Math

Grade 6

Covers week of May 4th –
week of June 16th
<table>
<thead>
<tr>
<th>Session(s)</th>
<th>Concept/Main Idea</th>
<th>Corresponding Pencil-Paper Packet Activity</th>
</tr>
</thead>
<tbody>
<tr>
<td>1-2</td>
<td>Equations in One Variable</td>
<td>Unit 6 Family Support Materials</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Unit 6 Lesson 1</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Unit 6 Lesson 3</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Lesson 3 Practice Problems</td>
</tr>
<tr>
<td>3-5</td>
<td>Equal and Equivalent Distributive Property</td>
<td>Unit 6 Lesson 6</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Unit 6 Lesson 6 Practice Problems</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Unit 6 Lesson 8</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Lesson 8 Practice Problems</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Unit 6 Lesson 9</td>
</tr>
<tr>
<td></td>
<td></td>
<td>iReady Practice (Identifying Equivalent Expressions)</td>
</tr>
<tr>
<td>6-7</td>
<td>Expressions with Exponents</td>
<td>Unit 6 Lesson 13</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Lesson 13 Practice Problems</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Unit 6 Lesson 14</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Lesson 14 Practice Problems</td>
</tr>
<tr>
<td>8-9</td>
<td>Negative Numbers</td>
<td>Unit 7 Family Support Materials</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Unit 7 Lesson 1</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Unit 7 Lesson 1 Practice Problems #1-2</td>
</tr>
<tr>
<td></td>
<td>Negative Numbers Continued</td>
<td>Unit 7 Lesson 2</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Unit 7 Lesson 2 Practice Problems #1-4</td>
</tr>
<tr>
<td></td>
<td></td>
<td>iReady Practice</td>
</tr>
<tr>
<td>10-11</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>12</td>
<td>Absolute Value</td>
<td>Unit 7 Lesson 6</td>
</tr>
<tr>
<td></td>
<td></td>
<td>iReady Practice</td>
</tr>
<tr>
<td>Week 13-14</td>
<td>Topic</td>
<td>Unit 7 Lessons</td>
</tr>
<tr>
<td>------------</td>
<td>-------</td>
<td>----------------</td>
</tr>
<tr>
<td>June 10 (B)</td>
<td>Inequalities</td>
<td>Unit 7 Lesson 8 (8.2 and Summary)</td>
</tr>
<tr>
<td>June 11 (G)</td>
<td></td>
<td>Unit 7 Lesson 9 (9.1, 9.2 and Summary)</td>
</tr>
<tr>
<td>June 12 (B)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>June 15 (G)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>June 16 (B)</td>
<td>The Coordinate Plane</td>
<td>Unit 7 Lesson 11 (11.2-11.3 and Summary)</td>
</tr>
</tbody>
</table>
Family Support Materials

Expressions and Equations

Equations in One Variable

Family Support Materials 1

This week your student will be learning to visualize, write, and solve equations. They did this work in previous grades with numbers. In grade 6, we often use a letter called a **variable** to represent a number whose value is unknown. Diagrams can help us make sense of how quantities are related. Here is an example of such a diagram:

![Diagram of equations with variable x and total of 15]

Since 3 pieces are labeled with the same variable x, we know that each of the three pieces represent the same number. Some equations that match this diagram are \( x + x + x = 15 \) and \( 15 = 3x \).

A **solution** to an equation is a number used in place of the variable that makes the equation true. In the previous example, the solution is 5. Think about substituting 5 for \( x \) in either equation: \( 5 + 5 + 5 = 15 \) and \( 15 = 3 \cdot 5 \) are both true. We can tell that, for example, 4 is **not** a solution, because \( 4 + 4 + 4 \) does not equal 15.

Solving an equation is a process for finding a solution. Your student will learn that an equation like \( 15 = 3x \) can be solved by dividing each side by 3. Notice that if you divide each side by 3, \( 15 \div 3 = 3x \div 3 \), you are left with \( 5 = x \), the solution to the equation.

Here is a task to try with your student:

Draw a diagram to represent each equation. Then, solve each equation.

\[
2y = 11 \quad \quad \quad \quad 11 = x + 2
\]

Solution:
$y = 5.5 \text{ or } y = \frac{11}{2}$

$x = 9$
Equal and Equivalent
Family Support Materials 2

This week your student is writing mathematical expressions, especially expressions using the distributive property.

In this diagram, we can say one side length of the large rectangle is 3 units and the other is $x + 2$ units. So, the area of the large rectangle is $3(x + 2)$. The large rectangle can be partitioned into two smaller rectangles, A and B, with no overlap. The area of A is 6 and the area of B is $3x$. So, the area of the large rectangle can also be written as $3x + 6$. In other words,

$$3(x + 2) = 3x + 3 \cdot 2$$

This is an example of the distributive property.

Here is a task to try with your student:

Draw and label a partitioned rectangle to show that each of these equations is always true, no matter the value of the letters.

- $5x + 2x = (5 + 2)x$
- $3(a + b) = 3a + 3b$

Solution:

Answers vary. Sample responses:
Expressions with Exponents

Family Support Materials 3

This week your student will be working with exponents. When we write an expression like \(7^n\), we call \(n\) the exponent. In this example, 7 is called the base. The exponent tells you how many factors of the base to multiply. For example, \(7^4\) is equal to \(7 \cdot 7 \cdot 7 \cdot 7\). In grade 6, students write expressions with whole-number exponents and bases that are

- whole numbers like \(7^4\)
- fractions like \(\left(\frac{1}{7}\right)^4\)
- decimals like \(7.7^4\)
- variables like \(x^4\)

Here is a task to try with your student:

Remember that a solution to an equation is a number that makes the equation true. For example, a solution to \(x^3 = 30 + x\) is 2, since \(2^3 = 30 + 2\). On the other hand, 1 is not a solution, since \(1^5\) does not equal \(30 + 1\). Find the solution to each equation from the list provided.

1. \(n^2 = 49\)
2. \(4^n = 64\)
3. \(4^n = 4\)
4. \(\left(\frac{3}{4}\right)^2 = n\)
5. \(0.2^3 = n\)
6. \(n^4 = \frac{1}{16}\)
7. \(1^n = 1\)
8. \(3^n ÷ 3^2 = 3^3\)

List: 0, 0.008, \(\frac{1}{2}\), \(\frac{9}{16}\), \(\frac{6}{8}\), 0.8, 1, 2, 3, 4, 5, 6, 7

Solution:
1. 7, because \(7^2 = 49\). (Note that -7 is also a solution, but in grade 6 students aren't expected to know about multiplying negative numbers.)

