Chapter

8 Decimals

Dear Student,

In this chapter, you'll be zooming in on the number line. Can you think of a number that is between 10 and 20 on the number line? How about a number that's between 1 and 2 on the number line?

You'll be seeing numbers like 3.25 and 98.6 when you zoom in on the number line. Have you seen numbers like this before? If so, where have you seen them?

Before you get started, though, you'll be looking at really big numbers like 9,638,702. What number is this? By reviewing some of the rules we use to write big numbers like this one, you will start to have ideas of what the digits to the right of the "." in the numbers 3.25 and 98.6 mean.

For the millionth time, enjoy!

Mathematically yours,
The authors of *Think Math!*
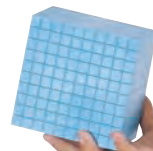
Ready, Set, Down the Hill

Every year since 1934, tens of thousands of people flock to Derby Down in Akron, Ohio, to watch the Soap Box Derby Championships. In home-built "cars" youths from age 8 through age 17 race down a hill depending only on gravity for power. Each racer's run is over in less than 30 seconds.

In a typical Soap Box Derby, cars cannot have a motor, but must have at least four wheels and brakes. The driver must wear a helmet. Spending to make the car is limited to a certain amount.

FACT·ACTIVITY 1

1. The estimated population of Akron, Ohio, in 2005 was 210,795. Write the estimated population in expanded form.

2. Find the population of the city or town where you live. Is it greater than or less than the population of Akron?

3. Competitors from the U.S. and from other countries travel to Akron for the Soap Box Derby Championships. The table shows the distances from some cities to Akron. List the cities in order from least to greatest distance from Akron.

4. Corey is traveling from Miami, Florida, to be in the Soap Box Derby Championship. Miami is 1,061 miles from Akron. Between which two distances in the chart is 1,061 miles?

Distance From Some Cities To Akron, Ohio	
City	Miles
Juneau, AK	2,780
Milford, CT	991
Montreal, Canada	1,152
Salem, OR	2,096
San Juan, Puerto Rico	1,668
San Diego, CA	2,036

Soap Box Derby racers compete as teams. An adult helps the child build the soap box car and local businesses might help too. The table at the right shows the times of some winners.

Use the table to answer the questions.

1 Which team had the fastest time? Explain.

2 What is the difference between Wargo's time and Kimball's time?

3 Up until 1964, stopwatches only recorded winning times to 1 decimal place. What would Pearson and Wargo's times be if they were only rounded to tenths?

4 How would you write Pearson's time as a mixed number?

| Soap Box Derby Winners		
Year	Team	Time (seconds)
2004	Kimball	27.19
2005	Pearson	26.95
2006	Wargo	26.93

CHAPTER PROJECT

Materials:
stopwatch (with hundredths of a second accuracy); wooden board (to use as ramp); 9 textbooks, close to the same thickness; tennis ball (or any ball that will roll across the classroom floor)

Build a ramp using a board and a textbook as shown. Rest one end of the ramp against the book and the other end on the floor near the wall. Roll the ball down the ramp. Record the time it takes to roll from the top of the ramp (start) to the wall (finish). Repeat four times, each time adding 2 more books.

- When you add more books to the ramp, does the recorded time increase or decrease?
- Which ramp produced the fastest time?
- Find the difference in time for each time you rolled the ball down the ramp.
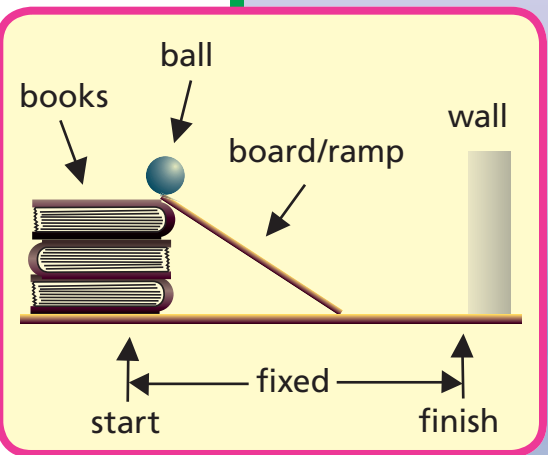
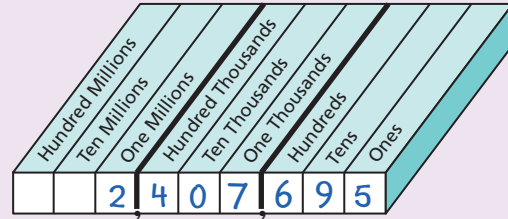books • ball • board/ramp • wall • fixed • start • finish

REVIEW MODEL
Reading and Writing Numbers

You can use a place-value chart to read and write whole numbers.

