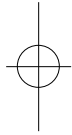
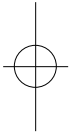


# Clickers in the Classroom

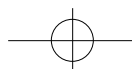
How to Enhance Science  
Teaching Using Classroom  
Response Systems

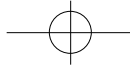


**Douglas Duncan**  
*University of Colorado*



San Francisco Boston New York  
Cape Town Hong Kong London Madrid Mexico City  
Montreal Munich Paris Singapore Sydney Tokyo Toronto





Senior Executive Editor: Adam Black  
Assistant Editor: Stacie Kent  
Senior Marketing Manager: Christy Lawrence  
Managing Editor, Production: Erin Gregg  
Production Editor: Eric Arima, Elm Street Publishing Services  
Manufacturing Manager: Pam Augspurger  
Text Design: Elm Street Publishing Services  
Cover Design: Armen Kojoyian  
Composition: Elm Street Publishing Services  
Text and Cover Printer: Courier, Stoughton

Cover Credits: Classroom: Patrick Ward/Corbis, Instructor: Barry  
Rosenthal /Getty

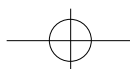
ISBN : 0-8053-8729-5

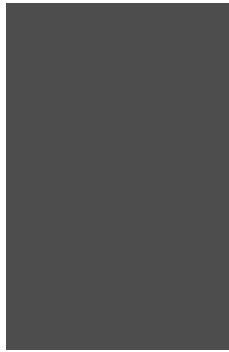
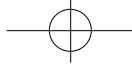
Copyright © 2005 Pearson Education, Inc., publishing as Addison Wesley, 1301 Sansome St., San Francisco, CA 94111. All rights reserved. Manufactured in the United States of America. This publication is protected by Copyright and permission should be obtained from the publisher prior to any prohibited reproduction, storage in a retrieval system, or transmission in any form or by any means, electronic, mechanical, photocopying, recording, or likewise. To obtain permission(s) to use material from this work, please submit a written request to Pearson Education, Inc., Permissions Department, 1900 E. Lake Ave., Glenview, IL 60025. For information regarding permissions, call (847) 486-2635.

Many of the designations used by manufacturers and sellers to distinguish their products are claimed as trademarks. Where those designations appear in this book, and the publisher was aware of a trademark claim, the designations have been printed in initial caps or all caps.



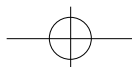
1 2 3 4 5 6 7 8 9 10—CRS— 08 07 06 05 04  
www.aw-bc.com

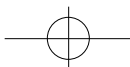
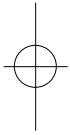
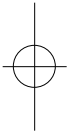
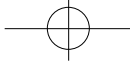


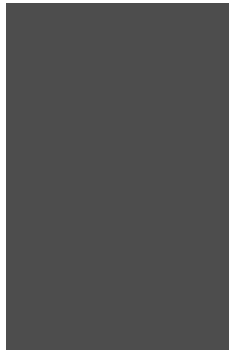
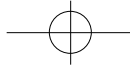


# Table of Contents

Acknowledgments	000
Forward— <i>Eric Mazur</i>	000
<b>1</b> Introduction	000
<b>2</b> Why Use a Classroom Response System?	000
<b>3</b> How Clickers Work, how to Register One, and how to Deal with Common Problems	000
<b>4</b> How Clickers Will Change Your Classroom—A Warning!	000
<b>5</b> What Are Your Class Goals and How Can Clickers Help Achieve Them?	000
<b>6</b> Clickers and Cooperative or Peer Instruction	000
<b>7</b> Clickers and Classroom Demonstrations	000
<b>8</b> To Grade or Not to Grade?	000
<b>9</b> What Do Students Think of Using Clickers?	000
<b>10</b> Clickers and Cheating	000
<b>11</b> A Checklist—Are You Ready?	000
Appendix 1: Sample Clicker Questions	000
Appendix 2: What Students Think of Peer Instruction	000
Appendix 3: CRS Best Practices	000
References	000





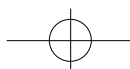


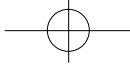
## Foreword

Have you ever found yourself standing in front of your class in the middle of a lecture and wondering what in the world is going on in the minds of your students? You look around the classroom. Some students are busy scribbling in their notebooks. A few are dozing off. Many are staring blankly at the screen or blackboard. Or are they just daydreaming? You pause and ask, “Does anyone have any questions?” Silence. Those who were scribbling continue to scribble. The ones who were staring at the screen look down when they notice you looking in their direction. The ones who were dozing off now seem to be fast asleep. “Any questions?” you repeat. The lack of response is agonizing. What is going on in their minds? Did they all understand what you just told them, or are they so totally lost that they don’t even know what to ask? If you are like me, chances are you will assume they are all right with the material and move on with the lecture. Most lectures are a one-way transfer of information from the lecturer to the students, and I discovered the hard way that this one-way transfer is very ineffective at helping students master information.