2. 3, because \(4^3 = 64\)

3. 1, because \(4^1 = 4\)

4. \(\frac{9}{16}\), because \((\frac{3}{4})^2\) means \((\frac{3}{4}) \cdot (\frac{3}{4})\)

5. 0.008, because \(0.2^3\) means \((0.2) \cdot (0.2) \cdot (0.2)\)

6. \(\frac{1}{2}\), because \((\frac{1}{2})^4 = \frac{1}{16}\)

7. Any number! \(1^n = 1\) is true no matter what number you use in place of \(n\).

8. 5, because this can be rewritten \(3^n \div 9 = 27\). What would we have to divide by 9 to get 27? 243, because \(27 \cdot 9 = 243\). \(3^5 = 243\).
Relationships Between Quantities

Family Support Materials 4

This week your student will study relationships between two quantities. For example, since a quarter is worth 25¢, we can represent the relationship between the number of quarters, \( n \), and their value \( v \) in cents like this:

\[ v = 25n \]

We can also use a table to represent the situation.

<table>
<thead>
<tr>
<th>( n )</th>
<th>( v )</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>25</td>
</tr>
<tr>
<td>2</td>
<td>50</td>
</tr>
<tr>
<td>3</td>
<td>75</td>
</tr>
</tbody>
</table>

Or we can draw a graph to represent the relationship between the two quantities:

Here is a task to try with your student:

A shopper is buying granola bars. The cost of each granola bar is $0.75.

1. Write an equation that shows the cost of the granola bars, \( c \), in terms of the number of bars purchased, \( n \).
2. Create a graph representing associated values of $c$ and $n$.

3. What are the coordinates of some points on your graph? What do they represent?

Solutions

1. $c = 0.75n$. Every granola bar costs $0.75 and the shopper is buying $n$ of them, so the cost is $0.75n$.

2. Answers vary. One way to create a graph is to label the horizontal axis with "number of bars" with intervals, 0, 1, 2, 3, etc, and label the vertical axis with "total cost in dollars" with intervals 0, 0.25, 0.50, 0.75, etc.

3. If the graph is created as described in this solution, the first coordinate is the number of granola bars and the second is the cost in dollars for that number of granola bars. Some points on such a graph are (2, 1.50) and (10, 7.50)
Lesson 1: Tape Diagrams and Equations

1.1: Which Diagram is Which?

1. Here are two diagrams. One represents $2 + 5 = 7$. The other represents $5 \cdot 2 = 10$. Which is which? Label the length of each diagram.

2. Draw a diagram that represents each equation.

   $4 + 3 = 7$  
   $4 \cdot 3 = 12$

1.2: Match Equations and Tape Diagrams

Here are two tape diagrams. Match each equation to one of the tape diagrams.

1. $4 + x = 12$  
2. $12 \div 4 = x$  
3. $4 \cdot x = 12$  
4. $12 = 4 + x$  
5. $12 - x = 4$  
6. $12 = 4 \cdot x$  
7. $12 - 4 = x$  
8. $x = 12 - 4$  
9. $x + x + x + x = 12$
1.3: Draw Diagrams for Equations
For each equation, draw a diagram and find the value of the unknown that makes the equation true.

1. $18 = 3 + x$

2. $18 = 3 \cdot y$

Are you ready for more?
You are walking down a road, seeking treasure. The road branches off into three paths. A guard stands in each path. You know that only one of the guards is telling the truth, and the other two are lying. Here is what they say:

- Guard 1: The treasure lies down this path.
- Guard 2: No treasure lies down this path; seek elsewhere.
- Guard 3: The first guard is lying.

Which path leads to the treasure?
Lesson 1 Summary

Tape diagrams can help us understand relationships between quantities and how operations describe those relationships.

Diagram A has 3 parts that add to 21. Each part is labeled with the same letter, so we know the three parts are equal. Here are some equations that all represent diagram A:

\[ x + x + x = 21 \]
\[ 3 \cdot x = 21 \]
\[ x = 21 \div 3 \]
\[ x = \frac{1}{3} \cdot 21 \]

Notice that the number 3 is not seen in the diagram; the 3 comes from counting 3 boxes representing 3 equal parts in 21.

We can use the diagram or any of the equations to reason that the value of \( x \) is 7.

Diagram B has 2 parts that add to 21. Here are some equations that all represent diagram B:

\[ y + 3 = 21 \]
\[ y = 21 - 3 \]
\[ 3 = 21 - y \]

We can use the diagram or any of the equations to reason that the value of \( y \) is 18.
Lesson 3: Staying in Balance

3.1: Hanging Around

For diagram A, find:

1. One thing that must be true

2. One thing that could be true or false

3. One thing that cannot possibly be true

For diagram B, find:

1. One thing that must be true

2. One thing that could be true or false

3. One thing that cannot possibly be true
3.2: Match Equations and Hangers

1. Match each hanger to an equation. Complete the equation by writing $x$, $y$, $z$, or $w$ in the empty box.

$$\square + 3 = 6 \quad 3 \cdot \square = 6 \quad 6 = \square + 1 \quad 6 = 3 \cdot \square$$

2. Find a solution to each equation. Use the hangers to explain what each solution means.
3.3: Connecting Diagrams to Equations and Solutions

Here are some balanced hangers. Each piece is labeled with its weight.

For each diagram:

1. Write an equation.

2. Explain how to reason with the diagram to find the weight of a piece with a letter.

3. Explain how to reason with the equation to find the weight of a piece with a letter.

Are you ready for more?
When you have the time, visit the site [https://solveme.edc.org/Mobiles.html](https://solveme.edc.org/Mobiles.html) to solve some trickier puzzles that use hanger diagrams like the ones in this lesson. You can even build new ones. (If you want to do this during class, check with your teacher first!)
Lesson 3 Summary

A hanger stays balanced when the weights on both sides are equal. We can change the weights and the hanger will stay balanced as long as both sides are changed in the same way. For example, adding 2 pounds to each side of a balanced hanger will keep it balanced. Removing half of the weight from each side will also keep it balanced.

An equation can be compared to a balanced hanger. We can change the equation, but for a true equation to remain true, the same thing must be done to both sides of the equal sign. If we add or subtract the same number on each side, or multiply or divide each side by the same number, the new equation will still be true.

This way of thinking can help us find solutions to equations. Instead of checking different values, we can think about subtracting the same amount from each side or dividing each side by the same number.

Diagram A can be represented by the equation $3x = 11$.

If we break the 11 into 3 equal parts, each part will have the same weight as a block with an $x$.

Splitting each side of the hanger into 3 equal parts is the same as dividing each side of the equation by 3.

- $3x$ divided by 3 is $x$.
- $11$ divided by 3 is $\frac{11}{3}$.
- If $3x = 11$ is true, then $x = \frac{11}{3}$ is true.
- The solution to $3x = 11$ is $\frac{11}{3}$.

Diagram B can be represented with the equation $11 = y + 5$.

If we remove a weight of 5 from each side of the hanger, it will stay in balance.

Removing 5 from each side of the hanger is the same as subtracting 5 from each side of the equation.

