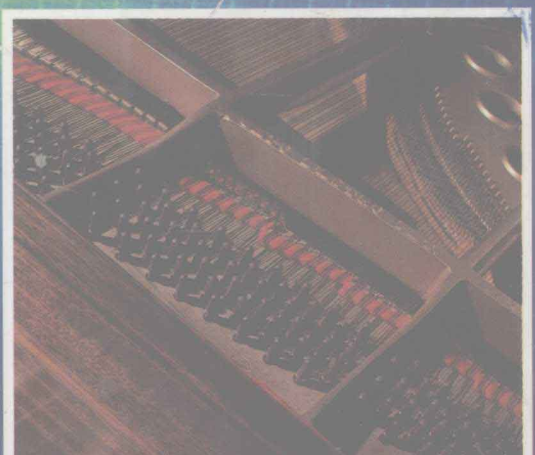
# ALGEBRA 1

LARSON, KANOLD, STIFF

$$f(n) = 440 \cdot (\sqrt[12]{2})^n$$

$$\frac{f_2}{f_1} = \frac{6}{5}$$



$$\frac{f_2}{f_1} = \frac{5}{4}$$

24.93

37.64

19.34

10.75

D. C. HEATH

# ALGEBRA 1

Roland E. Larson

Timothy D. Kanold

Lee Stiff

HEATH

**D.C. Heath and Company**
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## About the Cover

The cover shows the relationship of music and mathematics, one of the many real-life applications that you will work with in this text. The background is an enlargement of a Compact Disc (CD), and the lines are actually grooves in the CD. The mathematics shown on the cover represents the algebra of musical harmony. A symphony orchestra "tunes up" before a performance by having an oboist play the note "A-440," which has a frequency (pitch) of 440 vibrations per second. The frequency of every note on the piano keyboard is a multiple of 440, shown by the formula in the upper right of the cover. The exponent $n$ represents the position of the note above or below A-440. Two notes harmonize if the ratio of their frequencies, $\frac{f_2}{f_1}$, is an integer or a simple rational number.

As you read the text, see if you can find information that is directly related to the cover.


## Acknowledgments

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## Author Acknowledgments

In Algebra 1, we have included numerous examples and exercises that use real-life data. This would not have been possible without the help of many people and organizations. Our wholehearted thanks goes to all for their time and effort.

We tried to use the data accurately—to give honest and unbiased portrayals of real-life situations. In the cases where models were fit to data, we used the least-squares method. In all cases, the square of the correlation coefficient, $r^2$, was at least 0.95. In most cases, it was 0.99 or greater.


*(Acknowledgments continue on page 791)*



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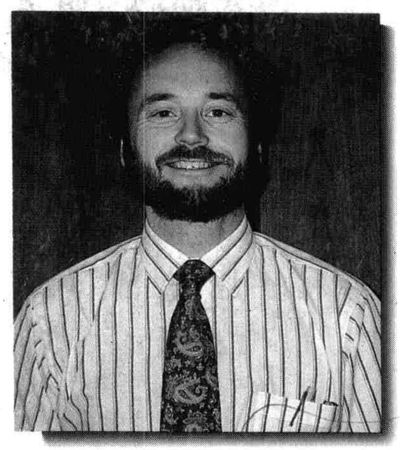
**Roland E. Larson** is Professor of Mathematics at the Behrend College of Pennsylvania State University in Erie. He is a member of NCTM and a highly successful author of many high school and college mathematics textbooks. Several of his D.C. Heath College titles have proven to be top choices for senior high school mathematics courses.

**Timothy D. Kanold** is Chairman of Mathematics and Science and a teacher at Adlai Stevenson High School in Prairie View, Illinois. He is the 1986 recipient of the Presidential Award for Excellence in Mathematics Teaching, as well as the 1991 recipient of the Outstanding Young Alumni Award from Illinois State University. A member of NCTM, he served on NCTM's *Professional Standards for Teaching Mathematics* Commission and is a member of the Regional Services Committee.