It doesn’t have to be that way even if you have hundreds of students in your class. When I first developed the Peer Instruction method, the idea was to find a way to engage the students during class and provide myself (and them) with feedback about their understanding. Initially we used a show of hands, then flashcards. In 1993 we began experimenting with a wired network of handheld calculators to poll the students. Now, a number of commercial systems are available, and tens of thousands of students are being polled each day using wireless devices. The reasons for the explosive growth are simple: First, interactive teaching has been demonstrated to lead to considerably larger learning gains; second, after an instructor has been exposed to the feedback this method of teaching affords, it is impossible to go back to the passive lecture format and remain ignorant about what goes on in the minds of students.

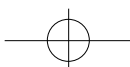
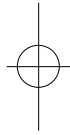
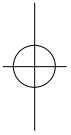
If you have never taught interactively this book will introduce you interactive teaching and to the technology that is currently available to support

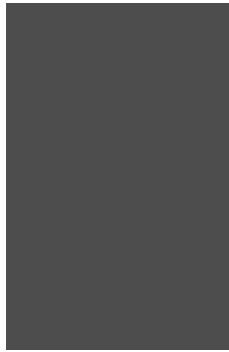




this method, and it will also provide you with a treasure chest of tips and pointers. Even if you are already using “clickers,” as they are often referred to, you will find the material in this book to be invaluable and will discover new ways of improving your teaching technique. In either case, this book is bound to change your classes, and I am sure you will enjoy reading it as much as I did.

*Eric Mazur*  
Harvard University

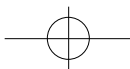
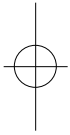
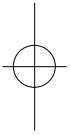
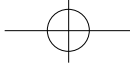




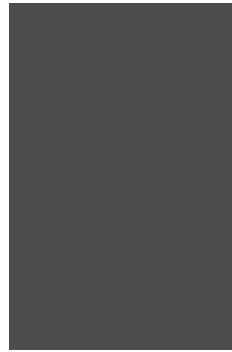
## About the Author

Douglas Duncan is a faculty member in the Department of Astrophysical and Planetary Sciences of the University of Colorado, where he directs the Sommers Bausch Observatory and Fiske Planetarium. Doug began his career at the Carnegie Observatories and subsequently joined the staff of the Hubble Space Telescope. He then worked at the University of Chicago and the Adler Planetarium, beginning a trend of modernization and closer connection between research and teaching in planetariums, which has spread nationwide. He has served as National Education Coordinator for the American Astronomical Society, and in that capacity led efforts for better teaching and public communication throughout the United States. He has also served as a science commentator on National Public Radio. Doug's current focus is science education and research into "fossil stars"—which date back almost to the Big Bang.









## Acknowledgments

I am pleased to dedicate this book to Mike Dubson, “father” of clickers at the University of Colorado and an unfailingly helpful and optimistic colleague—as well as the kind of science teacher all students should have. I’d like to give special thanks to Richard Rogers of the Provost’s office of the University of Massachusetts, Amherst, for sharing the results obtained with clickers at UMass, and to April Trees and Michelle Jackson for sharing the results of their survey of 1,500 University of Colorado students.

My journey towards better science teaching was started years ago by Amy Southon, a particularly insightful and courageous educator, who challenged me to show whether all those smiling students leaving my lectures were learning what I wanted them to. It took me a decade, Amy, but now I know.

At CU I am privileged to have a remarkable group of colleagues who are truly dedicated and imaginative in their teaching. These include Fran Bagenal, Webster Cash, Erica Ellingson, Jason Glenn, Jim Green, Nick Gnedin, Dick McCray, Bob Pappalardo, Nick Schneider, John Stocke, Ted Snow, and Juri Toomre. Thanks also go to Noah Finkelstein, Steve Pollock, Kathy Perkins, Patricia Rankin, and Carl Weiman.

Eric Mazur at Harvard; Tim Slater and Gina Brissenden of the Conceptual Astronomy and Physics Education Research Team at the University of Arizona; Lorrie Shepard, Dean of Education at the University of Colorado; and Mary Ann Shea, Director of the Faculty Teaching Excellence Program—thank you for your inspiration. Thank you for the valuable feedback and suggestions I received from a number of reviewers including Javed Iqbal (University of British Columbia),

Adam Black, Stacie Kent, and Erin Gregg at Addison-Wesley believed my assertion that there is a lot more to clickers than pushing a button, and then helped me to produce a book I hope has broad appeal. When you are ready to write your own book, see them. They are terrific.

Finally, I am most pleased to thank all my students and teaching assistants in the courses I taught at the University of Chicago and now teach at the University of Colorado. Your thoughts, questions, and enthusiasm have challenged and motivated me.

