Welcome to *Pre-Algebra*!

Why **pre**-algebra? Just as sports teams use **pre**season training to ensure readiness for the regular season by improving fitness, strength, and technical ability, pre-algebra helps produce optimum performance in algebra courses. As the NFL all-time leading rusher and Hall of Fame running back Emmitt Smith stated, **"All men are created equal. Some work harder in preseason."**

More specifically, *Pre-Algebra* will challenge you to improve in the following essential mathematical practices:

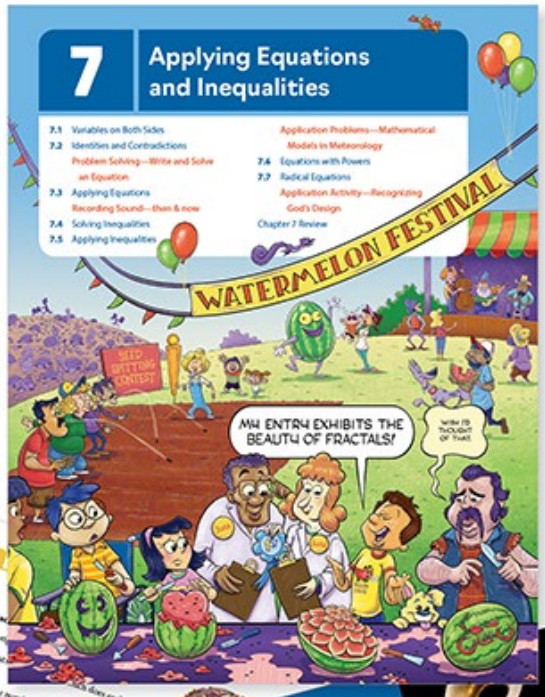
1. Persevere in problem solving.
2. Use abstract reasoning.
3. Construct logical arguments.
4. Use mathematical models.
5. Use appropriate tools.
6. Use precise language.
7. See and apply structure.
8. Generalize patterns.

That's a challenging list, but the text integrates instruction and exercises emphasizing these skills and provides ample review.

