3

Decimals

Harnessing the Wind

Wind is a clean, renewable source of energy used to produce electricity. It does not pollute or contribute to global warming.

Learning Goals

- use place value to represent numbers less than one thousandth
- multiply decimals by a 1-digit number
- divide decimals by a 1-digit number

Weather Dancer is a 72-m wind turbine in southern Alberta. It generates 2.96 gigawatt hours of electricity each year. Weather Dancer supplies electricity to 460 homes.

Electrical power is measured in units called watts.

1000 watts = 1 kilowatt
1 000 000 watts = 1 megawatt
1 000 000 000 watts = 1 gigawatt

The amount of electricity generated or consumed is measured in watt hours. One kilowatt hour means 1 kilowatt of electricity is used in 1 h.

CANADIAN ENVIRONMENT AWARDS   PRIX CANADIENS DE L'ENVIRONNEMENT
2004

The winner of the Canadian Environment Award in 2004 was William Big Bull, a member of the Piikani First Nation. Through his efforts, Weather Dancer was built.

- How are kilowatts, megawatts, and gigawatts related?
- About how many gigawatt hours of electricity will Weather Dancer generate in 5 years?
- How could you find how many megawatt hours of electricity Weather Dancer generates in 1 year?
- A typical Alberta household uses about 21.37 kilowatt hours of electricity each day. About how much is used in 1 week?

Numbers to Thousandths and Beyond

Decimals are all around us.
The ostrich is the world's largest living bird.
It can have a mass of 156.489 kg.
How do you read this number?
What is the meaning of each digit?

Explore

You will need a calculator and a copy of a place-value chart.
Write the headings and the number 27 in the chart, as shown below.

Tens	Ones •Tenths	Hundredths	Thousandths			
2	7 •					
	•					
	•					
	•					

a) Divide 27 by 50.
   Record it in the chart.
b) Divide your answer to part a by 50.
   Record it in the chart.
c) Divide your answer to part b by 25.
   Record it in the chart.

Show *and* Share

Share your work with another pair of students.
Use what you know about the headings in a place-value chart for whole numbers.
Write the missing headings in your place-value chart.
Take turns to say the numbers.

There are many patterns in the place-value chart.

Hundred Thousands	Ten Thousands	Thousands	Hundreds	Tens	Ones	Tenths	Hundredths	Thousandths	Ten-Thousandths	Hundred-Thousandths	Millionths
100 000	10 000	1000	100	10	1	$\frac{1}{10}$	$\frac{1}{100}$	$\frac{1}{1000}$	$\frac{1}{10\,000}$	$\frac{1}{100\,000}$	$\frac{1}{1\,000\,000}$

$1 = 10$ tenths $\frac{1}{100} = 10$ thousandths $\frac{1}{10\,000} = 10$ hundred-thousandths

As you move to the left, each position represents ten times as many as the position to its right.

The fairyfly is the world's smallest insect.

> I see a pattern: tens and tenths, hundreds and hundredths, thousands and thousandths.

This place-value chart shows the length of the male fairyfly in centimetres.

Ones	Tenths	Hundredths	Thousandths	Ten-Thousandths	Hundred-Thousandths	Millionths
0	0	1	3	9		

0   0.0   0.01   0.003   0.0009

We read this number as:
one hundred thirty-nine ten-thousandths

We can write this number in:
- standard form: 0.0139
- expanded form:
  0 ones + 0 tenths + 1 hundredth + 3 thousandths + 9 ten-thousandths
  = 0.01 + 0.003 + 0.0009

> We read the decimal as a whole number, then say the name of the position of the last digit.

In expanded form, we write 3.268 579 as:

3 ones + 2 tenths + 6 hundredths + 8 thousandths +
5 ten-thousandths + 7 hundred-thousandths + 9 millionths
= 3 + 0.2 + 0.06 + 0.008 + 0.0005 + 0.000 07 + 0.000 009

We read this decimal as: three and two hundred sixty-eight thousandths, five hundred seventy-nine millionths

> We leave a space after each group of 3 digits when the number has more than 4 decimal places.

Small decimals are often used in science. For example:

A garden snail moves very slowly. In 1 h, it travels 0.0483 km. We read this number as: four hundred eighty-three ten-thousandths

Sound travels very fast. It would take 0.0046 min for sound to travel from one end of a football field to the other. We read this number as: forty-six ten-thousandths
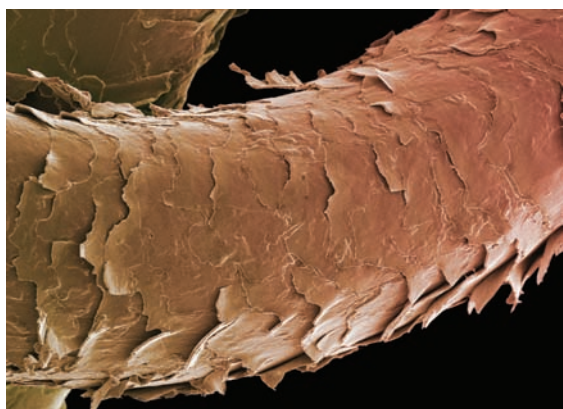
The diameter of a human hair is 0.000 025 m. We read this number as: twenty-five millionths

Math Link

Science

A virus is too small to see with the human eye. So, scientists use the nanometre (nm) to measure a virus.
1 nm = 0.000 000 001 m
The Ebola virus has length 0.000 02 cm, or 200 nm. As a comparison, the head of a pin has diameter 0.2 cm.

Practice

1. Use a place-value chart to show each number.
   a) 2.3425
   b) 0.142 86
   c) 0.0007
   d) 0.000 298

2. Use the numbers in the table.
Write the number that has a 5 in:
   a) the ten-thousandths position
   b) the millionths position
   c) the thousandths position
   d) the hundred-thousandths position
   e) the tenths position

0.635 734
0.506 312
1.003 825
3.702 456
2.184 592

3. Describe the meaning of each digit in 4.524 371.

4. Write each number in standard form.
   a) 8 and 26 ten-thousandths   **b)** 24 millionths
   c) 3 hundred-thousandths   **d)** 4 and 374 millionths

5. Write each number in expanded form.
   a) 0.0056   **b)** 0.000 49   **c)** 3.000 023   **d)** 0.348 619

6. Write a decimal that is between:
   a) 2.153 and 2.154   **b)** 0.6534 and 0.6535

**7.** Find two examples of very small numbers in the media. Write each number in a place-value chart. Explain how you use the patterns in the chart to read these numbers.

8. How are the values of the red digits in each number related?
   a) 5.000 05   **b)** 2.1433   **c)** 0.677 56   **d)** 4.234 654

9. Write the number in each fact in as many different forms as you can.
   a) A strand of silk in the web of a garden spider has a diameter of about 0.000 003 m.
   b) The diameter of one red blood cell is about 0.000 762 cm.
   c) The mass of a grain of rice is about 0.000 02 kg.
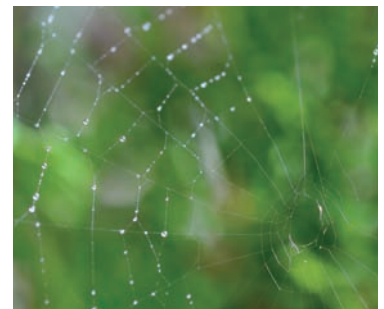
10. Use any or all of these digits: 1, 0, 2, 0, 4, 0, 5, 0
   a) Write 5 numbers less than one thousandth.
   b) Which of your numbers is the least? How do you know?
   c) Which of your numbers is the greatest? How do you know?

