

# 8.3

## Exploring Integer Division

### Focus on...

After this lesson, you will be able to...

- divide integers using integer chips

Grizzly bears lose much of their body mass during their winter sleep. A large male bear may enter his den at 300 kg in November. He may lose 75 kg by the time he emerges five months later. How would you represent a loss of 75 kg with an integer? What operation would you use to find the average loss of mass in one month?



### Explore the Math

#### Materials

- red and blue integer chips

#### Literacy Link

##### Understanding Division

In the division statement  $6 \div 2 = 3$ , the dividend is 6, the divisor is 2, and the quotient is 3.

This division statement means that in 6 there are 3 groups of 2. It also means that when 6 is separated into 2 equal groups, there are 3 in each group.

#### How can you use integer chips to divide two integers?

- The diagram shows a way to model the division  $(+8) \div (+2)$  using red integer chips.



- Explain how the diagram shows the quotient  $(+8) \div (+2)$ .
  - Copy and complete the division statement  $(+8) \div (+2) = \blacksquare$ .
  - Explain how the same diagram can also model  $(+8) \div (+4)$ .
  - Copy and complete the division statement  $(+8) \div (+4) = \blacksquare$ .
- Use red integer chips to model the division  $(+15) \div (+5)$ .
    - Copy and complete the division statement  $(+15) \div (+5) = \blacksquare$ .
    - Write the other division statement that the model can represent.

3. The diagram shows a way to model the division  $(-8) \div (-2)$  using blue integer chips.



- a) Explain how the diagram shows the quotient  $(-8) \div (-2)$ .  
 b) Copy and complete the division statement  $(-8) \div (-2) = \blacksquare$ .  
 c) Explain how the same diagram can also model  $(-8) \div (+4)$ .  
 d) Copy and complete the division statement  $(-8) \div (+4) = \blacksquare$ .
4. a) Use blue integer chips to model the division  $(-15) \div (-5)$ .  
 b) Copy and complete the division statement  $(-15) \div (-5) = \blacksquare$ .  
 c) Write the other division statement that the model can represent.
5. a) Model the division  $(-8) \div (+2)$  using integer chips. Explain your method.  
 b) Copy and complete the division statement  $(-8) \div (+2) = \blacksquare$ .

### Reflect on Your Findings

6. How can you use integer chips to divide two integers?

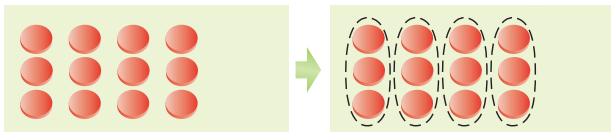
### Example 1: Divide Using Integer Chips

Determine each quotient using integer chips. Copy and complete each division statement.

- a)  $(+12) \div (+3)$   
 b)  $(-12) \div (-3)$   
 c)  $(-12) \div (+4)$

#### Solution

a)



There are 4 groups, so the quotient is  $+4$ .  
 The division statement is  $(+12) \div (+3) = +4$ .

Separate the 12 red chips into groups of 3 red chips and count the number of groups.

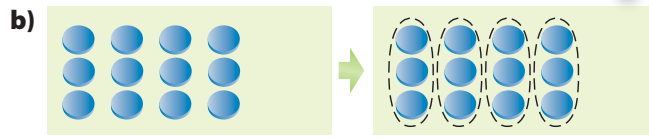
#### Strategies

Model It

Another way to model this division is to separate the 12 red chips into 3 equal groups. There are 4 red chips in each group, so each group represents  $+4$ .

#### Strategies

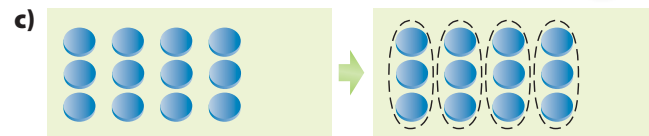
What other strategy could you use?



There are 4 groups, so the quotient is +4.  
The division statement is  $(-12) \div (-3) = +4$ .

Separate the 12 blue chips into groups of 3 blue chips and count the number of groups.

You cannot model this division by separating the 12 blue chips into  $-3$  groups.



There are 3 blue chips in each group, so the quotient is  $-3$ .  
The division statement is  $(-12) \div (+4) = -3$ .

Separate the 12 blue chips into 4 equal groups and count the number of blue chips in each group.

You cannot model this division by separating the 12 blue chips into groups that each represent +4.

### Show You Know

Determine each quotient using integer chips. Use diagrams to show your thinking.

- a)  $(+14) \div (+7)$     b)  $(-9) \div (-3)$     c)  $(-16) \div (+2)$

### Example 2: Apply Integer Division

One night, the temperature in Wetaskiwin, Alberta, was falling by  $2^\circ\text{C}$  each hour. How many hours did it take for the temperature to fall  $10^\circ\text{C}$  altogether? Show how you found your answer using integer chips.