Read the number 2,407,695.

Step 1 Fill in the digits in the chart, starting at the right.

Hundred Millions	Ten Millions	One Millions	Hundred Thousands	Ten Thousands	One Thousands	Hundreds	Tens	Ones
		2	4	0	7	6	9	5

Step 2 Read
the number of millions, ⟶ two *million,*
then the number of thousands, ⟶ four hundred seven *thousand,*
then the number of ones. ⟶ six hundred ninety-five

Write the number six million, five hundred eighty-one thousand, four hundred nine.

Step 1 Write the number of millions. ⟶ 6

Step 2 Continue, writing the number of thousands. ⟶ 6,581

Step 3 Continue, writing the number of ones. ⟶ 6,581,409

✔Check for Understanding

Read the number.

1 5,231,699

2 3,074,501

3 260,008

On a separate sheet of paper, write the number.

4 nine million, one hundred eight thousand, three hundred fourteen

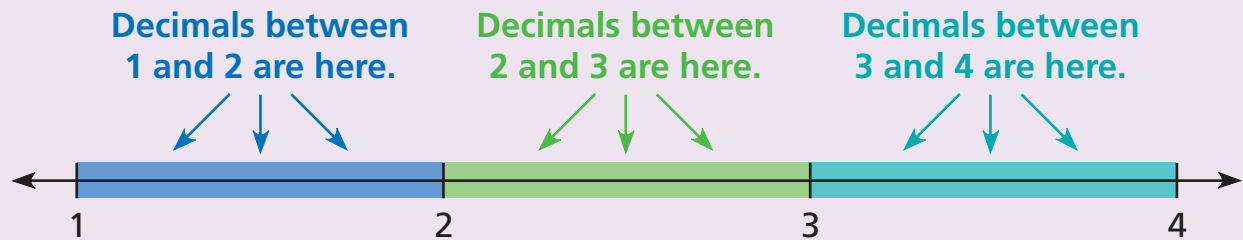**5** six million, two thousand, nine hundred sixty

6 four hundred twenty-two thousand, thirty-eight

REVIEW MODEL
Understanding Decimals

You have already learned that fractions are numbers that are *between* whole numbers on a number line.

Decimals are another way of writing fractions. Like fractions, decimals are found between whole numbers on a number line.

Decimals between 1 and 2 are here.

Decimals between 2 and 3 are here.

Decimals between 3 and 4 are here.

1 2 3 4

A decimal has one or more digits to the right of the decimal point. One way to read a decimal is to read left-to-right, inserting the word "point" for the decimal point. (You will learn more precise ways of reading decimals in later lessons.)

Decimal	Read
5.7	"five point seven"
12.39	"twelve point three nine" OR "twelve point thirty-nine"
0.4	"zero point four"

To input a decimal on a calculator, press the decimal point key for the decimal point.

To input 8.45, press **8** **·** **4** **5**

7	8	9
4	5	6
1	2	3
0	·	←
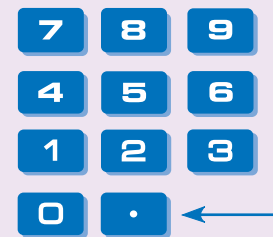
✔Check for Understanding

Name the two whole numbers between which the decimal lies.

1 2.5

2 13.711

3 0.9

State how you would read the decimal.

4 1.2

5 20.4

6 6.17

**7** Explain how you would input the number 92.05 on a calculator.

REVIEW MODEL
Placing Decimals

You can use the digits in a decimal number to decide where to place the number on the number line.

Place 12.74 on the number line.

Step ❶

Look at the whole-number portion of the number. Find it and the whole number that follows it on the number line. The number you are looking for lies somewhere between the two whole numbers.

