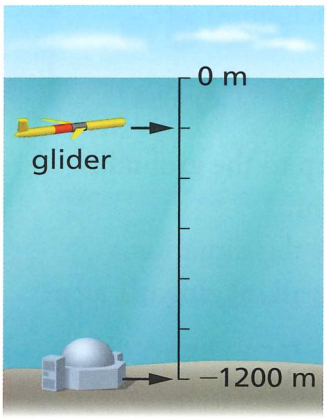
Lesson M Dividing Integers Using Patterns

YOU WILL NEED

- a number line
- pencil crayons
- number line app (optional)



research station

LEARNING GOAL

Model integer division with number patterns.

LEARN ABOUT the Math

The depth of an underwater research station in Clayoquot Sound is −1200 m. This is 6 times as deep as an undersea glider that is collecting data about whales nearby.

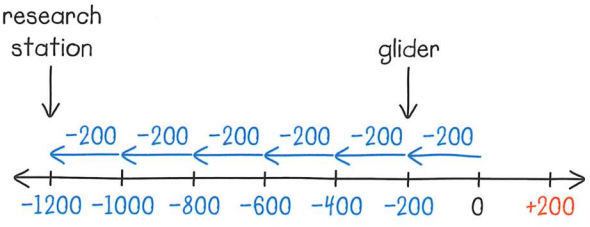
What integer shows the depth of the glider?

Example 1 | Using a number line

Use repeated addition on a number line to model the depth.

Nestor's Solution

(−1200) ÷ (+6) = (■200)



(+6) × (−200) = (−1200), so (−1200) ÷ (+6) = (−200).
The depth of the glider is −200 m.

−1200 is 6 times as deep as the glider.

I divided −1200 m by +6 to get the depth of the glider.

1200 ÷ 6 = 200, so the depth is either +200 m or −200 m.

I drew a number line and put the research station at −1200.

I started at 0 and thought about what I would add 6 times to get to −1200.

I would add −200, not +200, so the sign of the quotient is negative.

Example 2 | Using a pattern

Use a multiplication pattern to determine the depth.

Megan's Solution

$(-1200) \div (+6) = (-200)$

$(+200) \times (+6) = (+1200)$
$\uparrow$
$(+2) \times (+6) = (+12)$
$(+1) \times (+6) = (+6)$
$0 \times (+6) = 0$
$(-1) \times (+6) = (-6)$
$(-2) \times (+6) = (-12)$
$\downarrow$
$(-200) \times (+6) = (-1200)$

The depth of the glider is −200 m.

$1200 \div 6 = 200$, so the depth of the glider is either +200 m or −200 m.

I chose −200 m because the glider is below sea level at 0 m.

I know *glider depth* × 6 = *station depth.*

I used a multiplication pattern to check that the quotient is negative. I built a × (+6) pattern up and down from 0 m.

I could see that the depth of the station would be at −1200 m when the depth of the glider was −200 m.

Reflecting

A. How did thinking about multiplication help each student divide?

B. How does Megan's pattern explain why the quotients for $(+1200) \div (+6)$ and $(-1200) \div (+6)$ have opposite signs?

WORK WITH the Math

Example 3 | Dividing integers with different signs

Calculate $(+24) \div (-8)$.

Solution

quotient × *divisor* = *dividend*

I know you can multiply the quotient by the divisor to get the dividend.

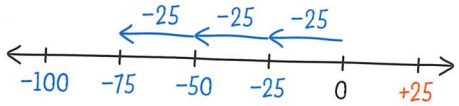
$0 \times (-8) = 0$	Think about what to multiply (-8) by to get $(+24)$.
$(-1) \times (-8) = (+8)$	
$(-2) \times (-8) = (+16)$	Build a pattern from $0 \times (-8)$. Extend the pattern until the product is $(+24)$.
$(-3) \times (-8) = (+24)$	
$(+24) \div (-8) = (-3)$	Rewrite the multiplication as *dividend* $\div$ *divisor* $=$ *quotient*.

Example 4 | Dividing 2 negative integers

Calculate $(-75) \div (-25)$.

Solution

$(-75) \div (-25) = (\blacksquare 3)$



Use $75 \div 25$ to determine the number part of the quotient.

Use a number line to show $(-75) \div (-25)$. Start at 0 and add -25 each time until you get to -75.

Since -25 was added 3 times,
$(-75) \div (-25) = (+3)$.

$(+\_) \div (+\_)$
$(-\_) \div (+\_)$
$(+\_) \div (-\_)$
$(-\_) \div (-\_)$

A Checking

1. Calculate. How did you determine the sign of the quotient?

a) $(-48) \div (+8)$
b) $(-28) \div (-2)$
c) $(+54) \div (-6)$
d) $0 \div (-5)$

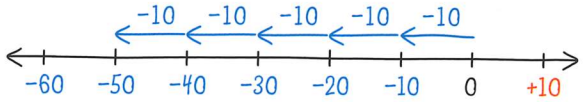
2. **a)** What sign will each quotient have? Give an example.
b) How can comparing the signs of the integers you are dividing help you choose the correct sign for the quotient?

B Practising

3. Calculate. Choose 1 division, and explain how you calculated.

a) $(+14) \div (-2)$
b) $(-16) \div (+8)$
c) $(-27) \div (+9)$
d) $(-18) \div (-3)$

4. Write a multiplication equation to match the number line. Then write a division equation.



5. The change in elevation from the top to the bottom of this fountain is −210 cm. What is the change for each step?

6. What signs are possible? With a partner, discuss how you can prove that you found all the possibilities.

a) (−36) ÷ (□3) = (□12)

b) (□81) ÷ (□9) = (+9)

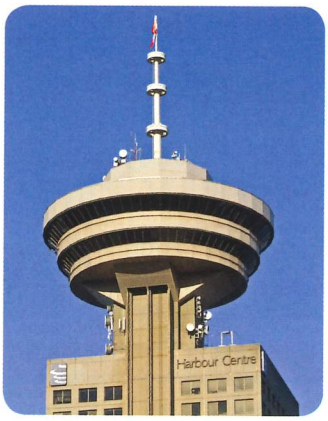
c) (□42) ÷ (−7) = (□6)

d) (+23) ÷ (□1) = (□23)

7. a) What are all the ways to complete (−12) ÷ □ = □ with integers?

b) How do you know that you found all the combinations?

c) Does +12 have the same number of combinations? Discuss your answer with a partner. Make a list to check.



8. The glass elevator on the Vancouver Lookout has a total descent of about −160 m. It travels about −4 m every second. How long does it take to reach the ground?

9. What integers fit each clue?

a) I am a multiple of +4 and −5. I am a positive integer.

b) I am a factor of −10. I am also a multiple of +2. I am a negative integer.

10. Create a clue about an integer. Trade clues with a partner. Identify your partner's integer, and explain your reasoning. Do you agree with your partner's explanation?

Ashley's question:
6 ÷ 2 can mean subtracting 2 from 6 over and over. Does integer division work the same way?

11. How would you answer Ashley's question? Compare answers with a partner.

12. Is each statement true or false? Use examples to explain.

a) When integers have the same sign, their quotient is positive.

b) The quotient of 2 integers can equal the dividend.

c) The dividend is always greater than the divisor and quotient.

d) The dividend always equals *quotient* × *divisor*.