- $11 - 5$ is 6.
- $y + 5 - 5$ is $y$.
- If $11 = y + 5$ is true, then $6 = y$ is true.
- The solution to $11 = y + 5$ is 6.
Unit 6 Lesson 3 Cumulative Practice Problems

1. Select all the equations that represent the hanger.

A. \( x + x + x = 1 + 1 + 1 + 1 + 1 + 1 \)
B. \( x \cdot x \cdot x = 6 \)
C. \( 3x = 6 \)
D. \( x + 3 = 6 \)
E. \( x \cdot x \cdot x = 1 \cdot 1 \cdot 1 \cdot 1 \cdot 1 \cdot 1 \)

2. Write an equation to represent each hanger.
3. a. Write an equation to represent the hanger.

b. Explain how to reason with the hanger to find the value of x.

c. Explain how to reason with the equation to find the value of x.

4. Andre says that x is 7 because he can move the two 1s with the x to the other side.

Do you agree with Andre? Explain your reasoning.

5. Match each equation to one of the diagrams.

   a. $12 - m = 4$
   b. $12 = 4 \cdot m$
   c. $m - 4 = 12$
   d. $\frac{m}{4} = 12$

   A
   \[
   \begin{array}{c}
   m \\
   12 \\
   4
   \end{array}
   \]
   B
   \[
   \begin{array}{c}
   12 \\
   4 \\
   m
   \end{array}
   \]
   C
   \[
   \begin{array}{c}
   m \\
   12 \\
   12 \\
   12 \\
   12
   \end{array}
   \]
   D
   \[
   \begin{array}{c}
   12 \\
   m \\
   m \\
   m \\
   m
   \end{array}
   \]

(From Unit 6, Lesson 1.)
6. The area of a rectangle is 14 square units. It has side lengths \( x \) and \( y \). Given each value for \( x \), find \( y \).
   
a. \( x = 2\frac{1}{3} \)

   b. \( x = 4\frac{1}{5} \)

   c. \( x = \frac{7}{6} \)

(From Unit 4, Lesson 13.)

7. Lin needs to save up $20 for a new game. How much money does she have if she has saved each percentage of her goal. Explain your reasoning.

   a. 25%

   b. 75%

   c. 125%

(From Unit 3, Lesson 11.)
Lesson 6: Write Expressions Where Letters Stand for Numbers

6.1: Algebra Talk: When $x$ is 6

If $x$ is 6, what is:

$x + 4$

$7 - x$

$x^2$

$\frac{1}{3}x$

6.2: Lemonade Sales and Heights

1. Lin set up a lemonade stand. She sells the lemonade for $0.50 per cup.

   a. Complete the table to show how much money she would collect if she sold each number of cups.

<table>
<thead>
<tr>
<th>lemonade sold (number of cups)</th>
<th>12</th>
<th>183</th>
<th>$c$</th>
</tr>
</thead>
<tbody>
<tr>
<td>money collected (dollars)</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

   b. How many cups did she sell if she collected $127.50? Be prepared to explain your reasoning.
2. Elena is 59 inches tall. Some other people are taller than Elena.

a. Complete the table to show the height of each person.

<table>
<thead>
<tr>
<th>person</th>
<th>Andre</th>
<th>Lin</th>
<th>Noah</th>
</tr>
</thead>
<tbody>
<tr>
<td>how much taller than Elena (inches)</td>
<td>4</td>
<td>$6\frac{1}{2}$</td>
<td>$d$</td>
</tr>
<tr>
<td>person's height (inches)</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

b. If Noah is $64\frac{3}{4}$ inches tall, how much taller is he than Elena?

6.3: Building Expressions

1. Clare is 5 years older than her cousin.

a. How old would Clare be if her cousin is:

- 10 years old?
- 2 years old?
- $x$ years old?

b. Clare is 12 years old. How old is Clare's cousin?
2. Diego has 3 times as many comic books as Han.
   a. How many comic books does Diego have if Han has:
      6 comic books?
      \( n \) books?
   b. Diego has 27 comic books. How many comic books does Han have?

3. Two fifths of the vegetables in Priya's garden are tomatoes.
   a. How many tomatoes are there if Priya's garden has:
      20 vegetables?
      \( x \) vegetables?
   b. Priya's garden has 6 tomatoes. How many total vegetables are there?

4. A school paid $31.25 for each calculator.
   a. If the school bought \( x \) calculators, how much did they pay?
   b. The school spent $500 on calculators. How many did the school buy?
Are you ready for more?

Kiran, Mai, Jada, and Tyler went to their school carnival. They all won chips that they could exchange for prizes. Kiran won $\frac{2}{3}$ as many chips as Jada. Mai won 4 times as many chips as Kiran. Tyler won half as many chips as Mai.

1. Write an expression for the number of chips Tyler won. You should only use one variable: $J$, which stands for the number of chips Jada won.

2. If Jada won 42 chips, how many chips did Tyler, Kiran, and Mai each win?

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Lesson 6 Summary

Suppose you share a birthday with a neighbor, but she is 3 years older than you. When you were 1, she was 4. When you were 9, she was 12. When you are 42, she will be 45.

If we let $a$ represent your age at any time, your neighbor’s age can be expressed $a + 3$.

<table>
<thead>
<tr>
<th>your age</th>
<th>1</th>
<th>9</th>
<th>42</th>
<th>$a$</th>
</tr>
</thead>
<tbody>
<tr>
<td>neighbor's age</td>
<td>4</td>
<td>12</td>
<td>45</td>
<td>$a + 3$</td>
</tr>
</tbody>
</table>

We often use a letter such as $x$ or $a$ as a placeholder for a number in expressions. These are called variables (just like the letters we used in equations, previously). Variables make it possible to write expressions that represent a calculation even when we don’t know all the numbers in the calculation.

How old will you be when your neighbor is 32? Since your neighbor’s age is calculated with the expression $a + 3$, we can write the equation $a + 3 = 32$. When your neighbor is 32 you will be 29, because $a + 3 = 32$ is true when $a$ is 29.
Unit 6 Lesson 6 Cumulative Practice Problems

1. Instructions for a craft project say that the length of a piece of red ribbon should be 7 inches less than the length of a piece of blue ribbon.

   a. How long is the red ribbon if the length of the blue ribbon is:

      10 inches? 27 inches? \( x \) inches?

   b. How long is the blue ribbon if the red ribbon is 12 inches?

2. Tyler has 3 times as many books as Mai.

   a. How many books does Mai have if Tyler has:

      15 books? 21 books? \( x \) books?

   b. Tyler has 18 books. How many books does Mai have?

3. A bottle holds 24 ounces of water. It has \( x \) ounces of water in it.

   a. What does \( 24 - x \) represent in this situation?

   b. Write a question about this situation that has \( 24 - x \) for the answer.

4. Write an equation represented by this tape diagram using each of these operations.

   \[
   \begin{array}{ccc}
   9 & \quad & 9 \quad & 9 \quad & \quad \quad 27 \\
   \end{array}
   \]

   a. addition

   b. subtraction

   c. multiplication

   d. division

(From Unit 6, Lesson 1.)
5. Select all the equations that describe each situation and then find the solution.
   a. Han's house is 450 meters from school. Lin's house is 135 meters closer to school. How far is Lin's house from school?
      • \( z = 450 + 135 \)
      • \( z = 450 - 135 \)
      • \( z - 135 = 450 \)
      • \( z + 135 = 450 \)
   b. Tyler's playlist has 36 songs. Noah's playlist has one quarter as many songs as Tyler's playlist. How many songs are on Noah's playlist?
      • \( w = 4 \cdot 36 \)
      • \( w = 36 \div 4 \)
      • \( 4w = 36 \)
      • \( \frac{w}{4} = 36 \)

(From Unit 6, Lesson 4.)