**Lee Stiff** is an Associate Professor of Mathematics Education in the College of Education and Psychology of North Carolina State University at Raleigh. He has taught mathematics at the high school and middle school levels. He is a member of the NCTM Board of Directors, served on NCTM's *Professional Standards for Teaching Mathematics* Commission, and is a member of the *Committee for a Comprehensive Mathematics Education of Every Child.*

Linda Bailey
Putnam City Schools
Oklahoma City, OK

Pat Beck
Putnam City North High School
Oklahoma City, OK

Lawrence Demetrak
San Marin High School
Novato, CA

Charleen M. DeRidder
Knox County Schools
Knoxville, TN

Melanie Donnell
Russellville High School
Russellville, AR

Joseph P. Dooley
Upper Darby High School
Upper Darby, PA

David J. Enterlin
Upper Darby High School
Upper Darby, PA

M. Jayne Fleener
University of Oklahoma
Norman, OK

Gail Gonyo
Adirondack Community College
Queensbury, NY

Wanda Heflin
Russellville High School
Russellville, AR

Karen Humble
Western Oaks Junior High School
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Regina D. Kiczek
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Jersey City, NJ

Fran Kormes
Harry S. Truman High School
Levittown, PA

Chicha Lynch
Capuchino High School
San Bruno, CA

Terry McBroom
San Marin High School
Novato, CA

Elizabeth J. Manes
Harry S. Truman High School
Levittown, PA

Deanna Mauldin
Liberty Bell Middle School
Johnson City, TN

Dominic Mendalla
Capuchino High School
San Bruno, CA

Dennis H. Noe
School District of Waukesha
Waukesha, WI

Dean Orfanedes
Capuchino High School
San Bruno, CA

Jennifer J. Penley
Liberty Bell Middle School
Johnson City, TN

Susan Shumate
Edmond Public Schools
Edmond, OK

Sharon Siegel
Dodgen Middle School
Marietta, GA

Linda Tassano
San Marin High School
Novato, CA

John Wellington
Upper Darby High School
Upper Darby, PA

To the Students

Mathematics evolved over the past few thousand years in many stages. *All* the early stages were centered around the use of mathematics to answer questions about real life. This is very much like the way we wrote *Algebra 1*. We centered the concepts around the real-life use of mathematics.

As mathematics development matured, people began to collect and categorize the different rules, formulas, and properties that had been discovered. This took place independently in many different parts of the world: Africa, Asia, Europe, North America, and South America. The mathematics that we use today is a combination of the work of literally thousands of people.

As you study our algebra book, be sure you understand the value and purpose of the concepts you're learning. Knowing **why** you are learning a concept helps you master it—and understand its relevance to your own life. That's why we begin each lesson explaining what you should learn and why you should learn it.

Remember, math is not a spectator sport—it's a valuable tool you can use in everyday life!

Roland E. Larson

Timothy D. Kanold

Lee Stiff

# Real-Life Applications

Look through this list for things that interest you. Then find out how they are used with algebra.



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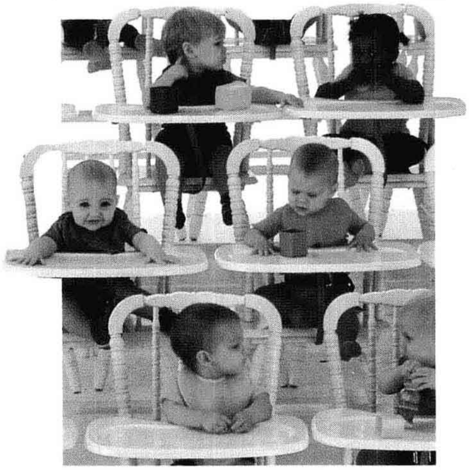



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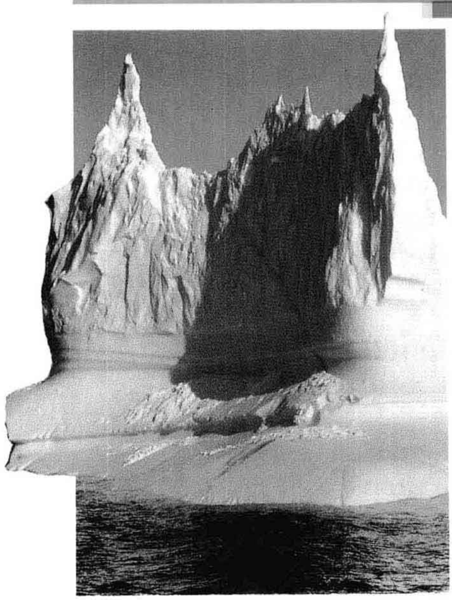