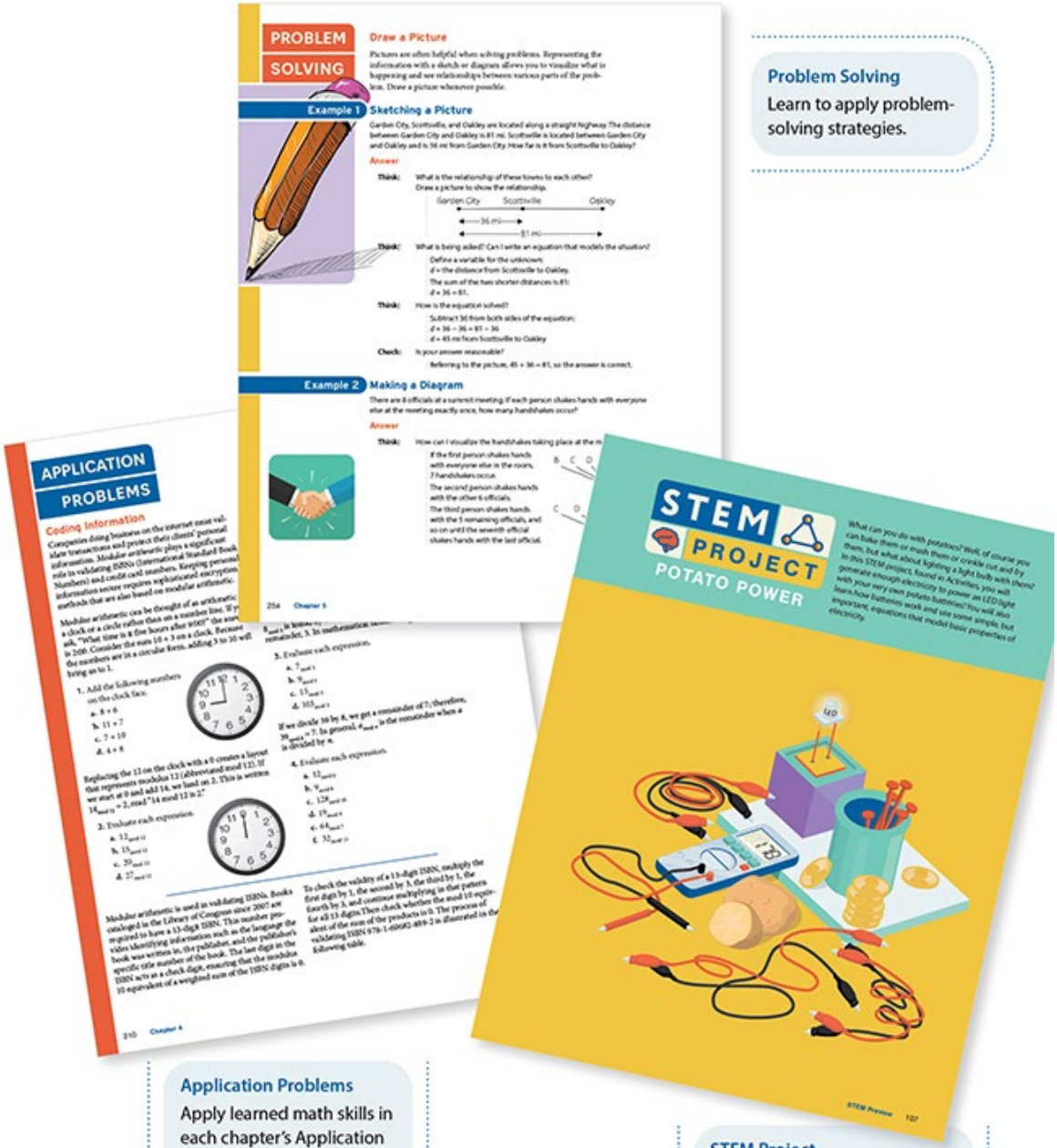
As you travel through *Pre-Algebra*, you will join an animated family on their own challenging journey. Enjoy their comic adventures, but also look for the underlying worldview theme in each one. While the Bible is not a mathematics textbook, it reveals the foundational truths that explain why math works, how it should be used, and why it is such an effective tool. You will encounter five themes to help you form a biblical view of mathematics: knowledge, modeling, reasoning, design, and ethics. Each theme is presented within the overarching worldview narrative of Creation, Fall, and Redemption.

Equipped with clearly stated objectives, step-by-step examples, skill checks, tips, and cumulative reviews, this text is designed to optimize your success. **Will you make the Pre-Algebra Hall of Fame this year?**

Chapter Introduction
Preview the flow of lessons in the chapter and the biblical worldview theme introduced in the cartoon.