6. You had $50. You spent 10% of the money on clothes, 20% on games, and the rest on books. How much money was spent on books?

(From Unit 3, Lesson 12.)

7. A trash bin has a capacity of 50 gallons. What percentage of its capacity is each amount? Show your reasoning.
   a. 5 gallons
   b. 30 gallons
   c. 45 gallons
   d. 100 gallons

(From Unit 3, Lesson 14.)
Lesson 8: Equal and Equivalent

8.1: Algebra Talk: Solving Equations by Seeing Structure

Find a solution to each equation mentally.

\[ 3 + x = 8 \]

\[ 10 = 12 - x \]

\[ x^2 = 49 \]

\[ \frac{1}{3}x = 6 \]

8.2: Using Diagrams to Show That Expressions are Equivalent

Here is a diagram of \( x + 2 \) and \( 3x \) when \( x \) is 4. Notice that the two diagrams are lined up on their left sides.

In each of your drawings below, line up the diagrams on one side.

1. Draw a diagram of \( x + 2 \), and a separate diagram of \( 3x \), when \( x \) is 3.
2. Draw a diagram of $x + 2$, and a separate diagram of $3x$, when $x$ is 2.

3. Draw a diagram of $x + 2$, and a separate diagram of $3x$, when $x$ is 1.

4. Draw a diagram of $x + 2$, and a separate diagram of $3x$, when $x$ is 0.

5. When are $x + 2$ and $3x$ equal? When are they not equal? Use your diagrams to explain.

6. Draw a diagram of $x + 3$, and a separate diagram of $3 + x$.

7. When are $x + 3$ and $3 + x$ equal? When are they not equal? Use your diagrams to explain.
8.3: Identifying Equivalent Expressions

Here is a list of expressions. Find any pairs of expressions that are equivalent. If you get stuck, try reasoning with diagrams.

\[
\begin{align*}
    a + 3 & \quad a \div \frac{1}{3} & \quad \frac{1}{3}a & \quad \frac{a}{3} & \quad a \\
    a + a + a & \quad a \cdot 3 & \quad 3a & \quad 1a & \quad 3 + a
\end{align*}
\]

Are you ready for more?

Below are four questions about equivalent expressions. For each one:

- Decide whether you think the expressions are equivalent.
- Test your guess by choosing numbers for \(x\) (and \(y\), if needed).

1. Are \(\frac{x \cdot x \cdot x \cdot x}{x}\) and \(x \cdot x \cdot x\) equivalent expressions?

2. Are \(\frac{x + x + x + x}{x}\) and \(x + x + x\) equivalent expressions?

3. Are \(2(x + y)\) and \(2x + 2y\) equivalent expressions?

4. Are \(2xy\) and \(2x \cdot 2y\) equivalent expressions?
Lesson 8 Summary

We can use diagrams showing lengths of rectangles to see when expressions are equal. For example, the expressions $x + 9$ and $4x$ are equal when $x$ is 3, but are not equal for other values of $x$.

![Diagram showing lengths of rectangles]

Sometimes two expressions are equal for only one particular value of their variable. Other times, they seem to be equal no matter what the value of the variable.

Expressions that are always equal for the same value of their variable are called equivalent expressions. However, it would be impossible to test every possible value of the variable. How can we know for sure that expressions are equivalent? We use the meaning of operations and properties of operations to know that expressions are equivalent. Here are some examples:

- $x + 3$ is equivalent to $3 + x$ because of the commutative property of addition.
- $4 \cdot y$ is equivalent to $y \cdot 4$ because of the commutative property of multiplication.
- $a + a + a + a + a$ is equivalent to $5 \cdot a$ because adding 5 copies of something is the same as multiplying it by 5.
- $h \div 3$ is equivalent to $h \cdot \frac{1}{3}$ because dividing by a number is the same as multiplying by its reciprocal.

In the coming lessons, we will see how another property, the distributive property, can show that expressions are equivalent.
Unit 6 Lesson 8 Cumulative Practice Problems

1. a. Draw a diagram of $x + 3$ and a diagram of $2x$ when $x$ is 1.

b. Draw a diagram of $x + 3$ and of $2x$ when $x$ is 2.

c. Draw a diagram of $x + 3$ and of $2x$ when $x$ is 3.

d. Draw a diagram of $x + 3$ and of $2x$ when $x$ is 4.

e. When are $x + 3$ and $2x$ equal? When are they not equal? Use your diagrams to explain.
2. a. Do \(4x\) and \(15 + x\) have the same value when \(x\) is 5?

   b. Are \(4x\) and \(15 + x\) equivalent expressions? Explain your reasoning.

3. a. Check that \(2b + b\) and \(3b\) have the same value when \(b\) is 1, 2, and 3.

   b. Do \(2b + b\) and \(3b\) have the same value for all values of \(b\)? Explain your reasoning.

   c. Are \(2b + b\) and \(3b\) equivalent expressions?

4. 80% of \(x\) is equal to 100.

   a. Write an equation that shows the relationship of 80%, \(x\), and 100.

   b. Use your equation to find \(x\).

(From Unit 6, Lesson 7.)
5. For each story problem, write an equation to represent the problem and then solve the equation. Be sure to explain the meaning of any variables you use.

   a. Jada’s dog was \(5 \frac{1}{2}\) inches tall when it was a puppy. Now her dog is \(14 \frac{1}{2}\) inches taller than that. How tall is Jada’s dog now?

   b. Lin picked \(9 \frac{3}{4}\) pounds of apples, which was 3 times the weight of the apples Andre picked. How many pounds of apples did Andre pick?

(From Unit 6, Lesson 5.)

6. Find these products.

   a. \((2.3) \cdot (1.4)\)

   b. \((1.72) \cdot (2.6)\)

   c. \((18.2) \cdot (0.2)\)

   d. \(15 \cdot (1.2)\)

(From Unit 5, Lesson 8.)

7. Calculate \(141.75 \div 2.5\) using a method of your choice. Show or explain your reasoning.

(From Unit 5, Lesson 13.)
Lesson 9: The Distributive Property, Part 1

9.1: Number Talk: Ways to Multiply
Find each product mentally.

\[ 5 \cdot 102 \]
\[ 5 \cdot 98 \]
\[ 5 \cdot 999 \]

9.2: Ways to Represent Area of a Rectangle

1. Select all the expressions that represent the area of the large, outer rectangle in figure A. Explain your reasoning.

- \[ 6 + 3 + 2 \]
- \[ 6 \cdot 3 + 6 \cdot 2 \]
- \[ 6 \cdot 3 + 2 \]
- \[ 6 \cdot 5 \]
- \[ 6(3 + 2) \]
- \[ 6 \cdot 3 \cdot 2 \]

2. Select all the expressions that represent the area of the shaded rectangle on the left side of figure B. Explain your reasoning.