#### Solution

Use the division of two integers to represent the situation. Represent the  $2^\circ\text{C}$  decrease each hour by the integer  $-2$ . Represent the total decrease of  $10^\circ\text{C}$  by the integer  $-10$ . The number of hours taken can be represented by the expression  $(-10) \div (-2)$ . Divide  $(-10) \div (-2)$  using integer chips.

The total change divided by the change per hour gives the number of hours.



There are 5 groups, so the quotient is +5.  
It took 5 h for the temperature to fall  $10^\circ\text{C}$  altogether.

Separate the 10 blue chips into groups of 2 blue chips. Count the number of groups.

#### Web Link

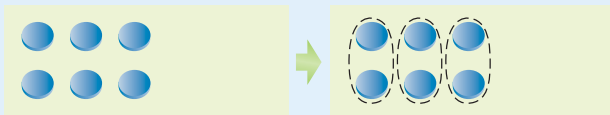
The name *Wetaskiwin* comes from the Cree term *wi-ta-ski-oo cha-ka-tin-ow*, which means "place of peace" or "hill of peace." To find out more about Aboriginal sources of Canadian place names, go to [www.mathlinks8.ca](http://www.mathlinks8.ca) and follow the links.

## Show You Know

The temperature in Buffalo Narrows, Saskatchewan, was falling by  $3^{\circ}\text{C}$  each hour. How many hours did it take for the temperature to fall  $12^{\circ}\text{C}$  altogether? Show how you found your answer using integer chips.

## Key Ideas

- You can use integer chips to model integer division.



$$(-6) \div (-2) = +3$$

$$(-6) \div (+3) = -2$$

## Communicate the Ideas

- Allison modelled the division  $(+12) \div (+6)$  by separating 12 red chips into groups of 6. Tyler modelled the same division by separating 12 red chips into 6 equal groups. Explain how they each determined the correct quotient.
  - Explain how each of their methods also models the division  $(+12) \div (+2)$ .
  - Using blue chips, could you use Tyler's method to model  $(-12) \div (+6)$ ? Explain.
  - Using blue chips, could you use Allison's method to model  $(-12) \div (+6)$ ? Explain.
- Wing modelled the division  $0 \div (+4)$  by separating 8 zero pairs into 4 groups. There were 2 zero pairs in each group. Explain how his model shows the quotient.
  - Could you model the same division with a different number of zero pairs? Explain.
  - Would you use integer chips to divide 0 by a positive or negative integer? Explain.

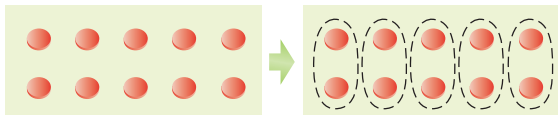
# Check Your Understanding

## Practise

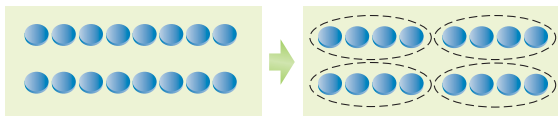
For help with #3 to #8, refer to Example 1 on pages 301–302.

3. Copy each division statement. Use the diagrams to complete it.

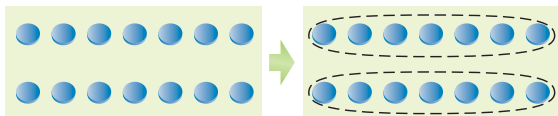
a)  $(+10) \div (+2) = \blacksquare$



b)  $(-16) \div (-4) = \blacksquare$

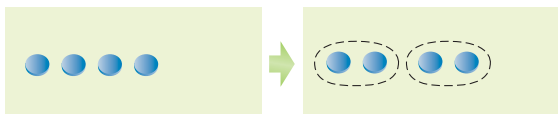


c)  $(-14) \div (+2) = \blacksquare$

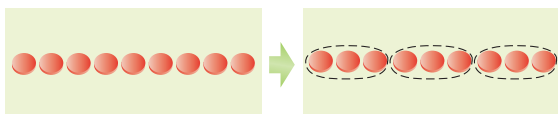


4. Copy each division statement. Use the diagrams to complete it.

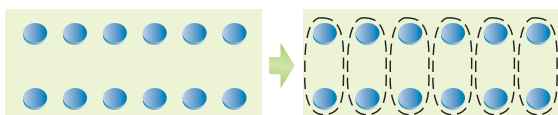
a)  $(-4) \div (-2) = \blacksquare$



b)  $(+9) \div (+3) = \blacksquare$

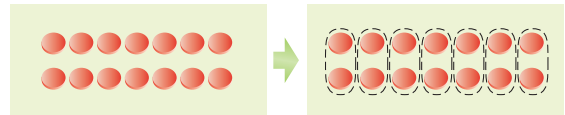


c)  $(-12) \div (+6) = \blacksquare$

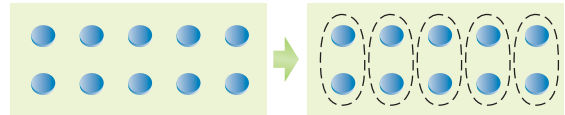


5. Copy both division statements. Use the diagrams to complete them.

a)  $(+14) \div (+2) = \blacksquare$   
 $(+14) \div (+7) = \blacksquare$

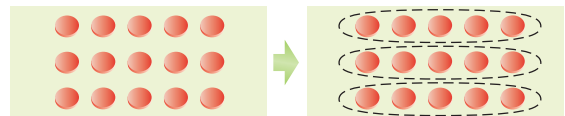


b)  $(-10) \div (-2) = \blacksquare$   
 $(-10) \div (+5) = \blacksquare$

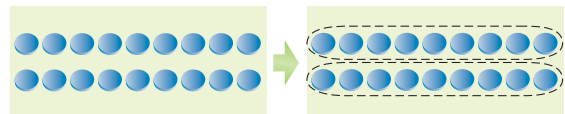


6. Copy both division statements. Use the diagrams to complete them.

a)  $(+15) \div (+5) = \blacksquare$   
 $(+15) \div (+3) = \blacksquare$



b)  $(-18) \div (-9) = \blacksquare$   
 $(-18) \div (+2) = \blacksquare$



7. Determine each quotient using integer chips. Have a partner check your chips. Then copy and complete the division statement

a)  $(+16) \div (+4) = \blacksquare$

b)  $(-7) \div (+7) = \blacksquare$

c)  $(-12) \div (-6) = \blacksquare$

8. Divide using integer chips. Then copy and complete the division statement.

a)  $(-20) \div (-10) = \blacksquare$

b)  $(-10) \div (+2) = \blacksquare$

c)  $(+4) \div (+2) = \blacksquare$

## Apply

For help with #9 to #11, refer to Example 2 on page 302. Use the division of two integers to represent each situation and solve the problem.

9. A submarine was diving at 3 m/min. How long did it take to dive 21 m?
10. From 11:00 p.m. to 5:00 a.m., the temperature in Saskatoon fell from  $-1\text{ }^{\circ}\text{C}$  to  $-19\text{ }^{\circ}\text{C}$ .
  - a) What was the change in temperature?
  - b) What was the change in temperature per hour? What assumption did you make?
11. Gary takes four bus trips on each day of the weekend. He spends \$16 each weekend on bus fares. How much does each trip cost?



12. Copy the pattern.

$$\begin{aligned} (-12) \div (-3) &= \blacksquare \\ (-9) \div (-3) &= \blacksquare \\ (-6) \div (-3) &= \blacksquare \\ (-3) \div (-3) &= \blacksquare \\ 0 \div (-3) &= \blacksquare \\ (+3) \div (-3) &= \blacksquare \\ (+6) \div (-3) &= \blacksquare \end{aligned}$$

- a) Use integer chips to complete the first four lines. Describe the pattern.
- b) Extend the pattern to determine the quotient  $(+6) \div (-3)$ .

13. Copy the pattern.

$$\begin{aligned} (-8) \div (-2) &= \blacksquare \\ (-6) \div (-2) &= \blacksquare \\ (-4) \div (-2) &= \blacksquare \\ (-2) \div (-2) &= \blacksquare \\ 0 \div (-2) &= \blacksquare \\ (+2) \div (-2) &= \blacksquare \\ (+4) \div (-2) &= \blacksquare \end{aligned}$$

- a) Use integer chips to complete the first four lines. Describe the pattern.
- b) Extend the pattern to determine the quotient  $(+4) \div (-2)$ .

14. The deepest recorded dive is 500 m for an emperor penguin and 2000 m for a sperm whale.



- a) Use the division of two integers to represent how many times as deep a sperm whale can dive as an emperor penguin.
- b) How can you model the division using only 20 integer chips?
- c) What is the quotient?

## Extend

15. Divide each of the following using integer chips or diagrams of chips. Explain your reasoning.
  - a)  $(+15) \div (+5) \div (+3)$
  - b)  $(-24) \div (-2) \div (+4)$
  - c)  $(-20) \div (+2) \div (-5)$
  - d)  $(-18) \div (+2) \div (+3)$
16. Since sunset 6 h ago, the temperature in Brandon, Manitoba, has decreased from  $+1\text{ }^{\circ}\text{C}$  to  $-11\text{ }^{\circ}\text{C}$ . Predict what the temperature will be 3 h from now. What assumptions did you make?