

Integers: Draw or Discard! game



Many elementary school-age students have been exposed to negative integers (e.g., -1 , -2 , -3 , ...) through their everyday experiences, such as with temperatures. Additionally, games often incorporate negative integers as a loss of points or money (e.g., Jeopardy). Using games to promote the learning of integers (e.g., -2 , -1 , 0 , 1 , 2 , ...) creates a friendly environment for classroom discourse and negotiation around the meaning of operations with negative integers.

Problem scenario

Integers: Draw or Discard! is a card game played with two to four players. Each group receives a set of integer cards (-8 , -7 , -6 , -5 , -4 , -3 , -2 , -1 , 0 , 1 , 2 , 3 , 4 , 5 , 6 , 7 , 8) with triplicate cards for each integer in the deck. With the deck of cards placed facedown, each player begins with a single card. On each player's turn, the player turns over the top card in the center deck so that the other players can see it. Then the player must decide to either draw or discard a card. If the player draws the card that is faceup in the center deck, he or she will add it to his or her hand. Otherwise, the player must discard one of the cards that he or she

already holds and place it faceup on the top of the discard pile.

The next player will either begin her turn with the card on top of the discard pile or turn over a new one. The number of cards that can be in a player's hand is unlimited. A player can have as many or as few cards in his or her hand as wanted. The sum of the integers in a player's hand is his or her points. The goal of the game is to be the person with the most points at the end (e.g., after 5 minutes of play, after 10 rounds, etc.).

The problem this month asks students to consider three players' hands and decide whether they should draw a card or discard a card from their hands to maximize their scores. The activity sheets (pp. 479–80) include questions related to this scenario. Recording sheets and a game card template are appended to the online version of this article.

Classroom setup

Prepare for game play by duplicating the number cards on card stock, using the template included with the online version of this article. Alternatively, you could create sets of integer cards by simply writing the integers on one

side of blank index cards. Three sets of integer cards are required for every two or four students, depending on how you decide to group your class.

Students playing this game should be familiar with adding and subtracting single-digit whole numbers, but they need not know about negative numbers. Begin by introducing the set of cards that players will use and explaining the rules of the game. As you do, demonstrate one round of play (the first player's turn and the second player's turn) using only the cards with positive integers, and model how to fill out the recording sheet (see the **online appendix**). Demonstrate one more turn for the first player by purposefully turning over a -2 card. Students will see the negative integer cards for the first time at this point, and they may ask such questions as, "What does the minus sign mean on the card?" or "How do we play with the negative cards?" Have students share their initial ideas with the group about how they think the negative integer cards should be handled (e.g., some may interpret them as numbers to subtract) and how negative cards would impact the total points in a hand. List students' ideas and strategies on the board, without telling students which ones are correct or more efficient.

Have the class play the Integers: Draw or Discard! game in groups of 2–4 students for five rounds. Have them record their points on the recording sheet. Encourage students to invent their own ways of adding and subtracting the positive and the negative integers on their cards as they play the game. If groups become stuck, draw out a number path (see **fig. 1**) and have students show you how to use it to find the total of a hand with a 2 card and a 3 card. Then ask them how they would show what happens if they draw or add a -1 card to the hand. Students can try to fill in numbers before zero if they end up with negative points.

The purpose of initially playing the game for a short amount of time is to give the students an opportunity to become familiar with the rules of the game and experience the decision making of discarding or drawing cards and totaling their points. Once students have played the game for 5 rounds, gather the class together and discuss strategies for deciding when to draw or discard and for calculating total points.

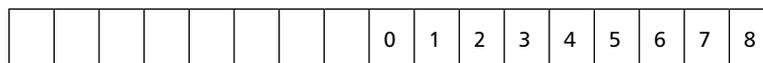
Where's the math?

The problems presented here involve positive and negative integers and situations that will challenge students' conceptions about addition and subtraction. In the first problem, students must confront the idea that they could end up with more points by discarding a card rather than drawing one. For the second problem, they will experience a situation where drawing a negative card can be better than discarding a positive card with a greater absolute value. Finally, in the third problem, they must consider a circumstance where discarding a negative number card with a greater absolute value will help more than discarding a zero card.

