, explain to students that their goal as a player is to destroy the monsters by launching pies at the exact location of the monsters on the number line. To make sure the pies launch directly at the monsters, students will have to supply either a positive or negative integer for each pie launcher (to be added, subtracted, multiplied, or divided) in the gray box so that the result of the expression will equal the location of one of the monsters.

Confusing the subtraction operator with a negative sign

Students may confuse the subtraction operator for a negative sign. If this occurs, explain to students that the subtraction sign in each gray box is an operator and not a negative sign. It is absolutely possible to have an expression that looks like -21 – -10. Students will see that the automated calculation evaluates this as -11. With problems like these, encourage students to understand that the expression says to take -10 away from -21 (which leaves only -11). Students may also begin to understand that one can rewrite the expression so that it looks like -21 + 10. Students <u>may</u> also begin to see that subtraction of a negative number is mathematically equivalent to adding the number's opposite or that subtraction of a positive number is mathematically equivalent to adding that number's opposite.

Pies landing at the launching location

Some students may find that their pies land at the same location as they were launched. Ask students why that happened. Students may begin to see that adding zero to or subtracting zero from any number produces the same number or that multiplying / dividing any number by one produces the same number.

Forgetting to click in the gray box

Students must click in the gray box to activate the integer selection box for a pie launcher. Then students will be able to select a positive or a negative integer for the unknown.

Check the monsters' heart count

Some students may think that they are not advancing in the game level because the monster is still walking toward the tower. Remind students that it will take a few hits to destroy the monsters. To find out if the monsters are close to being destroyed, have students click on the integer box above each monster. Each red heart in the box represents the number of hits it will take to destroy the monster.

Using all the launchers

Although it is advantageous to use as many launchers as possible in each level, not all launchers in each level may be usable. For example, if a launcher is at 13 and uses a “division” operator, getting to 10 is not possible because the launchers will not allow multiplication or division by rational numbers. While this is an artificial limitation of the game, you may want to tell students that they should see if they can use integer multiplication and division if they can, but to ignore these launchers when they cannot. If students don’t want to continually check the “not all launchers used” box, they can fill in the multiplication and division with a number that will get them close to a monster!

Sample Lesson Plan

When using *Monster Line* 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 arithmetic operators and are now using *Monster Line* 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 an unknown, positive and negative numbers, addition, subtraction, multiplication, division (list from Math Topics section); introduce game to students at the front of class (play first few levels together).

Lesson 2: Students play on individual computers. At the end of the class debrief student difficulties and successes.

Lesson 3: Review student difficulties and successes from the day before; have students continue to play levels. 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.

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Monster Line 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 7
The Number System

7.NS.A.1b: Understand $p + q$ as the number located a distance $|q|$ from p, in the positive or negative direction depending on whether q is positive or negative. Show that a number and its opposite have a sum of 0 (are additive inverses). Interpret sums of rational numbers by describing real-world contexts.

7.NS.A.2a: Understand that multiplication is extended from fractions to rational numbers by requiring that operations continue to satisfy the properties of operations, particularly the distributive property, leading to products such as (–1)(–1) = 1 and the rules for multiplying signed numbers. Interpret products of rational numbers by describing real-world contexts.