Reflect

How do the patterns in a place-value chart help you read and write decimals less than one thousandth?

2 Estimating Products and Quotients

Bernie needs 1.15 m of string to make a beaded sunglass cord.
He wants to make 6 cords.
About how much string does Bernie need altogether?
How can he use decimal benchmarks to help him estimate?

Explore

For each problem below:
• Estimate the answer.
• Record your strategy and your estimate.
Show your work.

➤ A nickel has a mass of 3.95 g.
What is the approximate mass of 7 nickels?

➤ Nine bags of dog food have
a mass of 134.55 kg.
What is the approximate mass of one bag?

Show and Share

Share your estimates with another pair of students.
Discuss the strategies you used to estimate.
How could you use decimal benchmarks to estimate?
Did you get the same estimates?
If your answer is no, is one estimate closer than the other? Explain.

Connect

➤ A ping-pong ball has a mass of 2.73 g.
Estimate the mass of 8 ping-pong balls.

Here are two strategies students used to estimate: 2.73×8
- Lara used front-end estimation.
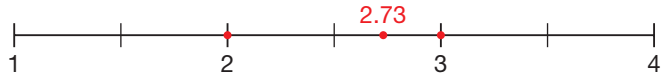 She wrote 2.73 as 2.
  Then multiplied: $2 \times 8 = 16$

> In *front-end estimation*, we use the place value of the front digits of a number.

The mass of 8 ping-pong balls is about 16 g.
This is an underestimate because 2 is less than 2.73.

- Hal used decimal benchmarks.
  Since 2.73 is closer to 3 than to 2,
  he wrote 2.73 as 3.
  Hal multiplied: $3 \times 8 = 24$

2.73

The mass of 8 ping-pong balls is about 24 g.
This is an overestimate because 3 is greater than 2.73.

➤ Four baseballs have a total mass of 575.94 g.
Estimate the mass of 1 baseball.

Here are two strategies students used to estimate: $575.94 \div 4$
- Aki used front-end estimation.
  He wrote 575.94 as 500.
  Then divided: $500 \div 4 = 125$

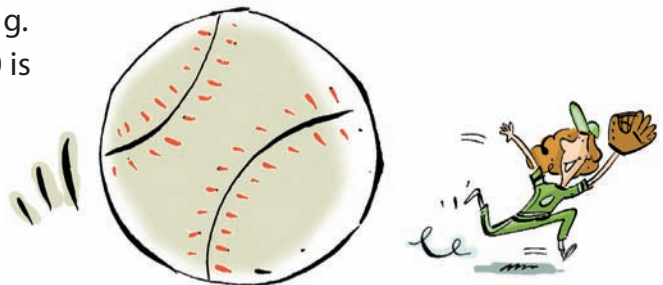The mass of 1 baseball is about 125 g.
This is an underestimate because 500 is less than 575.94.

- Adele looked for compatible numbers.
  Since 575.94 is close to 600,
  she divided: $600 \div 4 = 150$

> *Compatible numbers* are numbers that are easy to use mentally.

The mass of 1 baseball is about 150 g.
This is an overestimate because 600 is greater than 575.94.

1. Estimate each product or quotient. Which strategies did you use?
   Tell if your estimate is an overestimate or an underestimate.
   a) 7.01×9 **b)** 3.8×7 **c)** 11.85×5 **d)** 19.925×4
   e) $9.8 \div 5$ **f)** $12.31 \div 2$ **g)** $56.093 \div 7$ **h)** $225.3 \div 5$

2. Waldo paid $29.85 for 3 admission tickets to the Calgary Tower.
   Estimate the cost of one admission ticket.

3. A pair of ice cleats for ice fishing costs $14.89.
   About how much will 6 pairs of ice cleats cost?
   How did you find out?

4. Estimate the perimeter of each square.
   Tell if your estimate is an overestimate or an underestimate.
   How do you know?
   a)   1.3 cm **b)**   2.1 cm **c)**   2.6 cm
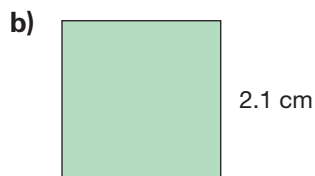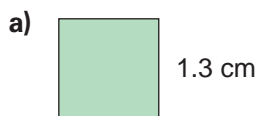
5. Estimate the side length of a square with perimeter:
   a) 24.2 cm **b)** 29.8 cm **c)** 35.6 cm

6. **a)** Is 9.47×5 greater than, or less than, 45?
      How can you estimate to find out?
   b) Is $23.86 \div 4$ greater than, or less than, 6?
      How can you estimate to find out?
   Show your work.

7. Copy and complete. Write $>$, $<$, or $=$.
   How did you decide which symbol to use?
   a) $5.6 \times 2 \square 1.4 \times 4$ **b)** $4.8 \div 2 \square 15.5 \div 5$

At Home

Reflect

Describe how you decide which strategy
to use to estimate the product or quotient
of a decimal and a whole number.

Describe a situation where
you might estimate the product
or quotient of a decimal and
a whole number.

3

Multiplying Decimals by a Whole Number

Many Canadians love the thrill of
riding a roller coaster.
The longer the ride, the greater the thrill.

Explore

This table shows the lengths of some of
the world's top roller coasters.
Choose 3 roller coasters you would like
to ride.
Suppose you rode each of them 8 times.
Estimate how far you would travel
on each roller coaster.
Then calculate the actual distance.

Roller Coaster	Country	Length (km)
The Beast	USA	2.243
The Steel Dragon	Japan	2.479
The Corkscrew	Canada	0.732
The Dragon Khan	Spain	1.269
The Mighty Canadian Minebuster	Canada	1.167
The Ultimate	England	2.268

Show and Share

Share your results with another pair of classmates.
Discuss the strategies you used to estimate and to calculate.
How do you know your answers are reasonable?

Connect ....

➤ The Superman Ride of Steel roller coaster is 1.646 km long.
Beth and Ujjal rode this roller coaster 3 times.
How far did Beth and Ujjal travel on the Superman Ride of Steel?

Multiply: 1.646 × 3
Here are two different strategies students used to calculate 1.646 × 3.