- \[ 4 \cdot 7 + 4 \cdot 2 \]
- \[ 4 \cdot 7 + 2 \]
- \[ 4 \cdot 5 \]
- \[ 4 \cdot 7 - 4 \cdot 2 \]
- \[ 4(7 - 2) \]
- \[ 4(7 + 2) \]
- \[ 4 \cdot 2 - 4 \cdot 7 \]
### 9.3: Distributive Practice

Complete the table. If you get stuck, skip an entry and come back to it, or consider drawing a diagram of two rectangles that share a side.

<table>
<thead>
<tr>
<th>column 1</th>
<th>column 2</th>
<th>column 3</th>
<th>column 4</th>
<th>value</th>
</tr>
</thead>
<tbody>
<tr>
<td>5 • 98</td>
<td>5(100 − 2)</td>
<td>5 • 100 − 5 • 2</td>
<td>500 − 10</td>
<td>490</td>
</tr>
<tr>
<td>33 • 12</td>
<td>33(10 + 2)</td>
<td>3 • 10 − 3 • 4</td>
<td>30 − 12</td>
<td></td>
</tr>
<tr>
<td>100(0.04 + 0.06)</td>
<td></td>
<td>8 • $\frac{1}{2}$ + 8 • $\frac{1}{4}$</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>9 + 12</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>24 − 16</td>
</tr>
</tbody>
</table>
Are you ready for more?

1. Use the distributive property to write two expressions that equal 360. (There are many correct ways to do this.)

2. Is it possible to write an expression like \(a(b + c)\) that equals 360 where \(a\) is a fraction? Either write such an expression, or explain why it is impossible.

3. Is it possible to write an expression like \(a(b - c)\) that equals 360? Either write such an expression, or explain why it is impossible.

4. How many ways do you think there are to make 360 using the distributive property?

Lesson 9 Summary

A term is a single number or variable, or variables and numbers multiplied together. Some examples of terms are 10, 8x, \(ab\), and 7yz.

When we need to do mental calculations, we often come up with ways to make the calculation easier to do mentally.

Suppose we are grocery shopping and need to know how much it will cost to buy 5 cans of beans at 79 cents a can.

We may calculate mentally in this way:

\[
5 \cdot 79 = 5 \cdot 70 + 5 \cdot 9 = 350 + 45 = 395
\]

In general, when we multiply two terms (or factors), we can break up one of the factors into parts, multiply each part by the other factor, and then add the products. The result will be the same as the product of the two original factors. When we break up one of the factors and multiply the parts we are using the distributive property.

The distributive property also works with subtraction. Here is another way to find \(5 \cdot 79\):

\[
5 \cdot (80 - 1) = 400 - 5 = 395
\]
Identifying Equivalent Expressions

- Determine whether each pair of expressions is equivalent. Show your work.

1. $2(x - y)$ and $2x - 2y$
2. $4(x + y)$ and $4y + 4x$

3. $4p + 3c$ and $(c + 2p)(2)$
4. $21q - 7p$ and $(3q - p)(7)$

5. $4(2a - 3v)$ and $8a + 6v$
6. $8(3x + c) - 1$ and $8c + 24x - 1$
Lesson 9: The Distributive Property, Part 1

Cool Down: Complete the Equation

Write a number or expression in each empty box to create true equations.

1. $7(3 + 5) = \underline{} + \underline{}$
2. $15 - 10 = \underline{}(3 - 2)$
Lesson 13: Expressions with Exponents

13.1: Which One Doesn't Belong: Twos
Which one doesn't belong?

\[2 \cdot 2 \cdot 2 \cdot 2\]
\[2^4\]
\[16\]
\[4 \cdot 2\]

13.2: Is the Equation True?
Decide whether each equation is true or false, and explain how you know.

1. \[2^4 = 2 \cdot 4\]

2. \[3 + 3 + 3 + 3 + 3 = 3^5\]

3. \[5^3 = 5 \cdot 5 \cdot 5\]

4. \[2^3 = 3^2\]

5. \[16^1 = 8^2\]

6. \[\frac{1}{2} \cdot \frac{1}{2} \cdot \frac{1}{2} \cdot \frac{1}{2} = 4 \cdot \frac{1}{2}\]

7. \[\left(\frac{1}{2}\right)^4 = \frac{1}{8}\]

8. \[8^2 = 4^3\]
13.3: What's Your Reason?

In each list, find expressions that are equivalent to each other and explain to your partner why they are equivalent. Your partner listens to your explanation. If you disagree, explain your reasoning until you agree. Switch roles for each list. (There may be more than two equivalent expressions in each list.)

1. a. $5 \cdot 5$
   
b. $2^5$
   
c. $5^2$
   
d. $2 \cdot 5$

2. a. $4^3$
   
b. $3^4$
   
c. $4 \cdot 4 \cdot 4$
   
d. $4 + 4 + 4$

3. a. $6 + 6 + 6$
   
b. $6^3$
   
c. $3^6$
   
d. $3 \cdot 6$

4. a. $11^5$
   
b. $11 \cdot 11 \cdot 11 \cdot 11 \cdot 11$
   
c. $11 \cdot 5$
   
d. $5^{11}$
5. a. \( \frac{1}{5} \cdot \frac{1}{5} \cdot \frac{1}{5} \)
   
   b. \( \left( \frac{1}{5} \right)^3 \)
   
   c. \( \frac{1}{15} \)
   
   d. \( \frac{1}{125} \)

6. a. \( \left( \frac{5}{3} \right)^2 \)
   
   b. \( \left( \frac{3}{5} \right)^2 \)
   
   c. \( \frac{10}{6} \)
   
   d. \( \frac{25}{9} \)

**Are you ready for more?**

What is the last digit of \( 3^{1,000} \)? Show or explain your reasoning.

**Lesson 13 Summary**

When working with exponents, the bases don't have to always be whole numbers. They can also be other kinds of numbers, like fractions, decimals, and even variables. For example, we can use exponents in each of the following ways:

\[
\left( \frac{2}{3} \right)^4 = \frac{2}{3} \cdot \frac{2}{3} \cdot \frac{2}{3} \cdot \frac{2}{3}
\]

\[
(1.7)^3 = (1.7) \cdot (1.7) \cdot (1.7)
\]

\[
x^5 = x \cdot x \cdot x \cdot x \cdot x
\]
Unit 6 Lesson 13 Cumulative Practice Problems

1. Select all expressions that are equal to $3 \cdot 3 \cdot 3 \cdot 3 \cdot 3$.
   A. $3 \cdot 5$
   B. $3^5$
   C. $3^4 \cdot 3$
   D. $5 \cdot 3$
   E. $5^3$

2. Noah starts with 0 and then adds the number 5 four times. Diego starts with 1 and then multiplies by the number 5 four times. For each expression, decide whether it is equal to Noah's result, Diego's result, or neither.
   a. $4 \cdot 5$
   b. $4 + 5$
   c. $4^5$
   d. $5^4$
3. Decide whether each equation is true or false, and explain how you know.

   a. $9 \cdot 9 \cdot 3 = 3^5$

   b. $7 + 7 + 7 = 3 + 3 + 3 + 3 + 3 + 3$

   c. $\frac{1}{7} \cdot \frac{1}{7} \cdot \frac{1}{7} = \frac{3}{7}$

   d. $4^1 = 4 \cdot 1$

   e. $6 + 6 + 6 = 6^3$

4. a. What is the area of a square with side lengths of $\frac{3}{5}$ units?

   b. What is the side length of a square with area $\frac{1}{16}$ square units?

   c. What is the volume of a cube with edge lengths of $\frac{2}{3}$ units?

   d. What is the edge length of a cube with volume $\frac{27}{64}$ cubic units?