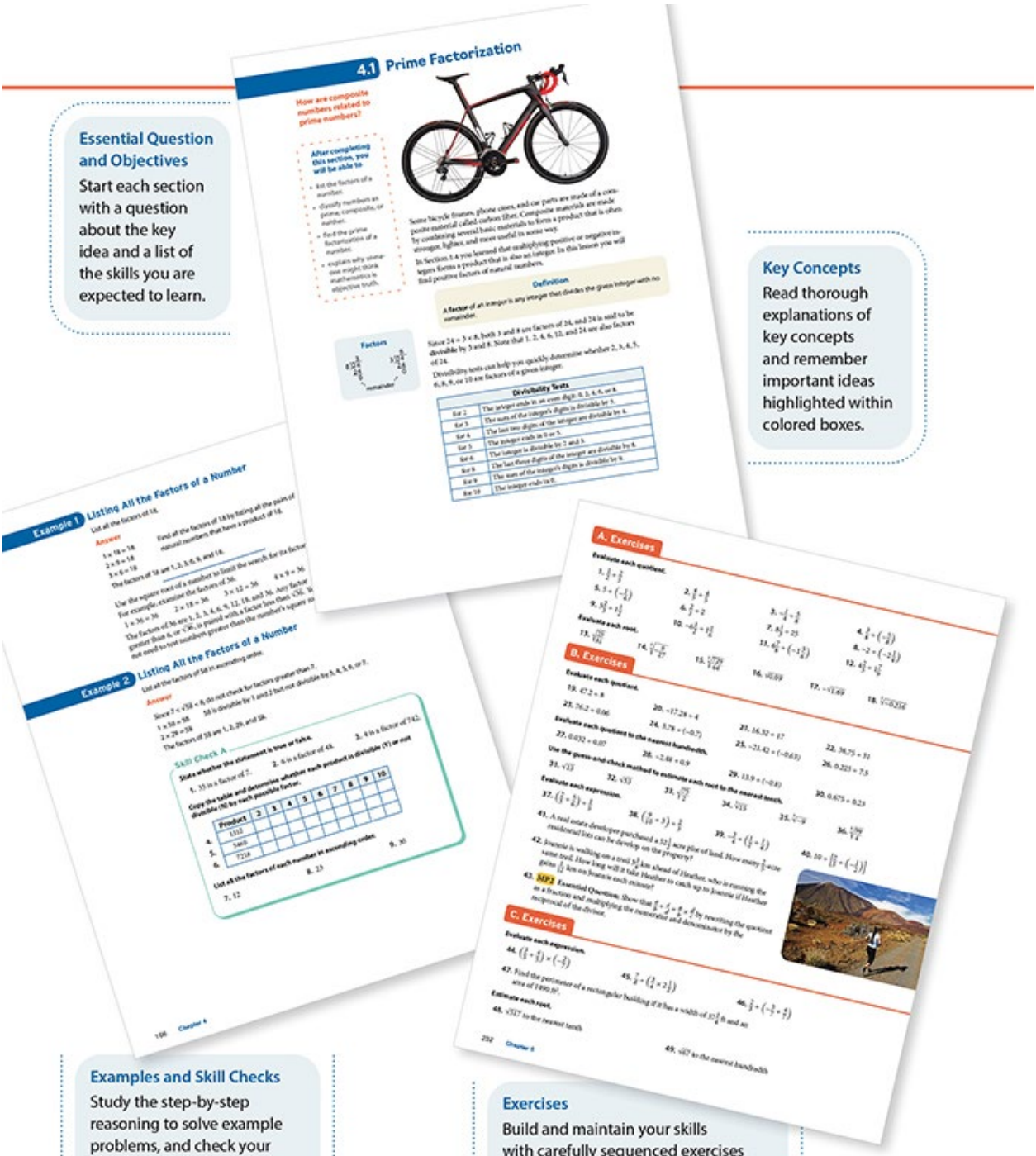
Invention and Technology—then & now
Read how mathematics was applied to solve problems and improve our way of living.



Problem Solving
Learn to apply problem-solving strategies.

Application Problems
Apply learned math skills in each chapter's Application Problems.

STEM Project
Preview the quarterly STEM projects located in Activities.



Essential Question and Objectives
Start each section with a question about the key idea and a list of the skills you are expected to learn.

Key Concepts
Read thorough explanations of key concepts and remember important ideas highlighted within colored boxes.

Examples and Skill Checks
Study the step-by-step reasoning to solve example problems, and check your understanding by completing the Skill Check exercises.