• Jiri used Base Ten Blocks on a place-value mat.
  He modelled 3 groups of 1.646.
  Jiri then traded 10 thousandths for 1 hundredth,
  10 hundredths for 1 tenth, and 10 tenths for 1 one.
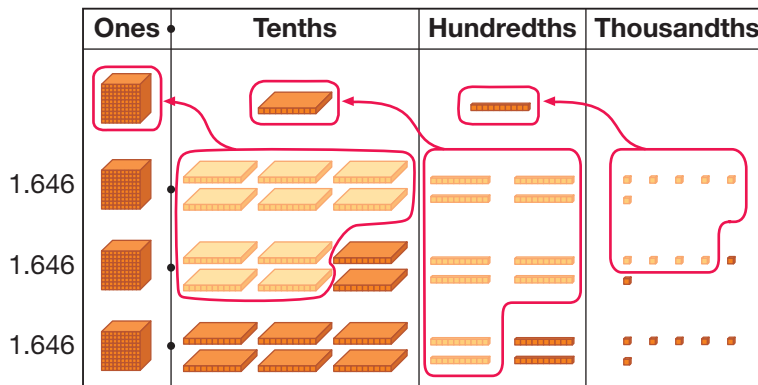
Jiri then counted the blocks.
4 ones + 9 tenths + 3 hundredths + 8 thousandths = 4.938
So, 1.646 × 3 = 4.938

• Hanna used the strategy for multiplying 2 whole numbers,
then estimated to place the decimal point.

The closest whole-number benchmark to 1.646 is 2.
2 × 3 = 6
Hanna placed the decimal point in the product so the
whole number part is a number close to 6; that is: 4.938

$$\begin{array}{r} 1646 \\ \times\ 3 \\ \hline 18 \\ 120 \\ 1800 \\ 3000 \\ \hline 4938 \end{array}$$

So, 1.646 × 3 = 4.938

Beth and Ujjal travelled 4.938 km on the Superman Ride of Steel.

Practice

1. Use Base Ten Blocks to multiply.

   a) 2.3
      × 2

   b) 1.8
      × 4

   c) 1.23
      × 5

   d) 2.42
      × 3

2. The decimal point is missing in each product.
   Use front-end estimation to place each decimal point.

   a) 7.1 × 5 = 355

   b) 3.12 × 6 = 1872

   c) 15.466 × 3 = 46398

   d) 1.408 × 5 = 7040

   e) 2.005 × 8 = 1604

   f) 8.25 × 4 = 330

3. Use benchmarks to estimate each product.

   a) 2.4 × 6

   b) 4.38 × 4

   c) 1.499 × 6

   d) 6.721 × 2

   e) 3.983 × 3

   f) 7.3225 × 5

4. Multiply.

   a) 8.2 × 4

   b) 1.02 × 6

   c) 5.9 × 2

   d) 6.112 × 3

   e) 3.525 × 7

   f) 5.354 × 6

5. Estimate to choose the correct product for each multiplication question.

	Question	Possible Products		
a)	2.85 × 3	855	85.5	8.55
b)	12.36 × 4	494.4	49.44	4.944
c)	148.73 × 5	7.4365	74.365	743.65

6. Elisa works in a hospital lab in Brandon, Manitoba.
   In 1 h, she tested 7 tubes of blood.
   Each tube contained 12.25 mL of blood.
   How much blood did Elisa test?
   How did you find out?

7. Naja saved $14.75 each week for 8 weeks.
   She had just enough money to buy a family membership
   to the Vancouver Aquarium. About how much was
   the cost of the membership?

8. Tianna has saved $9.75 each week for 7 weeks.
   She wants to buy a snowboard that costs $80.45, including tax.
   a) Does Tianna have enough money? How do you know?
   b) If your answer to part a is no, how much more money does Tianna need?

9. The decimal point in some of these products is in the wrong place. Identify the mistakes, then write each product with the decimal point in the correct place.
   a) $4.01 \times 5 = 200.5$ b) $7.893 \times 3 = 23.679$
   c) $89.85 \times 4 = 35.94$ d) $1.98 \times 3 = 0.594$

10. a) Akuna sold three 1.375-L bottles of birch syrup to raise money for his school in Hay River.
       Did Akuna sell more or less than 4 L of syrup?
       How much more or less? Explain how you know.
    b) Akuna sold each bottle of syrup for $74.79.
       How much money did he raise?

11. The Townsend's big-eared bat lives in river valleys in southern British Columbia. It has a mass of 8.812 g. What is the combined mass of 6 of these tiny bats?

12. Write a story problem that can be solved by multiplying 4.026 by 7. Trade problems with a classmate and solve your classmate's problem.

13. You can estimate how tall a child will be as an adult by doubling her height at 2 years of age. Serena is 2 years old and 81.4 cm tall. About how tall will Serena be as an adult?

14. The Three Dog Bakery in Vancouver sells bags of all-natural chicken-flavoured dog food for $7.95 each. Saima buys 3 bags.
    a) Saima gives the cashier $25.00.
       How much change should she receive?
    b) Each bag has a mass of 2.268 kg.
       Does Saima have more or less than 7 kg of dog food altogether? How do you know?

Reflect

Explain how you decide where to place the decimal point in the product 7.146×7.

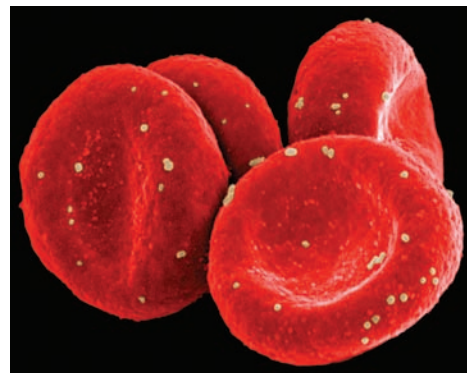# Multiplying a Decimal Less than 1 by a Whole Number

Iron is a part of our blood.
It helps to deliver oxygen throughout the body.
A typical Grade 6 student needs 0.008 g of iron each day.
How much iron does a Grade 6 student need in one week?

What happens if you use front-end estimation
to check your answer?

Explore

You will need a calculator.

Copy and complete the multiplication statements.
Use a calculator to find the products in the 2nd and 3rd columns.

$1 \times 1 =$	$0.1 \times 1 =$	$0.01 \times 1 =$
$1 \times 2 =$	$0.1 \times 2 =$	$0.01 \times 2 =$
$1 \times 3 =$	$0.1 \times 3 =$	$0.01 \times 3 =$
$1 \times 4 =$	$0.1 \times 4 =$	$0.01 \times 4 =$
$1 \times 5 =$	$0.1 \times 5 =$	$0.01 \times 5 =$
$1 \times 6 =$	$0.1 \times 6 =$	$0.01 \times 6 =$
$1 \times 7 =$	$0.1 \times 7 =$	$0.01 \times 7 =$
$1 \times 8 =$	$0.1 \times 8 =$	$0.01 \times 8 =$
$1 \times 9 =$	$0.1 \times 9 =$	$0.01 \times 9 =$

➤ Describe the patterns you see.
➤ Insert a column to the right.
  Use your patterns to predict the entries in this new column.

Show and Share

Share your patterns with another pair of students.
How are the products in each row alike? How are they different?
What do you notice about the product when you multiply 0.1 by a 1-digit whole number?
0.01 by a 1-digit whole number? 0.001 by a 1-digit whole number?

When you multiply a decimal less than 1 by a whole number,
the product is less than the whole number.
You can use place value and estimation to multiply a decimal less than 1
by a 1-digit whole number.

➤ To multiply 0.9 by 2:
Use Base Ten Blocks.
Model 2 groups of 0.9.
0.9 is nine tenths.
Nine tenths multiplied by 2 is 18 tenths.
Trade 10 tenths for 1 one.