5. Select all the expressions that represent the area of the shaded rectangle.
A. 3(10 - c)
B. 3(c - 10)
C. 10(c - 3)
D. 10(3 - c)
E. 30 - 3c
F. 30 - 10c

(From Unit 6, Lesson 10.)

6. A ticket at a movie theater costs $8.50. One night, the theater had $29,886 in ticket sales.

a. Estimate about how many tickets the theater sold. Explain your reasoning.

b. How many tickets did the theater sell? Explain your reasoning.

(From Unit 5, Lesson 13.)

7. A fence is being built around a rectangular garden that is 8 1/2 feet by 6 1/3 feet. Fencing comes in panels. Each panel is 2/3 of a foot wide. How many panels are needed? Explain or show your reasoning.

(From Unit 4, Lesson 12.)
Lesson 14: Evaluating Expressions with Exponents

14.1: Revisiting the Cube
Based on the given information, what other measurements of the square and cube could we find?

14.2: Calculating Surface Area
A cube has side length 10 inches. Jada says the surface area of the cube is $600 \text{ in}^2$, and Noah says the surface area of the cube is $3,600 \text{ in}^2$. Here is how each of them reasoned:

Jada’s Method: 
- $6 \cdot 10^2$
- $6 \cdot 100$
- $600$

Noah’s Method: 
- $6 \cdot 10^2$
- $60^2$
- $3,600$

Do you agree with either of them? Explain your reasoning.

14.3: Row Game: Expression Explosion
Evaluate the expressions in one of the columns. Your partner will work on the other column. Check with your partner after you finish each row. Your answers in each row should be the same. If your answers aren’t the same, work together to find the error.
<table>
<thead>
<tr>
<th>column A</th>
<th>column B</th>
</tr>
</thead>
<tbody>
<tr>
<td>5² + 4</td>
<td>2² + 25</td>
</tr>
<tr>
<td>2⁴ ⋅ 5</td>
<td>2³ ⋅ 10</td>
</tr>
<tr>
<td>3 ⋅ 4²</td>
<td>12 ⋅ 2²</td>
</tr>
<tr>
<td>20 + 2³</td>
<td>1 + 3³</td>
</tr>
<tr>
<td>9 ⋅ 2¹</td>
<td>3 ⋅ 6¹</td>
</tr>
<tr>
<td>(\frac{1}{9} \cdot \left(\frac{1}{2}\right)^3)</td>
<td>(\frac{1}{8} \cdot \left(\frac{1}{3}\right)^2)</td>
</tr>
</tbody>
</table>

**Are you ready for more?**

1. Consider this equation: \(\boxed{a}^2 + \boxed{b}^2 = \boxed{c}^2\). An example of 3 different whole numbers that could go in the boxes are 3, 4, and 5, since \(3^2 + 4^2 = 5^2\). (That is, 9 + 16 = 25.)

   Can you find a different set of 3 whole numbers that make the equation true?

2. How many sets of 3 different whole numbers can you find?
3. Can you find a set of 3 different whole numbers that make this equation true?
\[ \square^3 + \square^3 = \square^3 \]

4. How about this one? \[ \square^4 + \square^4 = \square^4 \]

Once you have worked on this a little while, you can understand a problem that is famous in the history of math. (Alas, this space is too small to contain it.) If you are interested, consider doing some further research on Fermat's Last Theorem.

**Lesson 14 Summary**

Exponents give us a new way to describe operations with numbers, so we need to understand how exponents get along with the other operations we know.

When we write 6 \( \cdot 4^2 \), we want to make sure everyone agrees about how to evaluate this. Otherwise some people might multiply first and others compute the exponent first, and different people would get different values for the same expression!

Earlier we saw situations in which 6 \( \cdot 4^2 \) represented the surface area of a cube with side lengths 4 units. When computing the surface area, we evaluate \( 4^2 \) first (or find the area of one face of the cube first) and then multiply the result by 6. In many other expressions that use exponents, the part with an exponent is intended to be evaluated first.

To make everyone agree about the value of expressions like 6 \( \cdot 4^2 \), the convention is to evaluate the part of the expression with the exponent first. Here are a couple of examples:

- \( 6 \cdot 4^2 = 45 + 5^2 \)
- \( 6 \cdot 16 = 45 + 25 \)
- \( 96 = 70 \)

If we want to communicate that 6 and 4 should be multiplied first and then squared, then we can use parentheses to group parts together:

- \( (6 \cdot 4)^2 = (45 + 5)^2 \)
- \( 24^2 = 50^2 \)
- \( 576 = 2,500 \)
Unit 6 Lesson 14 Cumulative Practice Problems

1. Lin says, “I took the number 8, and then multiplied it by the square of 3.” Select all the expressions that equal Lin’s answer.

A. $8 \cdot 3^2$
B. $(8 \cdot 3)^2$
C. $8 \cdot 2^3$
D. $3^2 \cdot 8$
E. $24^2$
F. 72

2. Evaluate each expression.

a. $7 + 2^3$

b. $9 \cdot 3^1$

c. $20 - 2^4$

d. $2 \cdot 6^2$

e. $8 \cdot \left(\frac{1}{2}\right)^2$

f. $\frac{1}{3} \cdot 3^3$

g. $(\frac{1}{3} \cdot 5)^5$
3. Andre says, "I multiplied 4 by 5, then cubed the result." Select all the expressions that equal Andre's answer.

A. $4 \cdot 5^3$

B. $(4 \cdot 5)^3$

C. $(4 \cdot 5)^2$

D. $5^3 \cdot 4$

E. $20^3$

F. 500

G. 8,000

4. Han has 10 cubes, each 5 inches on a side.

a. Find the total volume of Han's cubes. Express your answer as an expression using an exponent.

b. Find the total surface area of Han's cubes. Express your answer as an expression using an exponent.

5. Priya says that $\frac{1}{3} \cdot \frac{1}{3} \cdot \frac{1}{3} \cdot \frac{1}{3} = \frac{4}{3}$. Do you agree with Priya? Explain or show your reasoning.

(From Unit 6, Lesson 13.)
6. Answer each question. Show your reasoning.
   
a. 125% of $e$ is 30. What is $e$?

   b. 35% of $f$ is 14. What is $f$?