11   **12**   **13**   14   15

Step ❷
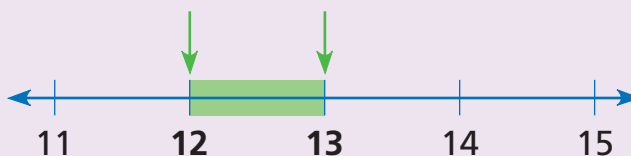
Focus on the part of the number line between the two whole numbers. Find the tenths digit of the number and the tenths digit that follows it on the number line. The number you are looking for lies somewhere between the two tenths digits.

12   **12.7 12.8**   13

Step ❸
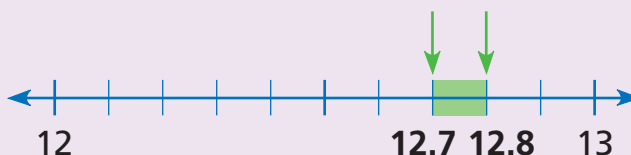
Focus on the part of the number line between the two tenths digits. Think of it as being divided into 10 equal parts, numbered 1 to 10. Find the hundredths digit of the number and mark the point.

0 1 2 3 4 5 6 7 8 9 10
12.7   **12.74**   12.8
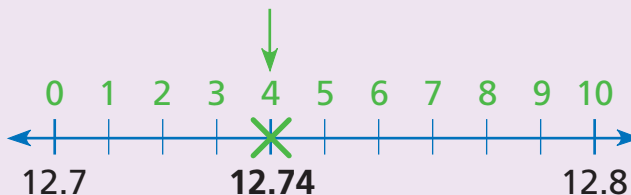
✔Check for Understanding

Draw a number line from 5 to 8. Mark it in tenths. Then mark and label each point on the number line.

1 5.73   **2** 7.19   **3** 6.05

EXPLORE
Comparing Fractions and Decimals

For each pair of numbers, decide which is larger. Then, on a separate sheet of paper, use words, pictures, or numbers to tell how you know.

1 0.5 and $\frac{3}{4}$

---

2 13.7 and $13\frac{4}{10}$

---

3 4.1 and $4\frac{7}{10}$

---

4 42.4 and $42\frac{3}{10}$

REVIEW MODEL
Comparing Fractions with Decimals

You can use a common benchmark or a number line to compare a fraction with a decimal.

Compare 6.8 and $6\frac{3}{10}$.

One Way

- Compare both numbers to the same number (called a benchmark). Here, compare both numbers to $6\frac{1}{2}$. (Remember: $\frac{1}{2} = \frac{5}{10}$.)

  $6.8 = 6\frac{8}{10}$. Since $\frac{8}{10}$ is larger than $\frac{5}{10}$, 6.8 is larger than $6\frac{1}{2}$.

  Since $\frac{3}{10}$ is smaller than $\frac{5}{10}$, $6\frac{3}{10}$ is smaller than $6\frac{1}{2}$.

  So, 6.8 is larger than $6\frac{3}{10}$.

Another Way

- Place both numbers on a number line. The number farther to the right is larger.

6.8 is larger than $6\frac{3}{10}$.

✔Check for Understanding

Which number is larger?

1 2.1 or $2\frac{9}{10}$

2 $6\frac{3}{10}$ or 5.9

3 1.4 or $1\frac{7}{10}$

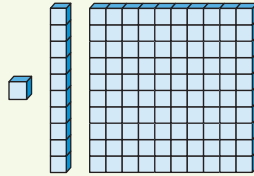**4** $9\frac{1}{2}$ or 9.9

5 4.6 or $4\frac{4}{10}$

6 $8\frac{1}{4}$ or 8.6

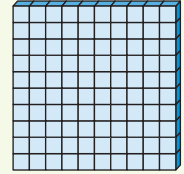# EXPLORE
Representing Decimals with Blocks

You've probably worked with blocks like these before:

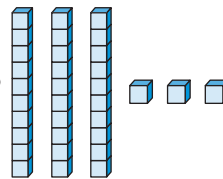**For this activity, a flat has a value of 1.**

1 What decimal shows the value of ?

2 What decimal shows the value of ?

3 What decimal shows the value of these blocks?

4 Use base-ten blocks to represent 1.23.

5 How can base-ten blocks help you solve this problem: 1.23 + 1.45?

6 Mr. Guttman's class is having a party and they're buying cheese to make sandwiches. They buy 1.23 pounds of cheddar cheese and 1.45 pounds of American cheese. How many pounds of cheese do they buy?
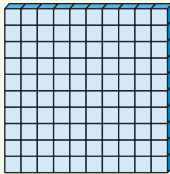
7 What is 1.23 + 1.45 + 1.00?