Ones	Tenths
0.9	
0.9	

1 one + 8 tenths = 1.8
So, $0.9 \times 2 = 1.8$

Ones	Tenths

➤ To multiply 0.15 by 4:
Use Base Ten Blocks.
Model 4 groups of 0.15.
0.15 is 15 hundredths, which is 1 tenth and 5 hundredths.

Ones	Tenths	Hundredths
0.15		
0.15		
0.15		
0.15		

Trade 10 hundredths
for 1 tenth.
Trade another 10 hundredths
for 1 tenth.

Ones	Tenths	Hundredths

0 ones + 6 tenths + 0 hundredths = 0.60
So, $0.15 \times 4 = 0.60$

0.60 is 60 hundredths,
which is 6 tenths.

➤ To multiply 0.0138 by 9, multiply the whole numbers: 138×9

$$
\begin{array}{r}
138 \\
\times\ 9 \\
\hline
72 \\
270 \\
900 \\
\hline
1242
\end{array}
$$

Estimate to place the decimal point.

So, $0.0138 \times 9 = 0.1242$

> To estimate, I use compatible numbers.
> 0.0138 is close to 0.01.
> 0.01 is 1 hundredth.
> One hundredth multiplied by 9 is 9 hundredths.
> Nine hundredths are close to 10 hundredths, or 1 tenth.
> Place the decimal point so the product is close to 1 tenth; that is:
> 0.1242
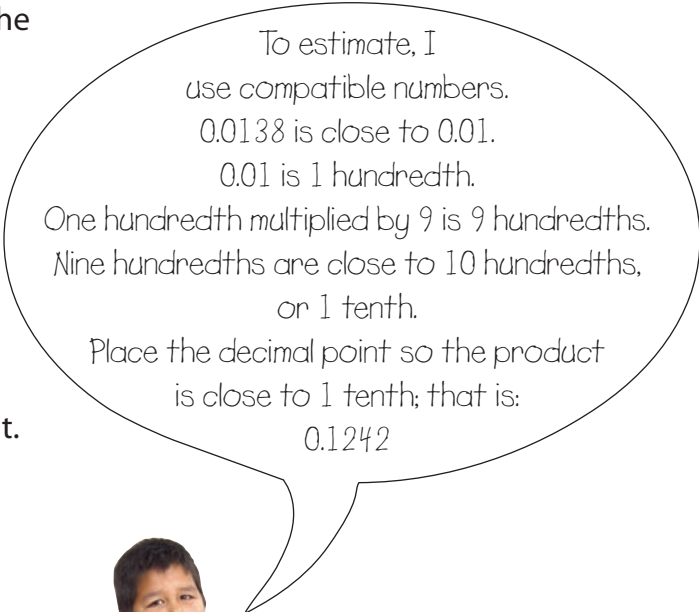
Practice

1. Use Base Ten Blocks.
   Multiply.
   a) 0.6×4 b) 0.12×3 c) 0.21×2
   d) 0.34×5 e) 0.215×3 f) 0.408×2

2. Copy this place-value chart.
   Multiply. Record each product in the chart.

Ones	•	Tenths	Hundredths	Thousandths	Ten-Thousandths
	•				

   a) 0.005×7 b) 0.42×9 c) 0.029×5
   d) 0.0328×9 e) 0.276×6 f) 0.1036×8

3. Multiply. Describe your strategies.
   a) 0.9×3 b) 0.25×6 c) 0.018×4
   0.09×3 0.025×6 0.0018×4
   0.009×3 0.0025×6 $0.000\,18 \times 4$
   What patterns do you see?

4. Shona cut a ribbon into 8 equal lengths
to finish sewing her Fancy Shawl Regalia.
Each piece was 0.158 m long.
   a) How long was the ribbon before Shona cut it?
   b) How many cuts did she make?

5.

Juice	Vitamin C per glass (g)
Pure Orange Juice	0.054
Pure Apple Juice	0.0009

Woman Dancing an Aboriginal
Fancy Dance

   a) Stefan drinks a glass of pure orange juice
each morning with his breakfast.
How much Vitamin C does Stefan get from orange juice each week?
   b) Stefan went to Sasamat Outdoor Centre's overnight camp for one week.
He drank a glass of pure apple juice each morning with his breakfast.
How much Vitamin C did Stefan get from apple juice that week?

6. Without multiplying, choose the correct product
for each multiplication question.
Explain your choice each time. Multiply to check.

	Question	Possible Products		
a)	0.063×9	5.67	0.567	0.0567
b)	0.349×7	2.443	0.2443	0.024 43
c)	0.0078×5	0.39	0.039	0.0039

7. Multiply as you would whole numbers. Estimate to place the decimal point.
   a) 0.359×5 **b)** 0.0112×9 **c)** 0.083×4
   d) 0.89×6 **e)** 0.0063×7 **f)** 0.097×8

8. A student said that since $11 \times 5 = 55$, then 0.0011×5 is 0.55.
Is the student's reasoning correct?
Give reasons for your answer.

Reflect

How can you use your knowledge of multiplication facts to help you
multiply a decimal less than 1 by a 1-digit whole number?

Dividing Decimals by a Whole Number

The Paralympic Games are an international sports competition for athletes with disabilities. They are held in the same year and city as the Olympic Games. Vancouver was named host of the 2010 Paralympic Games.

For most paralympic sports, the athletes are grouped into classes according to their balance, coordination, range of motion, and skills required for the sport.

Chantal Petitclerc, French-Canadian Paralympian and 5-Time Gold Medalist, Beijing 2008

Explore

One event in the Paralympics is the men's 1-km time trial cycling.
Each competitor completes 4 laps of a 250-m track.
In 2004, the winner of the gold medal in the CP3/4 class was Darren Kenny of Great Britain. He completed the 4 laps in 74.472 s.

The Canadian competitor in this event was Jean Quevillon.
He finished in 10th place, with a time of 83.848 s.

About what time did each cyclist take to complete one lap?
Use any materials you think may help.
Estimate first. Then calculate the times.

Show and Share

Share your solutions with another pair of classmates.
Discuss the strategies you used to estimate and to solve the problems.
How can you verify your answers?
In a race, do you think the time to complete each lap would be the same? Explain.

LESSON FOCUS | Divide decimals to thousandths by a 1-digit number.

St-Pierre-Jolys is a small town in Manitoba. Every August, it is home to the *Frog Follies* frog-jumping contest. The longest jump on record is 5.18 m.
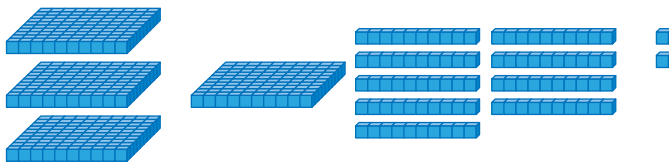
➤ Rochelle entered 3 frogs into the *Frog Follies*. The total distance the frogs travelled was 4.92 m. About how far did each frog travel?
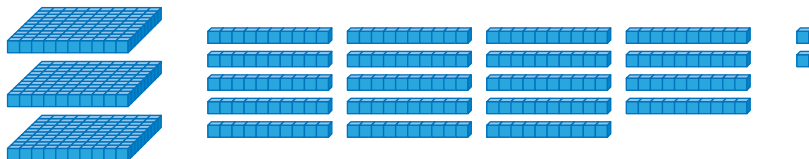Divide: 4.92 ÷ 3

Rochelle used Base Ten Blocks to model 4.92.   Rochelle recorded her work:

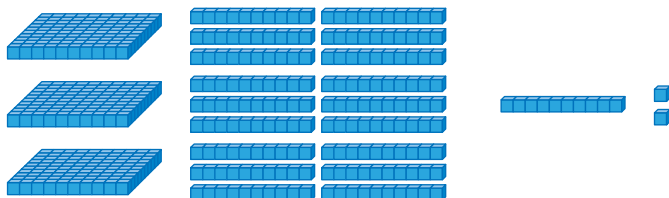|	o	t	h
	1		
3)	4	9	2
−	3		
	1		

Rochelle arranged the ones blocks into 3 equal rows.