(From Unit 6, Lesson 7.)

7. Which expressions are solutions to the equation $2.4y = 13.75$? Select all that apply.
   
   A. $13.75 - 1.4$
   
   B. $13.75 \cdot 2.4$
   
   C. $13.75 \div 2.4$
   
   D. \( \frac{13.75}{2.4} \)
   
   E. $2.4 \div 13.75$

(From Unit 6, Lesson 5.)

8. Jada explains how she finds $15 \cdot 23$:

   "I know that ten 23s is 230, so five 23s will be half of 230, which is 115. 15 is 10 plus 5, so $15 \cdot 23$ is 230 plus 115, which is 345."

   a. Do you agree with Jada? Explain.

   b. Draw a 15 by 23 rectangle. Partition the rectangle into two rectangles and label them to show Jada's reasoning.

(From Unit 5, Lesson 7.)
1. Select all the equations where \( x = 3 \) is a solution.

A. \( x - 3 = 0 \)
B. \( 1 + x = 2 \)
C. \( 9 - x = 3 \)
D. \( 6 = 2x \)
E. \( \frac{1}{3}x = 3 \)
F. \( x^2 = 9 \)

2. Which equation matches the hanger diagram?

A. \( x \cdot x = 1 \cdot 1 \cdot 1 \cdot 1 \cdot 1 \)
B. \( x = \frac{2}{5} \)
C. \( x + 3 = 5 \)
D. \( 2x = 5 \)
3. Select all the expressions that represent the total area of the rectangle.

A. \(4s\)
B. \(\frac{1}{3}s + 12\)
C. \(\frac{1}{3} \cdot s + \frac{1}{3} \cdot 12\)
D. \(\frac{1}{3}s + 4\)
E. \(\frac{1}{3}(s + 12)\)

7. Mai poured 2.6 liters of water into a partially filled pitcher. The pitcher then contained 10.4 liters.

a. Which diagram (A, B, or C) represents this situation?

b. Write an equation that represents this situation.

c. Solve the equation you wrote.

d. Explain what the solution to the equation means in this situation.
Family Support Materials

Rational Numbers

Negative Numbers and Absolute Value

Family Support Materials 1

This week, your student will work with signed numbers, or positive and negative numbers. We often compare signed numbers when talking about temperatures. For example, -30 degrees Fahrenheit is colder than -10 degrees Fahrenheit. We say “-30 is less than -10” and write: -30 < -10.

We also use signed numbers when referring to elevation, or height relative to the sea level. An elevation of 2 feet (which means 2 feet above sea level) is higher than an elevation of -4 feet (which means 4 feet below sea level). We say “2 is greater than -4” and write 2 > -4.

We can plot positive and negative numbers on the number line. Numbers to the left are always less than numbers to the right.

\[ \begin{array}{cccccc}
-2.7 & & -1.3 & & 0.8 & \\
-3 & -2 & -1 & 0 & 1 & 2 & 3
\end{array} \]

We can see that -1.3 is less than 0.8 because -1.3 is to the left of 0.8, but -1.3 is greater than -2.7 because it is to the right of -2.7.

We can also talk about a number in terms of its absolute value, or its distance from zero on the number line. For example, 0.8 is 0.8 units away from zero, which we can write as \(|0.8| = 0.8\), and -2.7 is 2.7 units away from zero, which we can write as \(|-2.7| = 2.7\). The numbers -3 and 3 are both 3 units from 0, which we can write as \(|3| = 3\) and \(|-3| = 3\).

Here is a task to try with your student:

1. A diver is at the surface of the ocean, getting ready to make a dive. What is the diver’s elevation in relation to sea level?

2. The diver descends 100 feet to the top of a wrecked ship. What is the diver’s elevation now?
3. The diver descends 25 feet more toward the ocean floor. What is the absolute value of the diver's elevation now?

4. Plot each of the three elevations as a point on a number line. Label each point with its numeric value.

Solution:

1. 0, because sea level is 0 feet above or below sea level

2. -100, because the diver is 100 feet below sea level

3. The new elevation is -125 feet or 125 feet below sea level, so its absolute value is 125 feet.

4. A number line with 0, -100, and -125 marked, as shown:

```
-140 -120 -100 -80 -60 -40 -20 0
```
**Inequalities**

**Family Support Materials 2**

This week, your student will compare positive and negative numbers with inequalities symbols (< and >). They will also graph inequalities in one variable, such as $x < 1$ or $1 > x$, on the number line.

For example, to represent the statement “the temperature in Celsius ($x$) is less than 1 degree,” we can write the inequality $x < 1$ and draw a number line like this:

![Number line with point at 1]

The diagram shows all numbers to the left of 1 (or less than 1) being possible values of $x$.

We call any value of $x$ that makes an inequality true a **solution to the inequality**.

This means $x$ values that are greater than -8 are solutions to the inequality $x > -8$. Likewise, $x$ values that are less than 15 could be a solution to the inequality $x < 15$. Depending on the context, however, the solutions may include only positive whole numbers (for example, if $x$ represents the number of students in a class), or any positive and negative numbers, not limited to whole numbers (for example, if $x$ represents temperatures).

Here is a task to try with your student:

A sign at a fair says, “You must be taller than 32 inches to ride the ferris wheel.” Write and graph an inequality that shows the heights of people who are tall enough to ride the ferris wheel.

Solution:

If $x$ represents the height of a person in inches, then the inequality $x > 32$ represents the heights of people who can ride the ferris wheel. We can also write the inequality $32 < x$.

The graph of the inequality is:

![Number line with point at 32]
The Coordinate Plane

Family Support Materials 3

This week, your student will plot and interpret points on the coordinate plane. In earlier grades, they plotted points where both coordinates are positive, such as point $A$ in the figure. They will now plot points that have positive and negative coordinates, such as points $B$ and $C$.

To find the distance between two points that share the same horizontal line or the same vertical lines, we can simply count the grid units between them. For example, if we plot the point $(2, -4)$ on the grid above (try it!), we can tell that the point will be 7 units away from point $A = (2, 3)$.

Points on a coordinate plane can also represent situations that involve positive and negative numbers. For instance, the points on this coordinate plane shows the temperature in degrees Celsius every hour before and after noon on a winter day. Times before noon are negative and times after noon are positive.
For example, the point (5, 10) tells us that 5 hours after noon, or 5:00 p.m., the temperature was 10 degrees Celsius.