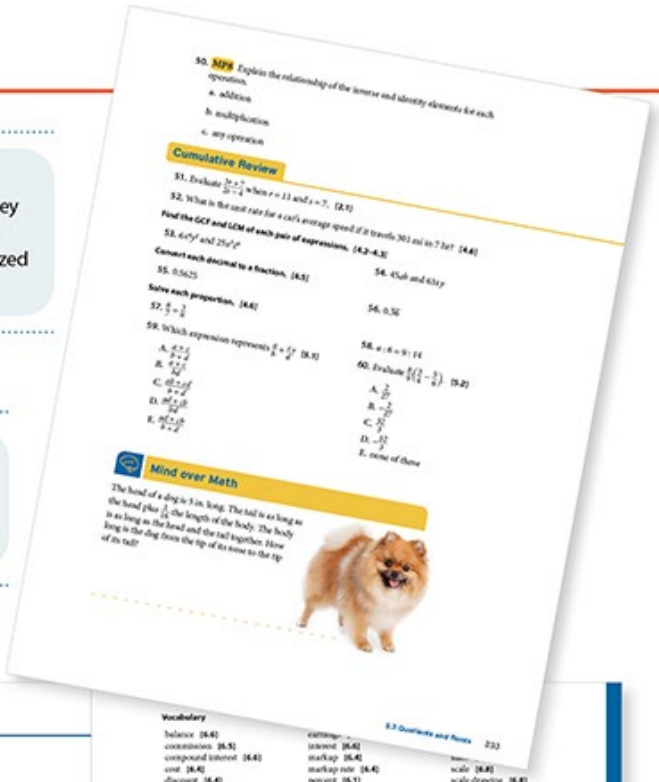
Exercises
Build and maintain your skills with carefully sequenced exercises that emphasize the essential question, biblical worldview shaping, and essential mathematical practices.

Cumulative Review

Systematically review key concepts and practice strategies for standardized testing.

Mind over Math

Challenge your critical thinking with this unique feature found in each chapter.



Cumulative Review

51. Evaluate $\frac{3r+7}{2r-4}$ when $r = 11$ and $s = 7$. [2.1]

52. What is the unit rate for a car's average speed if it travels 261 mi in 7 hr? [4.6]

Find the GCF and LCM of each pair of expressions. [4.2–4.3]

53. $4x^2y^3$ and $25x^2y$

Convert each decimal to a fraction. [4.5]

55. 0.5625

54. $45ab$ and $63xy$

Solve each proportion. [4.6]

57. $\frac{8}{9} = \frac{2}{x}$

56. 0.56

59. Which expression represents $\frac{a}{b} + \frac{c}{d}$? [3.1]

A. $\frac{a+c}{b+d}$

B. $\frac{ad+cb}{bd}$

C. $\frac{ab+cd}{b+d}$

D. $\frac{ab+cb}{bd}$

E. $\frac{ad+cb}{b+d}$

58. $a : b = 9 : 14$

60. Evaluate $\frac{2}{3}(\frac{1}{2} - \frac{3}{5})$. [3.2]

A. $\frac{2}{15}$

B. $-\frac{2}{15}$

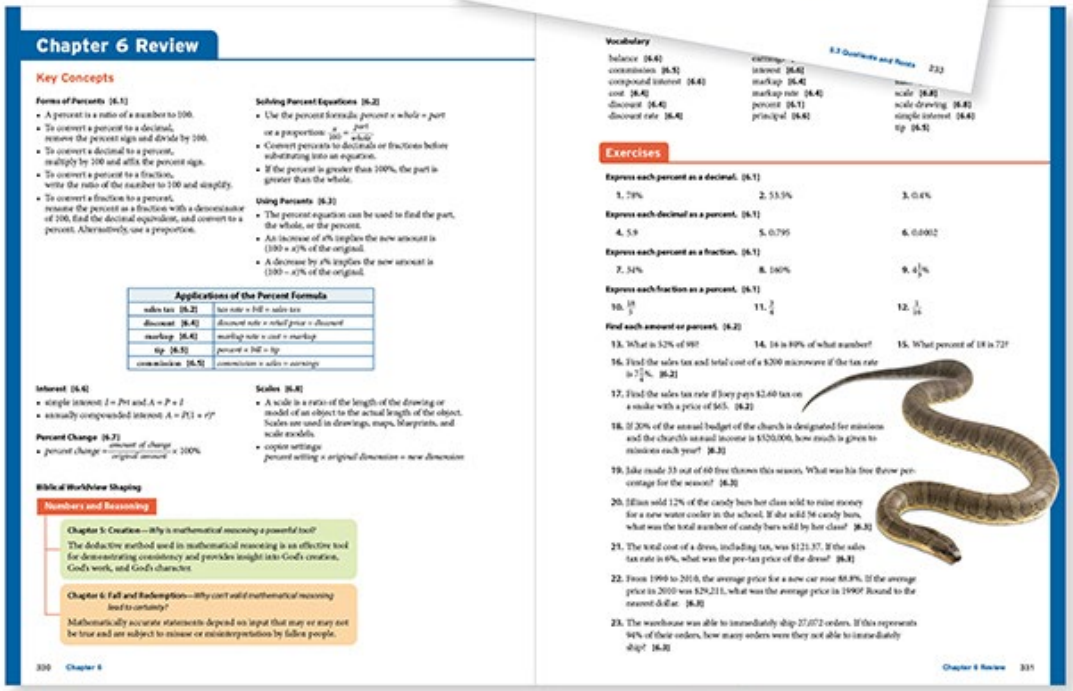
C. $\frac{15}{2}$

D. $-\frac{15}{2}$

E. none of these

Mind over Math

The head of a dog is 3 in. long. The tail is as long as the head plus $\frac{2}{15}$ the length of the body. The body is as long as the head and the tail together. How long is the dog from the tip of its nose to the tip of its tail?



Chapter 6 Review

Key Concepts

Forms of Percents [6.1]

- A percent is a ratio of a number to 100.
- To convert a percent to a decimal, remove the percent sign and divide by 100.
- To convert a decimal to a percent, multiply by 100 and affix the percent sign.
- To convert a percent to a fraction, write the ratio of the number to 100 and simplify.
- To convert a fraction to a percent, rename the percent as a fraction with a denominator of 100, find the decimal equivalent, and convert to a percent. Alternatively, use a proportion.

Solving Percent Equations [6.2]

- Use the percent formula: *percent* × *whole* = *part*
  or a proportion: $\frac{\%}{100} = \frac{part}{whole}$.
- Convert percents to decimals or fractions before substituting into an equation.
- If the percent is greater than 100%, the part is greater than the whole.

Using Percents [6.3]

- The percent equation can be used to find the part, the whole, or the percent.
- An increase of x% implies the new amount is $(100 + x)$% of the original.
- A decrease by x% implies the new amount is $(100 - x)$% of the original.

Applications of the Percent Formula	
sales tax [6.2]	*tax rate* × *bill* = *sales tax*
discount [6.4]	*discount rate* × *retail price* = *discount*
markup [6.4]	*markup rate* × *cost* = *markup*
tip [6.5]	*percent* × *bill* = *tip*
commission [6.5]	*commission* × *sales* = *earnings*

Interest [6.6]

- simple interest: $I = Prt$ and $A = P + I$
- annually compounded interest: $A = P(1 + r)^t$

Percent Change [6.7]

- *percent change* = $\frac{amount\ of\ change}{original\ amount} \times 100\%$

Scales [6.8]

- A scale is a ratio of the length of the drawing or model of an object to the actual length of the object. Scales are used in drawings, maps, blueprints, and scale models.
- *copier settings* × *original dimension* = *new dimension*

Biblical Worldview Shaping

Numbers and Reasoning

Chapter 5: Creation—*Why is mathematical reasoning a powerful tool?*

The deductive method used in mathematical reasoning is an effective tool for demonstrating consistency and provides insight into God's creation, God's work, and God's character.

Chapter 6: Fall and Redemption—*Why can't valid mathematical reasoning lead to certainty?*

Mathematically accurate statements depend on input that may or may not be true and are subject to misuse or misinterpretation by fallen people.