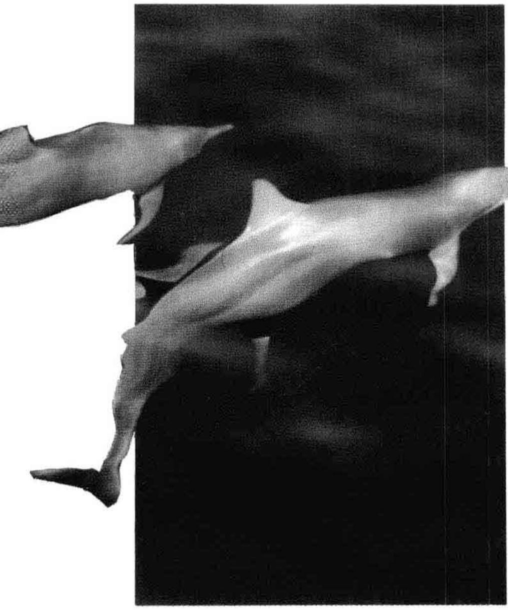

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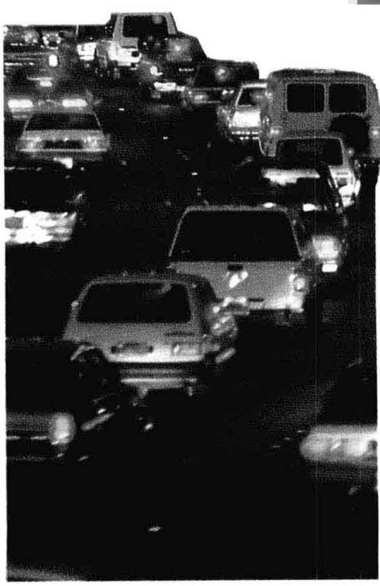

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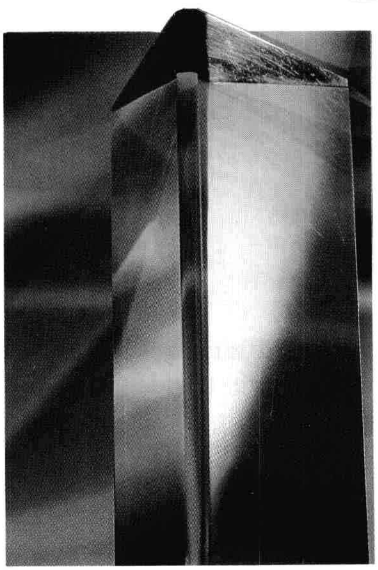

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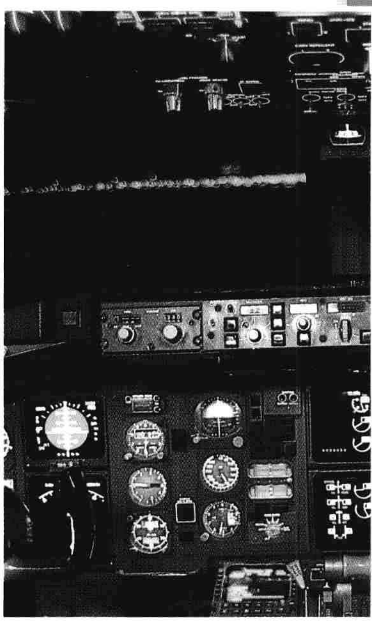

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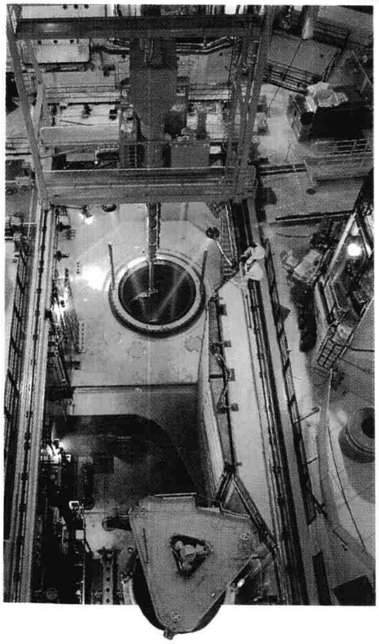



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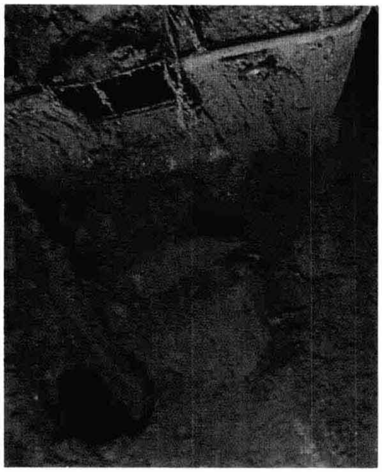



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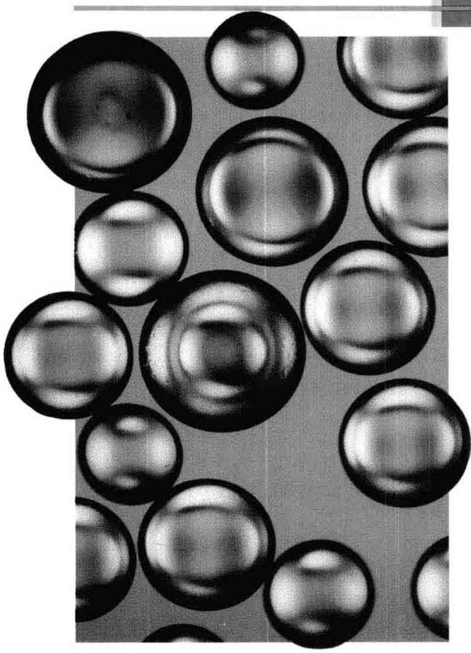

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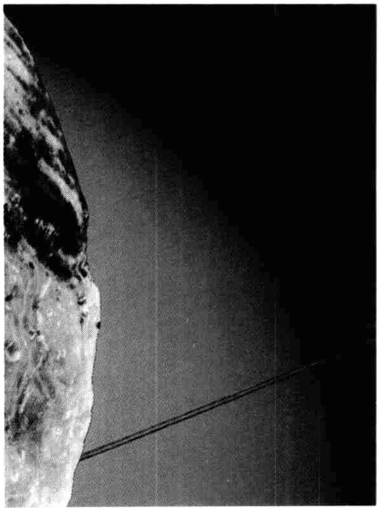


CHAPTER 1

# Connections to Algebra

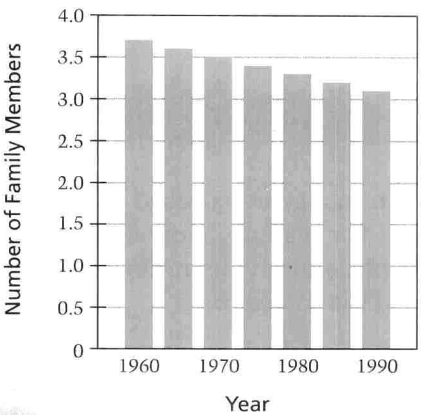
LESSONS



***Algebra is not just about x and y. It is also about toddlers. It models their world.***

**Real Life**
**Demographics**

Average Family Size in U.S.




One of the goals of algebra is to recognize patterns and relationships that occur in real life. *Tables* can help you recognize patterns. For instance, the following table shows that between 1960 and 1990, the average family size in the United States decreased by about one tenth of a family member every five years.

***(Source: U.S. Bureau of the Census)***

| **Year** | 1960 | 1965 | 1970 | 1975 | 1980 | 1985 | 1990 |
|---|---|---|---|---|---|---|---|
| **Family Size** | 3.7 | 3.6 | 3.5 | 3.4 | 3.3 | 3.2 | 3.1 |

Once a pattern has been found, it can be used to answer questions about the real-life situation. For instance, from the pattern above you could estimate the 1995 average family size to be about 3.0. The *bar graph* gives a picture of the decreasing family size between 1960 and 1990.

# 1.1 Numbers and Number Operations

*What you should learn:*

**Goal 1** How to represent numbers and number operations

**Goal 2** How to use grouping symbols

*Why you should learn it:*

You can apply what you know about numbers and number operations to help solve problems in algebra.

## Goal 1 Numbers and Number Operations

Much of what you will learn in algebra is based on numerical skills that you already have. For instance, you already know how to add, subtract, multiply, and divide numbers, and you will continue to use these skills in algebra.

Different kinds of numbers have different names. For example, the numbers 0, 1, 2, 3, and 4 are **whole numbers,** and the numbers $\frac{1}{2}$, $\frac{2}{3}$, and $\frac{5}{4}$ are **fractions.** What you call a number sometimes depends on the way you write the number. For example, the number $\frac{1}{2}$ can be written in three different forms.

Fraction form: $\frac{1}{2}$

Decimal form: 0.5

Percent form: 50%

Each of these forms represents the same number, which means that you could write $\frac{1}{2} = 0.5$ or $0.5 = 50\%$.

The decimal form of some numbers contains too many digits to write. For instance, no one could write *all* the digits of the decimal for $\frac{3}{7}$:

$$\frac{3}{7} = 0.4285714285\ldots$$

(The three dots mean that the number has more digits than are shown.) You can *approximate* this number to different degrees of accuracy. For instance, rounded to two decimal places, you could write

$\frac{3}{7} \approx 0.43.$ *Rounded to two decimal places*

If you wanted an approximation that is more accurate, you could round to three decimal places and write

$\frac{3}{7} \approx 0.429.$ *Rounded to three decimal places*

The symbol $\approx$ means *is approximately equal to.*

The number of decimal places that you should list when writing a decimal approximation depends on the context of the problem. For instance, with dollar amounts, you probably would not use more than two decimal places.