When students first encounter negative numbers, they may ignore negative signs or interpret them as subtraction signs (Bofferding 2010). In the context of this game, either interpretation can work. Students may group the numbers to add (positive numbers) versus subtract (negative numbers); however, they may have difficulty if the number to subtract (or the negative amount) is greater in absolute value than the positive numbers added together. Introducing a number path representation extended into the negatives can help students transition toward seeing that they can count down (past zero) just as they would when subtracting a smaller positive integer from a larger one. Students who know the additive inverse property—that a positive and a negative number with the same absolute value cancel, leaving zero ($-1 + 1 = 0$)—can use cancellation to determine the resulting value of their hand of cards. Suggesting that students try discarding different cards and comparing the totals could help them make connections between subtracting a negative number (getting rid of a number to subtract) and having larger totals.

FIGURE 1

If students end up with negative points, they could use a number path to fill in numerals before zero.



It might be tempting to tell students how to add the integers or what the best strategy is to play the game, but allow students to come up with their own creative and innovative strategies for adding and discarding. Support their creativity.

After the discussion, give each student the problem scenario activity sheet to complete. Students may work on the problems individually or with their game partners. When students are finished, have them share their answers to the problems using pictures, number paths, and/or equations (this part could carry over into a second day if students really engage in the discussion). If students are unfamiliar with the number path, consider introducing

it to the class to help students represent their strategies. If they disagree about whether the player should discard or draw, suggest that they find and compare the totals for both possibilities. Encourage students to share their thinking about the ways they interpret the “–” symbol on the cards (i.e., do the students interpret it as a subtraction sign or as a symbol designating a new kind of number?), and have the class discuss the various meanings. Providing opportunities for students to explore similarities in their reasoning may help those who are ignoring the negative signs to consider their meaning and help those who are subtracting to transition to considering negative numbers.

Extensions and variations

For younger students, start out by playing several rounds of the game with only positive numbers. Instead of playing for a set number of rounds, have them play until someone has a hand that adds to 15. This way, students will get used to the idea of discarding (or subtracting a card) when the total in their hand is too high.

This game may be played for an extended time, such as 25 rounds or 15 minutes. Providing cards of larger values can also increase the difficulty of the game. Have students play the game throughout the year to learn about the addition and subtraction of integers with increasing complexity.

Share your students' work

Try this game in your classroom. We are interested in how your students responded to the game, which problem-solving strategies they used, and how they explained or justified their reasoning. Send your thoughts and reflections—including information about how you posed the problem scenario, samples of students' work, and photographs showing your problem solvers in action—by **May 1, 2014**, to either of the Problem Solvers department editors (**Signe E. Kastberg**, Purdue University, 100 North University St., West Lafayette, IN 47907-2098; or **Erin Moss**, Millersville University, P.O. Box 1002, Millersville, PA 17551-0302) or e-mail either one: skastber@purdue.edu; erin.moss@millersville.edu. Selected submissions will be published in a subsequent issue of *Teaching Children*

Mathematics and acknowledged by name, grade level, and school name unless you indicate otherwise.

REFERENCE

Bofferding, Laura. 2010. “Addition and Subtraction with Negatives: Acknowledging the Multiple Meanings of the Minus Sign.” In *Proceedings of the 32nd Annual Meeting of the North American Chapter of the International Group for the Psychology of Mathematics Education*, edited by Patricia Brosnan, Diane B. Erchick, and Lucia Flevares, pp. 703–10. Columbus, OH.

Nicole Wessman-Enzinger, nmenzinger@gmail.com, is a Ph.D. candidate in mathematics education at Illinois State University. She is interested in how children think about negative integers and the contexts they use to make sense of them. **Laura Bofferding**, lbofferd@purdue.edu, is an assistant professor of mathematics education at Purdue University in West Lafayette, Indiana. She investigates young children's numerical reasoning, especially in relation to integers, and is interested in the identification and discussion of children's diverse solution strategies in lessons. Edited by **Signe E. Kastberg**, skastber@purdue.edu, a teacher of prospective elementary teachers at Purdue University in West Lafayette, Indiana; and **Erin Moss**, erin.moss@millersville.edu, an assistant professor in the mathematics department at Millersville University of Pennsylvania. Each month, this section of the Problem Solvers department features a new challenge for students. Readers are encouraged to submit problems to be considered for future columns. Receipt of problems will not be acknowledged; however, those selected for publication will be credited to the author. Find detailed submission guidelines for all departments at www.nctm.org/tcmdepartments.

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Download one of the free apps for your smartphone. Then scan this code to access the card template and a recording sheet at www.nctm.org/tcm059.



Name _____

Integers: Draw or Discard!

Henri, Omar, and Millie are playing the card game Integers: Draw or Discard! This is the same game that you and your partner just finished playing. Look at Henri's and Omar's hands and consider which move will result in more points. Be sure to show your work.

1. Henri has the following cards:
How many points does he have so far?

2

-4

6

2. Henri turns over a 3 card. He can either discard (subtract) one of the cards from his hand or draw (add) the 3 card. What do you think he should do? Why? Support your decision with examples.

3. Omar has the following cards:
How many points does he have so far?

3

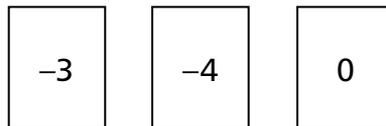
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4. He turns over a -1 card. Omar can either discard (subtract) one of the cards from his hand or draw (add) the -1 card. What do you think he should do? Why? Support your decision with examples.

Name _____

5. Millie has the following cards:
How many points does she have so far?



6. Millie turns over a -1 card. She could either discard (subtract) one of the cards from her hand or draw (add) the -1 card. What do you think she should do? Why? Support your decision with examples.
7. Henri, Omar, and Millie are playing this card game together. Who is winning this round? How did you decide who is winning?

From the April 2014 issue of **teaching children mathematics**

I ♥ spherical analogs of truncated icosahedrons.

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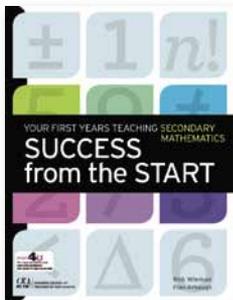
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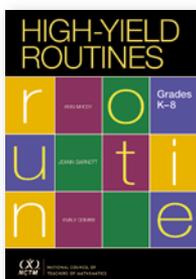


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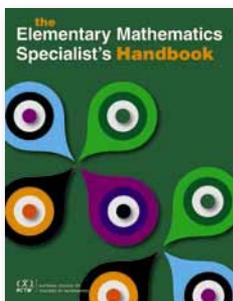
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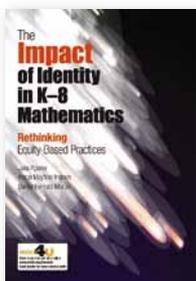


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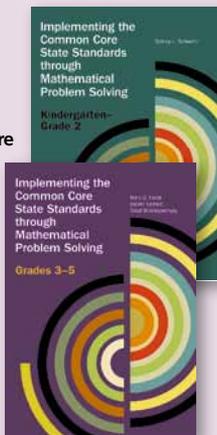
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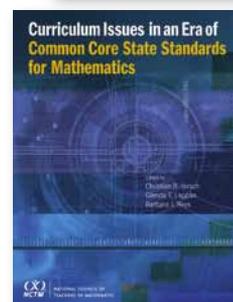
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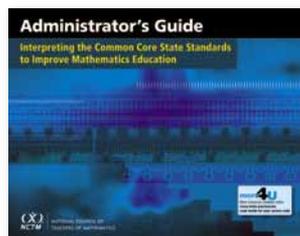


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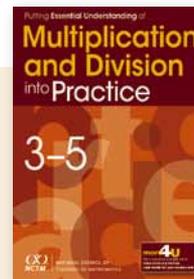
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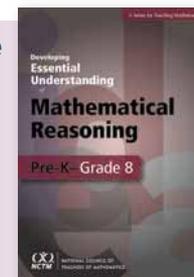
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