330 Chapter 6

Vocabulary

balance [6.6]
commission [6.5]
compound interest [6.6]
cost [6.4]
discount [6.4]
discount rate [6.4]
interest [6.6]
markup [6.4]
markup rate [6.4]
percent [6.1]
principal [6.6]
scale [6.8]
scale drawing [6.8]
simple interest [6.6]
tip [6.5]

Exercises

Express each percent as a decimal. [6.1]

1. 78%
2. 53.5%
3. 0.4%

Express each decimal as a percent. [6.1]

4. 5.9
5. 0.795
6. 0.0002

Express each percent as a fraction. [6.1]

7. 34%
8. 160%
9. $4\frac{1}{2}$%

Express each fraction as a percent. [6.1]

10. $\frac{18}{5}$
11. $\frac{3}{4}$
12. $\frac{1}{16}$

Find each amount or percent. [6.2]

13. What is 52% of 98?
14. 14 is 80% of what number?
15. What percent of 18 is 72?
16. Find the sales tax and total cost of a $200 microwave if the tax rate is $7\frac{1}{4}$%. [6.2]
17. Find the sales tax rate if Joey pays $2.60 tax on a snake with a price of $65. [6.2]
18. If 20% of the annual budget of the church is designated for missions and the church's annual income is $520,000, how much is given to missions each year? [6.3]
19. Jake made 33 out of 60 free throws this season. What was his free throw percentage for the season? [6.3]
20. Jillian sold 12% of the candy bars her class sold to raise money for a new water cooler in the school. If she sold 56 candy bars, what was the total number of candy bars sold by her class? [6.3]
21. The total cost of a dress, including tax, was $121.37. If the sales tax rate is 6%, what was the pre-tax price of the dress? [6.3]
22. From 1990 to 2010, the average price for a new car rose 88.8%. If the average price in 2010 was $29,211, what was the average price in 1990? Round to the nearest dollar. [6.3]
23. The warehouse was able to immediately ship 27,072 orders. If this represents 94% of their orders, how many orders were they not able to immediately ship? [6.3]

Chapter 6 Review 331

Chapter Review

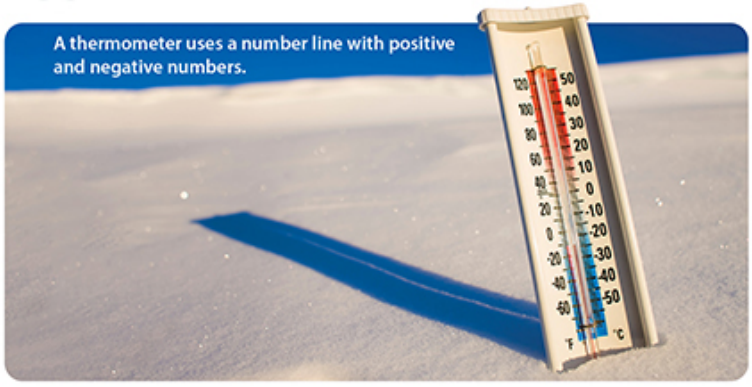
Prepare for assessments with a summary of key concepts and the biblical worldview theme, new vocabulary terms, and review exercises.

1.1 Opposites and Absolute Value

How do the absolute values of opposite integers compare?

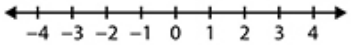
After completing this section, you will be able to

- order integers, using number lines.
- explain the assumption that makes number lines useful.
- state the opposite of an integer.
- find the absolute value of an integer.



Negative numbers are frequently used in everyday life. Temperatures below 0, an overdrawn bank account, and losing points in a game can all be represented by negative numbers.

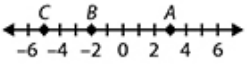
Recall that the set of whole numbers, $\mathbb{W} = \{0, 1, 2, 3, \ldots\}$, contains 0 and the natural (or counting) numbers, $\mathbb{N} = \{1, 2, 3, \ldots\}$. The set of **integers**, $\mathbb{Z} = \{\ldots, -3, -2, -1, 0, 1, 2, 3, \ldots\}$, is frequently used to label a number line.