8 What is 1.23 + 1.45 + 0.10?

9 What is 1.23 + 1.45 + 0.01?

EXPLORE
Adding Decimals with Blocks

Once again, has a value of 1.

Use base-ten blocks to represent this problem and find the answer.

1 Naomi wore a pedometer to find out how far she walked each day. On Monday, she walked 1.18 miles home from school and then 0.16 miles to her friend Jennifer's house. How far did she walk on Monday?

1.18   +   0.16   =   ■

Use base-ten blocks to represent and answer these problems.

2 Jill wanted to know whether she had enough birdseed in her 1-pound box to fill her two birdfeeders. She knew that one birdfeeder used 0.46 pounds of seed and the other used 0.37 pounds. How much birdseed does she need? Will she have enough?

0.46   +   0.37   =   ■

3 Serena needs school supplies. She bought a notebook that cost $1.64 and a pencil that cost $0.53. How much money did she spend on supplies?

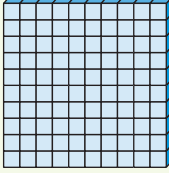1.64   +   0.53   =   ■

4 Aki and Chris had a contest to see who could make the longest line of dominoes in one minute. Aki won with a line that was 0.42 meters long. Chris's line was 0.28 meters. Chris decided to finish building her line so it would be as long as Aki's. How much longer does it need to be?

0.28   +   ■   =   0.42

EXPLORE
Subtracting Decimals with Blocks

Once again, [grid block image] has a value of 1.

1 Represent this problem with base-ten blocks.

| **0.71** | − | **0.45** | = | ■ |

---

2 What is the difference between 0.71 and 0.45?

Use base-ten blocks to represent and complete these subtraction sentences.

3 0.83   −   0.37   =   ■

4 1.24   −   0.52   =   ■

5 1.03   −   ■   =   0.85

REVIEW MODEL
Problem Solving Strategy
Act It Out

> On his first try, Cory high-jumped **1.1** meters. On his second try, he high-jumped **0.94** meters. How much higher did he jump on his second try than he did on his first?

Strategy: Act it Out

Read to Understand

What do you know from reading the problem?

Cory high-jumped twice. He made **1.1** meters on his first try and **0.94** meters on his second try.

What do you need to find out?
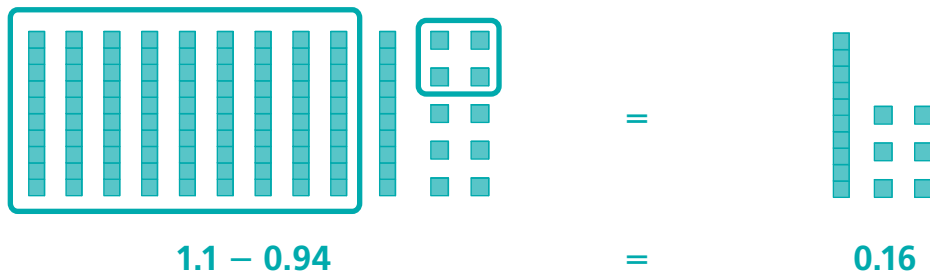
the difference between the heights

Plan

How can you solve this problem?

You could *act it out* using base-ten blocks.

Solve

How can you find the difference between the two heights?

Use base-ten blocks to model **1.1**. Exchange one rod for **10** cubes. Remove **9** rods and **4** cubes, representing **0.94**. The difference is **0.16**.

$$1.1 - 0.94 \qquad = \qquad 0.16$$

Check

Look back at the problem. Did you answer the questions that were asked? Does the answer make sense?

Yes; to check if the answer makes sense, I can add **0.16 + 0.94** and see if the sum is **1.1**.
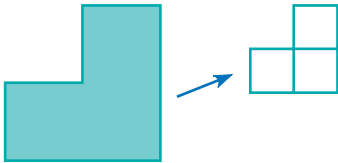
Problem Solving Practice

Use the strategy *act it out* to solve.