Each row has 1 one, with 1 one, 9 tenths, and 2 hundredths left over.
Rochelle traded 1 one for 10 tenths. Now there are 19 tenths.

Rochelle arranged the 19 tenths among 3 groups. Each group has 1 one and 6 tenths, with 1 tenth and 2 hundredths left over.

	o	t	h
	1	6	
3)	4	9	2
−	3	↓	
	1	9	
−	1	8	
		1	

Rochelle traded 1 tenth for 10 hundredths.
Now there are 12 hundredths.
She shared the hundredths blocks equally among the 3 groups.
Each group has 4 hundredths.
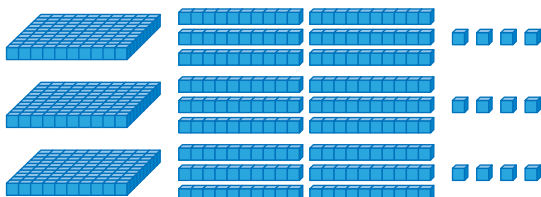
Each group has 1 one, 6 tenths, and 4 hundredths.

	o	t	h
	1	6	4
3)	4	9	2
−	3	↓	
	1	9	↓
−	1	8	↓
		1	2
−		1	2
			0

So, $4.92 \div 3 = 1.64$
Each frog travelled 1.64 m.

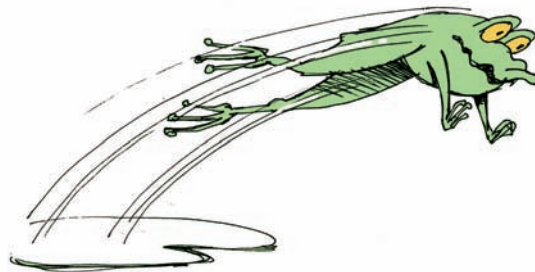➤ Luc's frog travelled 16.64 m in 4 jumps.
About how far did the frog travel in 1 jump?

Divide: $16.64 \div 4$

- Dominique used a strategy for dividing 2 whole numbers,
  then used front-end estimation to place the decimal point.
  She used repeated subtraction to divide.

4)	1	6	6	4			
−	4	0	0		1	0	0
	1	2	6	4			
−	4	0	0		1	0	0
		8	6	4			
−	4	0	0		1	0	0
		4	6	4			
−	4	0	0		1	0	0
			6	4			
	−	4	0			1	0
			2	4			
	−	2	4				6
			0	4	1	6	

Write 16.64 as 16.
$16 \div 4 = 4$
Dominique placed the decimal
point in the answer so the whole
number part is a number close
to 4; that is: 4.16

So, $16.64 \div 4 = 4.16$

We can use multiplication
to check:
$4.16 \times 4 = 16.64$
So, the answer is correct.

- Marcel used a strategy for dividing 2 whole numbers,
  then used estimation to place the decimal point.
  To divide: $1664 \div 4$

Marcel broke 1664 into numbers that he could divide easily by 4.
$1664 = 1000 + 600 + 64$

$1000 \div 4 = 100$ tens $\div 4$ $600 \div 4 = 60$ tens $\div 4$ $64 \div 4 = 16$
          $= 25$ tens $= 15$ tens
          $= 250$ $= 150$

So, $1664 \div 4 = 250 + 150 + 16$
                $= 416$

Marcel estimated to place the decimal point.
Since 16.64 is about 16, and $16 \div 4 = 4$, he placed the decimal point
between the 4 and the 1.
So, $16.64 \div 4 = 4.16$

Luc's frog travelled about 4.16 m in 1 jump.

1. Use Base Ten Blocks to divide.
   a) 6.25 ÷ 5   b) 4.24 ÷ 4   c) 1.68 ÷ 3   d) 3.9 ÷ 6

2. The decimal point is missing in each quotient.
   Use estimation to place each decimal point.
   a) 8.2 ÷ 2 = 41   b) 3.81 ÷ 3 = 127
   c) 1.992 ÷ 8 = 249   d) 9.45 ÷ 5 = 189
   e) 11.916 ÷ 9 = 1324   f) 62.8 ÷ 8 = 785

3. Estimate each quotient. Which strategies did you use?
   a) 26.34 ÷ 8   b) 15.27 ÷ 3   c) 2.304 ÷ 4
   d) 5.8 ÷ 8   e) 8.088 ÷ 6   f) 2.316 ÷ 2

4. Divide. Multiply to check your answers.
   a) 27.025 ÷ 5   b) 3.42 ÷ 6   c) 7.735 ÷ 7
   d) 16.072 ÷ 8   e) 30.9 ÷ 5   f) 3.438 ÷ 6

5. Estimate to choose the correct quotient for each division question.

	Question	Possible Quotients		
a)	8.124 ÷ 6	1.354	13.54	135.4
b)	37.92 ÷ 3	0.1264	1.264	12.64
c)	7.624 ÷ 8	0.953	9.53	95.3

6. Aqpik Peter is a young Inuit speed skater from Nunavut. He is one of 3 First Nations athletes being showcased for the 2010 Vancouver Olympics. At practice, Aqpik skated 2.75 km in 5 min. About how far did Aqpik skate in 1 min?

7. Eric cycled 2.25 km in 5 min.
   Josie cycled 2.72 km in 8 min.
   Who travelled farther in 1 min?
   Show your work.

8. Sharma paid $58.50 to board her cat at a kennel
   in Yellowknife for 5 days.
   Her friend Miles paid $12.50 each day to board his cat
   at a different kennel for 5 days.
   Who paid the lesser amount?
   Explain how you know.

9. The decimal point in some of these quotients
   is in the wrong place. Identify the mistakes, then write
   each quotient with the decimal point in the correct place.
   a) $44.8 \div 8 = 0.56$ b) $14.805 \div 5 = 2.961$
   c) $3.15 \div 6 = 5.25$ d) $8.127 \div 1 = 0.8127$

10. A student divided 1.374 by 4 and got 3.435.
    a) Without dividing, how do you know the answer is incorrect?
    b) What do you think the student did wrong?
    c) What is the correct answer? How can you check?

11. Write a story problem that can be solved by dividing 14.28 by 3.
    Trade problems with a classmate and solve your classmate's problem.

12. A square park has a perimeter of 14.984 km.
    How long is each side of the square?

13. In good weather, Hannah rides her bike to school and back each day.
    One week, Hannah rode her bike on 4 days.
    That week, Hannah rode 10.832 km in total.
    The following week, she rode her bike all 5 days.
    How far did Hannah ride the second week?

Reflect

Why is estimating important when dividing with decimals?
Use words, pictures, or numbers to explain.

6 Dividing Decimals

You and 2 friends have found $10.
You want to share the money.
How much will each person get?

Explore

A group of hikers on a 4-day trip travelled
96.575 km on the Trans Canada Trail.
About how far did the group travel each day?

To pay for the trip, each group of 3 hikers
had to raise at least $125.50.
How much did each hiker have to raise?

Use any materials you want.
Solve the problems. Show your work.

Show *and* Share

Share your work with another pair of classmates.
What strategies did you use?
Are your answers exact? How do you know?
What strategies can you use to check your answers?

➤ Four hikers want to share a 9.45-L jug of water equally. How much water will each hiker get?

Divide: 9.45 ÷ 4

Use long division.
Divide as with whole numbers.

		2	3	6	2	5
4	)	9	4	5	0	0
−		8				
		1	4			
−		1	2			
			2	5		
	−		2	4		
				1	0	
			−		8	
				2	0	
			−		2	0
						0

Since there is a remainder, write a 0 in the dividend so we can continue to divide.

There is still a remainder. Write another 0 in the dividend.

Estimate to place the decimal point.
The closest whole-number benchmark to 9.45 is 9.

9.45

9   10

9 ÷ 4 is a little more than 2.
So, place the decimal point in the quotient so the whole number part is a number close to 2; that is: 2.3625
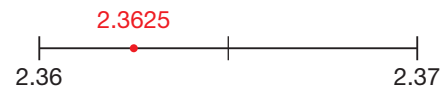
So, 9.45 ÷ 4 = 2.3625   This quotient is *exact*.

When a quotient is a measurement, we give the answer
in a form that makes sense.
Since the volume of water was given to a hundredth of a litre,
we write the quotient to the closest hundredth.
2.3625 is closer to 2.36 than to 2.37,
so write the quotient as 2.36.

2.3625

├──────────┼──────────┤
2.36   2.37

Each hiker got about 2.36 L of water.

Check the answer by multiplying the quotient
by the divisor.
$2.36 \times 4 = 9.44$
9.44 is close to the dividend, 9.45.
So, the answer is reasonable.

➤ One morning, the hikers travelled 10.4 km in 3 h.
About how far did the hikers travel in 1 h?

Divide: $10.4 \div 3$
Divide as whole numbers. Use short division.
Write zeros in the dividend.

$$\begin{array}{r} 3\,4\,6\,6\,6 \\ 3\overline{)10^14^20^20^20^2} \end{array}$$

> Sometimes you may never stop dividing, no matter how many zeros you write in the dividend.

Estimate to place the decimal point.
The closest whole-number benchmark to 10.4 is 10.
$10 \div 3$ is a little more than 3.
So, place the decimal point between the 3 and the 4;
that is: 3.4666 …
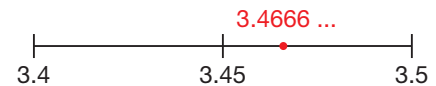
So, $10.4 \div 3 = 3.4666 \ldots$ This quotient is
approximate.

> The dots indicate that the decimal places go on forever.

Since the distance was given to a tenth of a kilometre,
we write the quotient to the closest tenth.
3.4666 … is closer to 3.5 than to 3.4,
so, write the quotient as 3.5.

3.4666 ...

├──────────┼──────────┤
3.4   3.45   3.5

The hikers travelled about 3.5 km in 1 h.

Check the answer by multiplying the quotient by the divisor.
$3.5 \times 3 = 10.5$
10.5 is close to the dividend, 10.4.
So, the answer is reasonable.

Practice

1. Estimate to choose the correct quotient for each division question.

	Question	Possible Quotients		
a)	4.4 ÷ 5	0.88	8.8	88
b)	10.32 ÷ 6	0.172	1.72	17.2
c)	87.2 ÷ 4	0.218	2.18	21.8

2. Divide. Estimate to place the decimal point.
   a) 8.235 ÷ 6   **b)** 12.6 ÷ 5   **c)** 39.77 ÷ 2
   d) 88.2 ÷ 5   **e)** 2.367 ÷ 4   **f)** 4.573 ÷ 5

3. Divide. Write each quotient to the same number of decimal places as there are in the dividend.
   a) 3.05 ÷ 2   **b)** $49.67 ÷ 6   **c)** 6.1 ÷ 9
   d) 1.189 ÷ 3   **e)** 24.73 ÷ 9   **f)** $26.53 ÷ 6

4. In a snail-racing contest, Noba's snail crawled 1.677 m in 5 min. About how far did the snail travel each minute?

5. Check each division below. For each incorrect quotient, explain the error, then write the correct quotient.
   a) 1.44 ÷ 6 = 0.24   **b)** $15.97 ÷ 5 = $3.194
   c) 4.422 ÷ 3 = 14.74   **d)** 17.27 L ÷ 3 = 5.756 L

6. Richard divided a 1.954-L bottle of spicy tomato juice equally among 5 glasses. How much juice is in each glass?

7. Marina packed eight 2.54-L bottles of fruit juice for a 3-day camping trip to Beauvais Lake Provincial Park in Alberta. About how many litres of fruit juice does that allow for each day?

8. Three friends rent a movie for $6.49 and buy a package of popcorn for $1.82. They share the cost equally. How much should each person pay? Show your work.

Reflect

How do you know if a quotient is exact or approximate? Include examples in your explanation.

Dividing a Decimal Less than 1 by a Whole Number

How can you find 0.06 ÷ 3?
What happens if you use front-end estimation to check your answer?

Explore

You will need a calculator and a place-value chart.

➤ Use a calculator to find each quotient.

a)	b)	c)
1 ÷ 4	25 ÷ 5	168 ÷ 8
0.1 ÷ 4	2.5 ÷ 5	16.8 ÷ 8
0.01 ÷ 4	0.25 ÷ 5	1.68 ÷ 8
0.001 ÷ 4	0.025 ÷ 5	0.168 ÷ 8
	0.0025 ÷ 5	0.0168 ÷ 8
		0.001 68 ÷ 8

Record the quotients in a place-value chart.

Division	Tens	Ones	Tenths	Hundredths	Thousandths	Ten-Thousandths	Hundred-Thousandths
1 ÷ 4							
0.1 ÷ 4							

➤ What patterns do you see in the expressions and their quotients?
Use these patterns to find the quotients below.

d)	2 ÷ 8	0.2 ÷ 8	0.02 ÷ 8	0.002 ÷ 8	0.0002 ÷ 8
e)	35 ÷ 7	3.5 ÷ 7	0.35 ÷ 7	0.035 ÷ 7	0.0035 ÷ 7
f)	198 ÷ 9	19.8 ÷ 9	1.98 ÷ 9	0.198 ÷ 9	0.0198 ÷ 9

Show and Share

Share the patterns you found with another pair of students.
What patterns do you see in the dividends? In the quotients?
How can you use the quotient of 12 ÷ 4 to help you find 0.12 ÷ 4?
To find 0.012 ÷ 4?
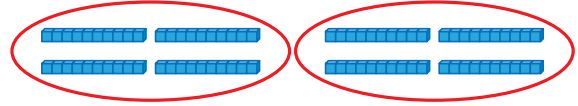
Connect

Here are two strategies to divide a decimal less than 1 by a whole number.

➤ Use Base Ten Blocks.
  • To divide 0.8 by 2:
    0.8 is eight tenths.
    Eight tenths divided by 2 is 4 tenths.
    So, 0.8 ÷ 2 = 0.4

  • To divide 0.15 by 3:
    0.15 is fifteen hundredths.
    Fifteen hundredths divided by 3 is 5 hundredths.
    So, 0.15 ÷ 3 = 0.05

➤ Use place value.
  To divide 0.074 by 8:

  Estimate first. 0.074 is close to 0.072.
  0.072 is 72 thousandths.
  Seventy-two thousandths divided by 8 is 9 thousandths.   We know 72 ÷ 8 = 9.
  So, 0.074 ÷ 8 is about 0.009.

		o	t	h	th	Tth	Hth
		0	0	0	9	2	5
8	)	0	0	7	4	0	0
			−	7	2		
					2	0	
				−	1	6	
						4	0
				−		4	0
							0

Write zeros in the dividend until there is no remainder.

So, 0.074 ÷ 8 = 0.009 25
Since 0.009 25 is close to the estimate, 0.009, the answer is reasonable.

Practice

1. Divide.
   a) 0.28 ÷ 4
   b) 0.042 ÷ 7
   c) 0.015 ÷ 3
   d) 0.024 ÷ 6
   e) 0.16 ÷ 8
   f) 0.0036 ÷ 9

2. Find each quotient. What patterns do you see?
   a)   0.9 ÷ 3
         0.09 ÷ 3
        0.009 ÷ 3

   b)   0.56 ÷ 7
        0.056 ÷ 7
      0.0056 ÷ 7

   c)   0.108 ÷ 9
       0.0108 ÷ 9
     0.001 08 ÷ 9

3. Quincy has 0.926 m of string.
   Suppose he cuts the string into 4 equal lengths.
   What is the length of each piece of string?

4. a) A typical hamster eats 0.084 kg of food a week.
   About how much food does a hamster
   eat in one day?
   b) Jiri's hamster was put on a special diet.
   Over 5 days, his hamster ate about 0.054 kg of food.
   About how much food did Jiri's hamster eat in one day?

5. Without dividing, choose the correct quotient for each division question.
   Explain your choice each time. Divide to check.

	Question	Possible Quotients		
a)	0.072 ÷ 9	0.8	0.08	0.008
b)	0.124 ÷ 8	0.155	0.0155	0.001 55
c)	0.0045 ÷ 2	0.225	0.0225	0.002 25

6. A student said that since 51 ÷ 3 = 17, then 0.051 ÷ 3 is 0.17.
   Is the student's reasoning correct? Give reasons for your answer.

7. Divide. Which strategies did you use to estimate?
   a) 0.66 ÷ 8
   b) 0.058 ÷ 4
   c) 0.375 ÷ 5
   d) 0.05 ÷ 8
   e) 0.0061 ÷ 2
   f) 0.039 ÷ 6

Reflect

How can you use division facts to help you divide a decimal less
than 1 by a whole number?
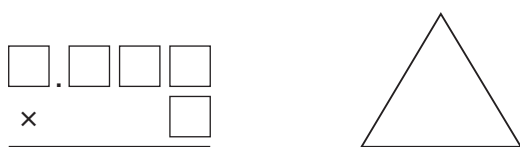
Make the Lesser Product

You will need a spinner with 10 congruent sectors, labelled 0 to 9, an open paper clip as a pointer, and a sharp pencil to keep it in place.

Players create a product of a decimal and a whole number. The object of the game is to make the lesser product.

Decide who will be Player A and Player B.

➤ Each player copies the grid and triangle below.

➤ Player A spins the pointer on the spinner.
   In a box on his grid, Player A writes the number the pointer lands on.
   If Player A decides that he does not want to use that number,
   he writes it in the triangle.
   Only one number can be written in the triangle.
➤ Player B has a turn.
➤ Players continue to take turns until all the boxes are full.
   Once a number is placed, it cannot be changed.
➤ Players find the product of their numbers.
   The player with the lesser product wins.
➤ Play the game again. This time, the greater product wins.

Strategies Toolkit

Explore

Suppose you are asked to solve this problem:
Discuss what this question asks you to do.
Solve the problem.

Show and Share

Share your work with another pair
of classmates. Describe what you did
to make sure you understood
the problem. Compare your solutions.

> Use each of the digits 3, 4, 5, and 6 once.
> Replace each □ with a digit to make the greatest possible product.
>
> □.□□
> × □

Connect

Here are some strategies you can use to understand
what the problem is about:

- Copy the problem.
- Underline the important words.
- Look at each part, one at a time.
  Think about what each part means.
- Highlight what you are asked to find.
- Decide what form your answer should take.
  Will your answer include:
  - a number?
  - a table?
  - a diagram?
  - a written explanation?
  - a graph?
- Think about how many parts your answer needs.

Strategies for Success

- **Check and reflect.**
- **Focus on the problem.**
- **Represent your thinking.**
- **Explain your thinking.**

Here is one way to solve this problem:
Which items sell for <u>less than $0.75 each</u>?

Shower scrunchies	5 for $4.00
Lip gloss	6 for $3.90
Plush pens	9 for $6.57
Yoyos	3 for $2.43
Candy necklaces	4 for $2.76

After I find an item, I must try to find another item.

Find as many items as you can.
<u>Write</u> the price of <u>each item you find</u> in <u>dollars</u>.

There are 3 items. They are:
lip gloss, $0.65; plush pen, $0.73; candy necklace, $0.69

Practice

The table shows the results of the men's
4 × 100 m relay final at the Melbourne 2006
Commonwealth Games.
Use the data in the table to answer the questions.
Describe what you did to understand each problem.

Country	Time (s)
Antigua and Barbuda	40.76
Canada	39.21
Jamaica	38.36
Mauritius	39.97
South Africa	38.98

1. a) Which country won the men's relay race?
   How do you know?
   b) Where did Canada place? How did you find out?

2. a) Each of the 4 relay team members runs a distance
   of 100 m. About how long did each country's
   team members take to run 100 m?
   Show your solution.
   b) Do you think each team member took the same
   amount of time? Explain.

Reflect

Describe what you can do to understand a problem.
Use examples to explain.

LESSON

1

1. Write each number in standard form.
   a) 2 and 12 ten-thousandths
   b) 7 millionths
   c) 16 and 46 hundred-thousandths
   d) 1 and 51 millionths

2. How are the values of the red digits in each number related?
   a) 0.626   b) 5.489 48   c) 0.000 355   d) 9.39

3. The Bigleaf Maple tree is native to the Queen Charlotte Islands. It produces winged seeds that can be carried long distances by the wind. A seed has a mass of about 0.126 582 g. Write this number as many ways as you can.