Here is a task to try with your student:

In the graph of temperatures above:

1. What was the temperature at 7 a.m.?

2. For which recorded times was it colder than 5 degrees Celsius?

Solution:

1. It was -5 degrees Celsius at 7:00 a.m. You can see this at the point (-5, -5).

2. It was 5 degrees Celsius right at noon, and for the times recorded before that, it was colder.
Lesson 1: Positive and Negative Numbers

1.1: Notice and Wonder: Memphis and Bangor

Memphis, TN
Saturday 5:00 PM
Light Rain Showers

37°F
3°C

Bangor, ME
Saturday 6:00 PM
Partly Cloudy

1°F
-17°C

What do you notice? What do you wonder?
1.2: Above and Below Zero

1. Here are three situations involving changes in temperature and three number lines. Represent each change on a number line. Then, answer the question.

   a. At noon, the temperature was 5 degrees Celsius. By late afternoon, it has risen 6 degrees Celsius. What was the temperature late in the afternoon?

   b. The temperature was 8 degrees Celsius at midnight. By dawn, it has dropped 12 degrees Celsius. What was the temperature at dawn?

   c. Water freezes at 0 degrees Celsius, but the freezing temperature can be lowered by adding salt to the water. A student discovered that adding half a cup of salt to a gallon of water lowers its freezing temperature by 7 degrees Celsius. What is the freezing temperature of the gallon of salt water?

   ![Number lines]

2. Discuss with a partner:

   a. How did each of you name the resulting temperature in each situation?

   b. What does it mean when the temperature is above 0? Below 0?

   c. Do numbers less than 0 make sense in other contexts? Give some specific examples to show how they do or do not make sense.
1.3: High Places, Low Places

1. Here is a table that shows elevations of various cities.

<table>
<thead>
<tr>
<th>city</th>
<th>elevation (feet)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Harrisburg, PA</td>
<td>320</td>
</tr>
<tr>
<td>Bethell, IN</td>
<td>1,211</td>
</tr>
<tr>
<td>Denver, CO</td>
<td>5,280</td>
</tr>
<tr>
<td>Coachella, CA</td>
<td>-22</td>
</tr>
<tr>
<td>Death Valley, CA</td>
<td>-282</td>
</tr>
<tr>
<td>New York City, NY</td>
<td>33</td>
</tr>
<tr>
<td>Miami, FL</td>
<td>0</td>
</tr>
</tbody>
</table>

a. On the list of cities, which city has the second highest elevation?

b. How would you describe the elevation of Coachella, CA in relation to sea level?

c. How would you describe the elevation of Death Valley, CA in relation to sea level?

d. If you are standing on a beach right next to the ocean, what is your elevation?

e. How would you describe the elevation of Miami, FL?

f. A city has a higher elevation than Coachella, CA. Select all numbers that could represent the city's elevation. Be prepared to explain your reasoning.

- 11 feet
- 35 feet
- 4 feet
- 8 feet
- 0 feet
2. Here are two tables that show the elevations of highest points on land and lowest points in the ocean. Distances are measured from sea level.

<table>
<thead>
<tr>
<th>mountain</th>
<th>continent</th>
<th>elevation (meters)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Everest</td>
<td>Asia</td>
<td>8,848</td>
</tr>
<tr>
<td>Kilimanjaro</td>
<td>Africa</td>
<td>5,895</td>
</tr>
<tr>
<td>Denali</td>
<td>North America</td>
<td>6,168</td>
</tr>
<tr>
<td>Pikchu Pikchu</td>
<td>South America</td>
<td>5,664</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>trench</th>
<th>ocean</th>
<th>elevation (meters)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mariana Trench</td>
<td>Pacific</td>
<td>-11,033</td>
</tr>
<tr>
<td>Puerto Rico Trench</td>
<td>Atlantic</td>
<td>-8,600</td>
</tr>
<tr>
<td>Tonga Trench</td>
<td>Pacific</td>
<td>-10,882</td>
</tr>
<tr>
<td>Sunda Trench</td>
<td>Indian</td>
<td>-7,725</td>
</tr>
</tbody>
</table>

a. Which point in the ocean is the lowest in the world? What is its elevation?

b. Which mountain is the highest in the world? What is its elevation?

c. If you plot the elevations of the mountains and trenches on a vertical number line, what would 0 represent? What would points above 0 represent? What about points below 0?

d. Which is farther from sea level: the deepest point in the ocean, or the top of the highest mountain in the world? Explain.
Are you ready for more?

A spider spins a web in the following way:

- It starts at sea level.
- It moves up one inch in the first minute.
- It moves down two inches in the second minute.
- It moves up three inches in the third minute.
- It moves down four inches in the fourth minute.

Assuming that the pattern continues, what will the spider's elevation be after an hour has passed?

Lesson 1 Summary

Positive numbers are numbers that are greater than 0. Negative numbers are numbers that are less than zero. The meaning of a negative number in a context depends on the meaning of zero in that context.

For example, if we measure temperatures in degrees Celsius, then 0 degrees Celsius corresponds to the temperature at which water freezes.

In this context, positive temperatures are warmer than the freezing point and negative temperatures are colder than the freezing point. A temperature of -6 degrees Celsius means that it is 6 degrees away from 0 and it is less than 0. This thermometer shows a temperature of -6 degrees Celsius.

If the temperature rises a few degrees and gets very close to 0 degrees without reaching it, the temperature is still a negative number.
Another example is elevation, which is a distance above or below sea level. An elevation of 0 refers to the sea level. Positive elevations are higher than sea level, and negative elevations are lower than sea level.
Unit 7 Lesson 1 Cumulative Practice Problems

1. a. Is a temperature of -11 degrees warmer or colder than a temperature of -15 degrees?

   b. Is an elevation of -10 feet closer or farther from the surface of the ocean than an elevation of -8 feet?

   c. It was 8 degrees at nightfall. The temperature dropped 10 degrees by midnight. What was the temperature at midnight?

   d. A diver is 25 feet below sea level. After he swims up 15 feet toward the surface, what is his elevation?

2. a. A whale is at the surface of the ocean to breathe. What is the whale’s elevation?

   b. The whale swims down 300 feet to feed. What is the whale’s elevation now?

   c. The whale swims down 150 more feet more. What is the whale’s elevation now?

   d. Plot each of the three elevations as a point on a vertical number line. Label each point with its numeric value.

3. Explain how to calculate a number that is equal to \(\frac{21}{15}\).

(From Unit 6, Lesson 5.)
Lesson 2: Points on the Number Line

2.1: A Point on the Number Line

Which of the following numbers could be \( B \)?

\[
\begin{align*}
2.5 & \quad \frac{2}{5} & \quad \frac{5}{2} & \quad \frac{25}{10} & \quad 2.49
\end{align*}
\]

2.2: What's the Temperature?

1. Here are five thermometers. The first four thermometers show temperatures in Celsius. Write the temperatures in the blanks.

a. _____  b. _____  c. _____  d. _____  e. _____

The last thermometer is missing some numbers. Write them in the boxes.
2. Elena says that the thermometer shown here reads -2.5°C because the line of the liquid is above -2°C. Jada says that it is -1.5°C. Do you agree with either one of them? Explain your reasoning.

3. One morning, the temperature in Phoenix, Arizona, was 8°C and the temperature in Portland, Maine, was 12°C cooler. What was the temperature in Portland?

2.3: Folded Number Lines

Your teacher will give you a sheet of tracing paper on which to draw a number line.

1. Follow the steps to make your own number line.

   - Use a straightedge or a ruler to draw a horizontal line. