


Barbara J. Dougherty

Fay Zenigami

Linda Venenciano

Cynthia Twibell

PUBLISHED by the
Curriculum Research \& Development Group, University of Hawai'i
Barbara J. Dougherty, Director
Lori Ward, Managing Editor
Spencer Oshita, Editorial Assistant
Dean Lodes, $x$ to Why Project Manager
Chanel Meadows, Production Coordinator
Instructional Design by Dean Lodes
Illustrations by Byron Inouye
Layout and design by Darrell Asato and Byron Inouye

## © 2019 University of Hawai'i

All rights reserved. No part of this publication, with the exception of the game boards, may be reproduced or transmitted in any form or by any means, electronic or mechanical, including photocopying, recording, or otherwise, without written permission from the publisher. Game boards may be reproduced for educational purposes in accordance with copyright law.

ISBN 978-1-58351-175-6 (softcover)
ISBN 978-1-58351-176-3 (pdf)

## REVIEWERS

Eric Kobayashi
Kara Suzuka
Seanyelle Yagi
The $x$ to Why project team wishes to acknowledge the support from the University Laboratory School, Honolulu, HI and the principal, Keoni Jeremiah. The students in middle and high school grades were instrumental in providing usability and feasibility feedback for these games.

DISTRIBUTED by the
Curriculum Research \& Development Group
College of Education
University of Hawai'i at Mānoa
1776 University Ave.
Honolulu, HI 96822
crdg@hawaii.edu
www.hawaii.edu/crdg

## CONTENTS

$x$ TO WHy ALGEBRA FOR UNDERSTANDING ..... v
INTRODUCTION ..... 1
GR3+ CLOSE enCOUNTER (WN IN ..... 2
LEVEL 1 ..... 2
LEVEL 2 ..... 4
LEVEL 3 ..... 6
LEVEL 4 ..... 8
GR3+ FIND A PLACE: WHOLE NUMBERS WN PV ..... 10
LEVEL 1 ..... 10
LEVEL 2 ..... 12
LEVEL 3 ..... 14
GR6+ FIND A PLACE: DECIMAL NUMBERS (DE PV) ..... 16
LEVEL 1 ..... 16
LEVEL 2 ..... 18
LEVEL 3 ..... 20
GR5+ FRACTION SNAP FR ..... 22
LEVEL 1 ..... 22
LEVEL 2 ..... 24
LEVEL 3 ..... 26
LEVEL 4 ..... 28
GR6+ FRACTION FRENZY (FR ..... 30
LEVEL 1 ..... 30
LEVEL 2 ..... 32
LEVEL 3 ..... 34
LEVEL 4 ..... 36
GR3+ QUAD SQUAD: MULTIPLICATION WN IN ..... 38
LEVEL 1 ..... 38
LEVEL 2 ..... 40
LEVEL 3 ..... 42
LEVEL 4 ..... 44

## CONTENTS

GR3+ CAPTURE ISLAND ©N ..... 46
GR3+ SPACE KNOCKOUT (WN) (IN) (0) ..... 48
GR3+ * YIPPEE 3! ..... 50
GR3+ *SCORE 4 ..... 53
GR3+ RULE MASTER © ..... 56

## EXPLANATION OF SYMBOLS

(NI) = Whole Numbers
(II) $=$ Integers
${ }^{F}$ ) $=$ Fractions
(DE) = Decimals
PV) = Place Value
(0) = Order of Operations
(G) = Generalized Patterns

* = Problems are selected or designed by the teacher.


## Do you wish your students enjoyed math more? <br> Do your students lack a deep understanding of math ideas? <br> Do you wonder how to reach students who are below grade level?

We at the Curriculum Research \& Development Group are committed to supporting you in addressing these issues. $x$ to Why is a multi-faceted project that focuses on students who struggle in middle and high school mathematics, while increasing access to algebraic concepts and skills for all students.

All of the $x$ to Why materials have these important characteristics of effective lessons.

1. An introduction to new concepts and skills through problem solving
2. Five forms of communication strategies (reading, writing, speaking, critical listening, and multiple representations)
3. Concepts and skills connected among and within topics
4. Time to learn through distributed practice
5. Challenging problems that have multiple access points

Each component of $x$ to Why is classroom tested during development to ensure that it will meet the diverse needs of your students.

One teacher said,
"I love seeing students engage in math and taking an interest in analyzing patterns that produced winning strategies. My students have had to think more deeply about the concepts than they did on their homework!"

Another teacher noted,
"My kids are actually talking about math! That is very exciting to watch."
One student commented about the games,
"It was fun, I would definitely play it again. Playing this math game helped me practice what I learned and made me want to get better at it!"

Teachers and students alike enjoy a different approach to learning mathematics!

## INTRODUCTION

$N^{\text {sights }}$ Math Games for Conceptual Understanding is a resource for you to use with any mathematics curriculum. The games in this book support your students as they acquire a deeper understanding of number relationships and generalizations that lead to conceptual knowledge and robust procedural skills. These types of concepts and skills are foundational to accessing more sophisticated mathematical ideas.

The learning outcomes for each game are closely aligned to late elementary through high school. In some games, there are different levels or versions that may range from simple to more complex mathematical ideas and are, therefore, appropriate for use in a range of classrooms. This will allow you to match the game's mathematical ideas and complexity to the levels of your students. Sometimes, you may want to review previously learned skills to focus on the number sense ideas. Or, you can use the level or version that more closely fits with the content you are teaching at grade level.

Each game in this volume includes learning outcome(s), instructions, and a game sheet. Sometimes suggestions about organizing your classroom (such as playing in pairs or teacher-led) are included to assist you in making the game a success with your students.

The games in this volume are user-friendly and accessible for all students. They have been classroom tested by students and teachers, and the suggestions we received have contributed to creating games that are highly engaging while at the same time promoting robust mathematical learning.

We suggest that you play the games with your colleagues or family before using them in the classroom so that you can become familiar with them and adapt them to fit your students' needs or classroom format. We hope you and your students enjoy them!

## Learning Outcome

Students develop number flexibility as they estimate differences with two-digit numbers.

## Introduction

Close enCounter Level 1 is played by a pair of students and involves the subtraction of 2 two-digit numbers to get as close as possible to a two-digit target difference. The game builds students' flexibility in subtracting with whole numbers.

## Materials

$\star 1$ deck of standard playing cards with the face cards (K, Q, J, jokers) removed per pair of students
$\star 1$ Close enCounter Level 1 game sheet per pair of students
$\star 1$ calculator per pair of students

## Directions

1. The teacher informs players that the deck contains 4 of each digit 0 through 9 . The digit 0 is represented by the " 10 " and 1 is represented by the " $A$ " (ace).
2. The teacher designates a player in each pair to serve as the dealer. The dealer shuffles the cards, draws the top 2 cards, and places them face up to form a two-digit target number for the round of play. The target number is written on the game sheet.
3. The dealer then deals 4 cards to each player. Players reveal their cards and decide how to arrange them to form 2 two-digit numbers so that the difference between these numbers is as close as possible to the target number. The minuend (top number) should be larger than the subtrahend (bottom number) so that the difference is positive. No calculators or pencils are allowed at this time.
4. Once each player decides their difference is as close as can be to the target number, they record their numbers on the game sheet and may then use the calculator to find the difference between these 2 numbers for the round. Each player records their difference for the round.
5. Each player then determines how far away their difference is from the target number. This will always be a positive number, regardless of whether the difference they created is greater than or less than the target number. Each player records this number for that round in the score box.
6. The dealer places the cards that were used on the bottom of the deck. This ends the round and a new round can start. Pairs play 5 rounds.

## Scoring

At the end of 5 rounds, each player finds the sum of their differences from all the rounds. The player with the lowest sum is the winner.
 LEVEL 1 ROUND 1


ROUND 3


ROUND 5



ROUND 4


5RDRE

| ROUND | PLAYERA | PLAYER B |
| :---: | :---: | :---: |
| 1 |  |  |
| 2 |  |  |
| 3 |  |  |
| 4 |  |  |
| 5 |  |  |
| TOTAL |  |  |

# Algebra for Understanding 



## $M^{\text {Power }}$

## A Path to Understanding Algebra

- Full academic-year algebra curriculum for middle and high school classes focused on supporting struggling learners
- Strengthens and builds robust algebraic thinking
- Teacher materials include lesson guides, assessments, and explorations

$\mathbf{N}^{\text {Sights }}$


## Math Games for Conceptual Understanding

- Games that promote the development of strategies, concepts, and skills
- Available in print or online formats

$M^{1}$
Bark
Warming Up to Think Mathematically
- Short warm-up problems to get students ready for class
- Appropriate for middle and high school grades


BHold

## Explorations to Promote Algebraic Thinking

- Algebra-based problem-solving tasks to build conceptual understanding
- Appropriate for middle and high school grades
- Experiences that introduce middle and high school teachers to teaching from a problem-solving approach
- Focuses on understanding and motivating students who struggle
- Includes classroom-tested tasks and instructional strategies