Negative integers are indicated with a negative sign, such as −4, but positive integers do not require a sign. Zero is neither positive nor negative. The number associated with a point on the number line is called its **coordinate**. The point, which is usually named with a capital letter, is called the **graph** of the number.

Example 1 Stating the Coordinate

State the coordinate of points *A*, *B*, and *C*.



Answers

A: 3
B: −2
C: −5

1. Point *A* is 3 units to the right of 0.
2. Point *B* is 2 units to the left of 0.
3. Point *C* is 5 units to the left of 0.

Tip

The small end of the symbol points toward the smaller number.

$5 > 2$

Skill Check A

Draw a number line and graph each point on the line.

1. *X*: −1 **2.** *Y*: 4 **3.** *Z*: −4

Number lines can be used to compare integers. Consider a number line with 2 integers graphed. The number to the *left* on the number line is *less than* (<) the number on the right. The number to the *right* is *greater than* (>) the number on the left.

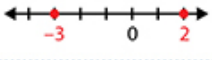
Example 2 Comparing Integers

Compare the following integers, using < or >.

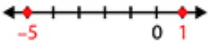
a. 2 and −3 **b.** −5 and 1

Answers

a. $2 > -3$ 2 is to the right of −3 on the number line, so 2 is greater than −3.



b. $-5 < 1$ −5 is to the left of 1 on the number line, so −5 is less than 1.

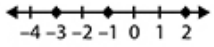


You can also use inequality symbols to order a set of integers from least to greatest or from greatest to least.

Example 3 Ordering Integers

Write the integers −1, 2, and −3 in order from least to greatest using <.

Answer



−3 is farthest to the left on the number line. It is the least number.

2 is farthest to the right on the number line. It is the greatest number.

−1 is between −3 and 2 on the number line. It is greater than −3 but less than 2.

$-3 < -1 < 2$

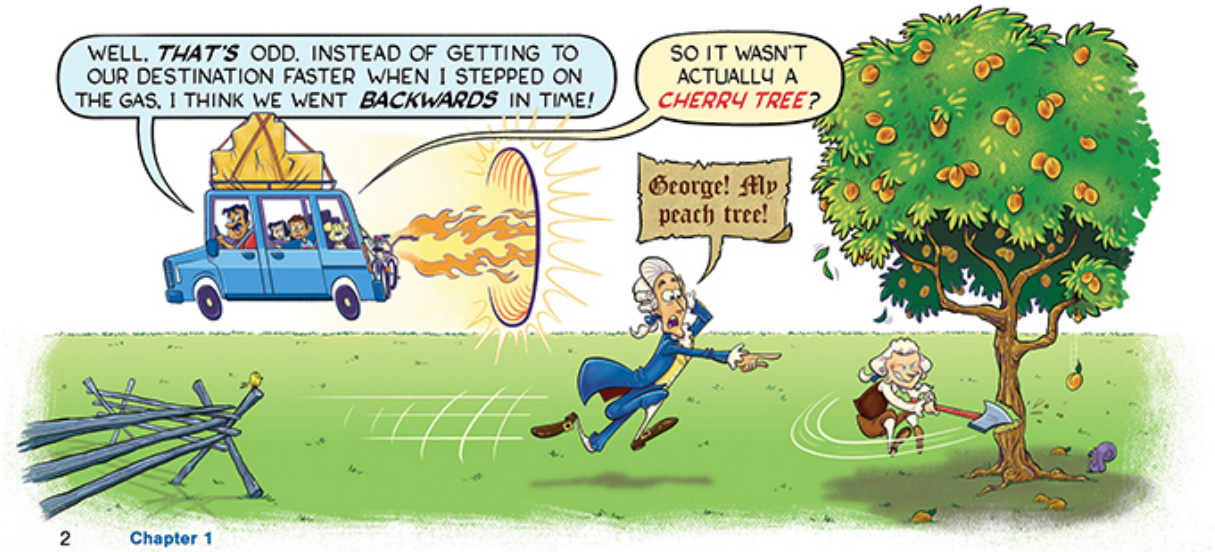
Skill Check B

Compare the integers, using < or >.