1 The shaded figure below is made of three congruent squares. How can the shaded figure be divided into four congruent figures?

2 Six students went to a meeting. Each student shook hands with each of the other students once. How many handshakes were exchanged?

Mixed Strategy Practice

Use any strategy to solve.

3 There are 16 rows of seats in the West Side Theater. Each row has 12 seats. Tickets to a play cost $5. If all the seats are sold, how much money will the theater owner make?

4 Joanie rode her bike at a rate of 8 miles per hour for 3 hours. She wants to ride 50 miles. How much farther does she have to ride?

5 Al is 10 years older than Bob. Carl is 10 years younger than Dave. Dave is 30 years older than Bob. List the four is order from oldest to youngest.

6 The figure below is made from 18 toothpicks. Which two toothpicks can you remove so that exactly four squares remain?

7 If you take Glen's age, multiply it by 2, add 16, and divide by 5, you get his brother's age. Glen's brother is 6. How old is Glen?

8 Mr. Babbitt made two telephone calls. The calls lasted a total of 44 minutes. If one call lasted 6 minutes more than the other, how long did the longest call last?

Choose the best vocabulary term from Word List A for each sentence.

Word List A

base-10 system
denominator
diagram
digits
distance
dollar notation
hundredths
meter stick
metric system
non-decimal
  portion
numerator
place value
sum
tenths
whole numbers

1 The ___?___ is the number in a fraction that is below the bar.

2 ___?___ are symbols, such as 0, 1, 2, 3, 4, 5, 6, 7, 8, and 9, that are used to write numbers.

3 The answer to an addition problem is called a(n) ___?___.

4 In ___?___ the cents are written as a decimal part of a dollar.

5 The value of a digit in a number is determined by its ___?___.

6 The ___?___ between two cities is how far you have to travel to get from one city to the other.

7 Pennies tell how many ___?___ of a dollar there are.

8 The set of ___?___ starts at 0 and goes up one unit at a time without end.

Complete each analogy using the best term from Word List B.

Word List B

decimal
  portion
digits
grid
place value
point
tenths

9 Letters are to words as ___?___ are to numbers.

10 Dollar is to dimes as one is to ___?___.

🗨 **Talk Math**

Discuss with a partner what you have just learned about decimals. Use the vocabulary terms *tenths* and *hundredths.*

11 How can you use a 10-by-10 grid to represent decimals?

12 How can you subtract a decimal number from a whole number?

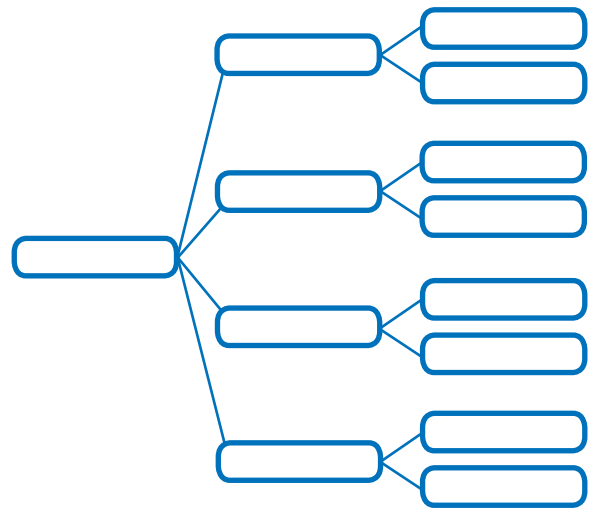**13** How can you add money amounts written in dollar notation?

Word Web

14 Create a word web for the word *point.*
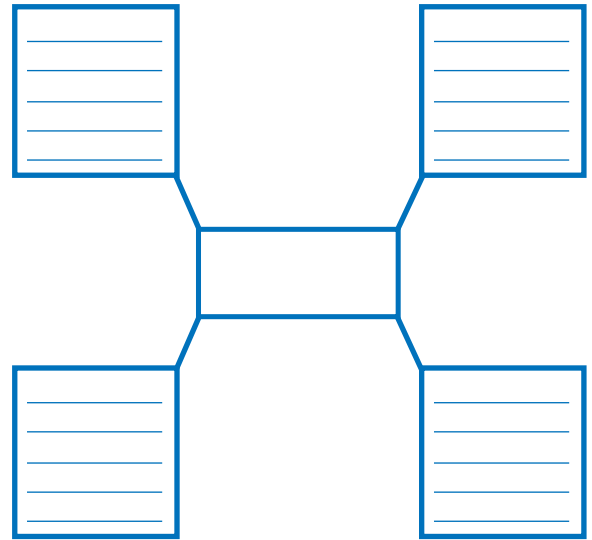
Tree Diagram

15 Create a tree diagram using the words *numbers, whole numbers, fractions,* and *decimals.* Use what you know and what you have learned about fractions and decimals.

What's in a Word?

DIGITS The word *digits* refers to symbols, such as 0, 1, 2, or 3. The word *digit* comes from a Latin word meaning "finger or toe." So the word *digits* also can be used to refer to a person's fingers and toes. People have often used fingers to help them count, which may explain why we have exactly 10 digits in our number system.

GO ONLINE

Technology
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GAME

Ordering Numbers

Game Purpose
To practice using place value to compare and order numbers

Materials
• Activity Master 68: *Number Cards*

Ordering Numbers

How to Play the Game

1 This is a game for 4, 5, or 6 players. Your group will need 3 copies of Activity Master 68. Cut out all the cards.

2 Mix up all the cards. Place them face down in a pile.

3 One player picks 7 cards and places them face up in the middle of the group.
• Each player uses the number on each card once to create a 7-digit number. Secretly record your number.
• Everyone shows their numbers. Work as a group to put the numbers in order from least to greatest.

4 This is how you earn points:
• 2 points if no one else made up the number
• 1 point for the smallest number (even if someone else has it)
• 1 point for the largest number (even if someone else has it)

Example: The digits are 9, 7, 1, 6, 4, 2, 3.

Carlene	Lamont	Reese	Tammi
1,234,679	6,971,324	9,764,321	7,964,321

No one else has it, and it's the smallest number: 3 points.

No one else has it: 2 points.

No one else has it, and it's the largest number: 3 points.

No one else has it: 2 points.

5 Mix the cards and play again. First player to 10 points wins!

GAME

Guess My Number

Game Purpose
To practice zooming in between numbers on the number line and to gain experience comparing decimals

How to Play the Game

1 Play this game with a group. Decide who will go first. That player will be the Number Master.

2 The Number Master thinks of a secret number with two digits to the right of the decimal point. The goal is to guess the secret number.
- Draw a long line. Label the endpoints with the whole numbers on either side of the secret number.
- Tell everyone that the secret number is between the two whole numbers.

3 Players ask *yes*-or-*no* questions to zoom in on the secret number on the number line.

4 When the answer is *no,* the Number Master crosses out the section of the number line that does not contain the secret number.

Example: The secret number is 3.67. Jorge asks "Is the number less than 3.5?" The answer is *no.*
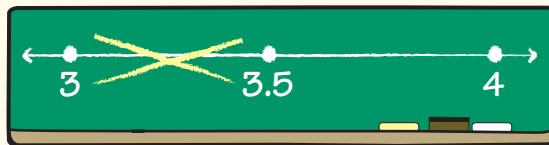
5 Play until someone guesses the secret number. Then choose a different Number Master, and play again. Take turns so that everyone has a chance to be the Number Master.

CHALLENGE

Ayesha and her friends created decimal patterns. Then they made up questions about the patterns to challenge each other.

Student	Pattern
Ayesha	0.14, 0.28, 0.42, 0.56
Luke	5.1, 4.8, 4.5, 4.2
Cameron	0.3, 2, 3.7, 5.4
Tanya	4, 3.64, 3.28, 2.92
Erin	2.5, 4.09, 5.68, 7.27
Seth	12, 10.92, 9.84, 8.76

Use the patterns above to answer the questions.

1 Which patterns increase?

2 Which patterns decrease?

3 Find the next number in each student's pattern.

4 Find the rule for each student's pattern.

5 Find the eighth number in each student's pattern.

6 Write the first number of each pattern in order from smallest to largest.

7 Write the eighth number for each pattern in order from smallest to largest.

Now make up your own decimal pattern.

8 What are the first four terms in your pattern?

9 Does your pattern increase or decrease?

10 Explain the rule you used to create the pattern.