2

4. Estimate. Which strategies did you use? Tell if your estimate is an overestimate or an underestimate.
   a) 6.23×4 b) 21.872×3 c) 9.49×7
   d) $18.39 \div 3$ e) $125.431 \div 5$ f) $19.8 \div 4$

3

5. The decimal point is missing in each product. Use front-end estimation to place each decimal point.
   a) $6.9 \times 7 = 483$ b) $7.53 \times 3 = 2259$
   c) $11.288 \times 4 = 45152$ d) $2.307 \times 5 = 11535$
   e) $3.005 \times 4 = 1202$ f) $4.916 \times 5 = 2458$

6. The Giant Fan Palm produces the world's largest seed. A seed has a mass of about 9.075 kg. What is the combined mass of 6 of these seeds?

4

7. Multiply. Estimate to place the decimal point.
   a) 0.321×6 b) 0.0249×5 c) 0.0043×7

8. The recipe Sebastian wants to make requires 1.5 L of evaporated milk. He has four 0.385-L cans. Does he have enough milk? Show your work.

5

9. Estimate each quotient. Which strategies did you use?

    a) 36.57 ÷ 6   **b)** 22.41 ÷ 4   **c)** 4.189 ÷ 2

    d) 42.3 ÷ 9   **e)** 8.27 ÷ 4   **f)** 7.1348 ÷ 8

10. Estimate to choose the correct quotient for each division question.

	Question	Possible Quotients		
a)	9.348 ÷ 3	3.116	31.16	311.6
b)	52.925 ÷ 5	0.105 85	1.0585	10.585
c)	1.888 ÷ 8	0.236	2.36	23.6

11. James Steacy of Saskatoon won the silver medal
in the men's discus throw at the 2006 Commonwealth
Games in Melbourne, Australia. In the finals, James threw
the discus 6 times for a total distance of 431.94 m.
About how far did he throw each discus?

6

12. Divide.

    a) 24.15 ÷ 6   **b)** $31.87 ÷ 8   **c)** 9.3 ÷ 6

    d) 14.523 L ÷ 4   **e)** 3.5 m ÷ 9   **f)** $11.68 ÷ 9

13. The Coulter Pine produces the world's
most massive pine cones. The combined mass
of 8 of these cones is 25.259 kg.
Find the mass of one Coulter Pine cone
to the nearest hundredth
of a kilogram.

7

14. Divide. Which strategies did you use
to estimate?

    a) 0.58 ÷ 8   **b)** 0.066 ÷ 4   **c)** 0.142 ÷ 8

    d) 0.0075 ÷ 6   **e)** 0.081 ÷ 6   **f)** 0.09 ÷ 5

15. Darcy takes one chewable multivitamin
each morning. Each week, Darcy gets
0.0119 g of riboflavin from the vitamins.
How much riboflavin is in one multivitamin?
Show your work.

UNIT

3 Learning Goals

☑ use place value to represent
numbers less than
one thousandth

☑ multiply decimals by a
1-digit number

☑ divide decimals by a
1-digit number

Harnessing the Wind

Every day, thousands of people *ride the wind* in Calgary.
Calgary's C-Train is North America's first wind-powered
public transit system.
It runs on electricity generated by 12 wind turbines.

On average, the Calgary C-Train uses 403.846 megawatt hours of electricity each week.

In Canada, the current cost of wind-generated electricity is 5 to 10 cents per kilowatt hour.

As of early 2008, Canada produced about 15 342 gigawatt hours of electricity from wind per day.

The typical Canadian home uses about 25.75 kilowatt hours of electricity per day.

1. How many megawatt hours of electricity does the Calgary C-Train use in one day?

2. It takes about 2.34 kilowatt hours of electricity to do one load of laundry.
   A large family does one load of laundry each day.
   a) About how many kilowatt hours of electricity does the family use on laundry in one week?
   b) Suppose this electricity was wind generated. How much would it cost to generate the electricity for the weekly laundry? Explain your answer.

3. A wind farm in Saskatchewan has 9 identical turbines. Together they generate 18.9 gigawatt hours of electricity in 1 year. How much electricity does 1 turbine generate?

4. Use some of the data on pages 87 and 120. Write a problem about wind energy. Solve your problem. Show your work.

Reflect on Your Learning

What did you find easy about working with decimals?
What was difficult for you?
Give examples to illustrate your answers.

Unit

1

1. The pattern rule that relates the input to the output is:
   Add 2 to the input. Then divide by 5.
   Find the missing numbers in the table at the right.
   How can you check your answers?

Input	Output
3	1
?	3
18	?
43	?
?	14

2. The table, below right, shows the input and output for
   a machine with two operations.
   a) Identify the numbers and operations in the machine.
   b) Write a pattern rule that relates the input to the output.
   c) Graph the data in the table.
      Describe the relationship shown on the graph.
   d) Write an expression to represent the pattern.
   e) Find the output when the input is 14.
      Which strategy did you use?

Input	Output
5	11
6	14
7	17
8	20

3. a) Make an Input/Output table for this graph.
   b) How does the graph represent the pattern?
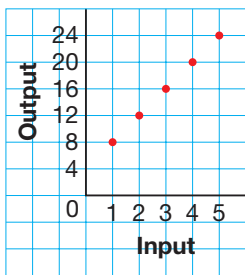
4. Which of the scales are balanced? How do you know?
   a) Left pan: 4×12 Right pan: $60 - 12$
   b) Left pan: $27 + 8$ Right pan: 8×4
   c) Left pan: $37 - 23$ Right pan: $42 \div 3$

2

5. In 2007, about 304 000 people visited the Telus
   World of Science in Calgary. About 54 500 of these
   visitors were students. In 2006, the total number of
   visitors was 263 000.
   a) By how much did the attendance increase
      from 2006 to 2007?
   b) How many of the visitors in 2007 were not students?
   c) What was the total attendance over the 2 years?

Unit

6. Find all the common multiples of 3 and 4 between 10 and 100.

7. Find all the factors of each number. Record the factors as a "rainbow."
Which factors are prime numbers?
a) 49   **b)** 32   **c)** 66   **d)** 96

8. Evaluate each expression. Explain why the answers are different.
a) 15 + 6 ÷ 3   **b)** (15 + 6) ÷ 3

9. Use a number line. Order these integers from least to greatest.
+5, −6, −8, 2, 0, −5, −1

10. Write the number in each fact in as many different forms as you can.
a) The Asian watermeal is the world's smallest flowering plant.
It has a mass of about 0.000 15 g.
b) The typical length of a human liver cell is about 0.000 05 m.

11. Jenny paid $19.25 for 7 admission tickets to the Assiniboine Park Zoo
in Manitoba. Estimate the cost of 1 admission ticket.
How did you find out?

12. Multiply.
a) 3.7 × 9   **b)** 4.03 × 5
c) 6.841 × 6   **d)** 0.004 × 9
e) 0.0013 × 3   **f)** 0.093 × 7

13. In the 2006 Turin Olympics, Cindy Klassen
of Winnipeg, Manitoba won a silver medal
in the women's 1000-m speed skating event.
She skated 9 laps in 76.09 s. About how long
did it take Cindy to skate 1 lap?

14. Divide.
a) 3.192 ÷ 7   **b)** 11.59 ÷ 5
c) 36.752 ÷ 8   **d)** 0.049 ÷ 7
e) 0.0096 ÷ 8   **f)** 0.0567 ÷ 9