1. −4 _____ 0 **2.** −6 _____ −11 **3.** 3 _____ −9

4. Order −3, 5, and −7 from least to greatest using <.

5. Order 8, −6, 0, and −1 from greatest to least using >.



A. Exercises

Fill in the blank.

1. The natural numbers consist of the ____ integers.
2. The integer ____ is neither positive nor negative.
3. The set of integers is indicated by the symbol ____.
4. The opposite of a positive integer is a ____ integer.
5. The absolute value of every nonzero integer is a ____ integer.

Draw a number line and graph each point on the line.

6. A: 3
7. B: −3
8. C: 2
9. D: −4

State the opposite of each number.

10. 8
11. −16
12. −4.5
13. $\frac{1}{2}$

Find each absolute value.

14. $|-7|$
15. $|3|$
16. $|0|$
17. $|-152|$

Compare using < or >.

18. 9 ____ −3
19. −2 ____ −13
20. −4 ____ 2
21. −15 ____ −10
22. $|-5|$ ____ 1
23. $|-13|$ ____ $|-18|$

B. Exercises

Order the integers from least to greatest using <.

24. 1, −3, 0
25. −4, −9, −7
26. −3, −9, −5, −17
27. −4, $|-2|$, 5, 3

Order the integers from greatest to least using >.

28. −2, −5, 3
29. −11, 0, −19
30. −2, 6, −7, 2
31. −18, $|11|$, −4, $|-23|$

Evaluate each expression.

32. $-(-13)$
33. $-|5|$
34. $-|-6|$
35. $-(7-4)$
36. $|17-9|$
37. $-|5-3|$

38. Define opposite numbers.
39. Define the absolute value of a number.

Classify each statement as *always*, *sometimes*, or *never* true. Explain your reasoning.

40. The absolute value of a number is negative.

41. The absolute value of an integer is positive.

42. The opposite of the absolute value of an integer is not negative.

43. **Essential Question:** How do the absolute values of opposite integers compare?

44. **BWS Essential Question:** What assumption is necessary for number lines to be useful?

45. The low temperatures for 5 days in northern Minnesota are −12°F, −32°F, 2°F, −10°F, and 8°F.

a. Which temperature is the farthest from 0°F?

b. Which temperature is the closest to 0°F?

46. A team exploring a shipwreck 210 ft below the ocean's surface uses a submarine 100 ft below the surface, a diver at the shipwreck, and a support helicopter 260 ft above the ocean's surface.

a. Write integers that represent the elevation of the diver, submarine, and helicopter.

b. Which of these objects is closest to the surface?

47. The latitude at the equator is 0°. Positive latitudes are north of the equator, while negative latitudes are south of the equator. Carlos lives in Bolivia at a latitude 16° south of the equator, and Pedro lives in Nicaragua at a latitude 12° north of the equator.

a. State an integer that represents the latitude of each boy.

b. Which boy lives the farthest from the equator?

C. Exercises

Evaluate each expression and then order the values from least to greatest using <.

48. $|2|, -|-2|, |2 - 2|, |2 \cdot 2|$

49. $|-8|, |-8| - |-8|, -|8|, |8| \cdot |-8|$

50. $|6 + 3|, |6 - 3|, -|6 \cdot 3|, -|6 \div 3|$

51. $|-10| \cdot |8|, |10| - |-8|, |10| + |-8|, -|10 \div 5|$

52. MP2 Classify the following as *always*, *sometimes*, or *never* true: If $a < b$, then $|a| > |b|$. Explain your reasoning.

53. MP2 Can $|x| = -x$? Explain why or why not.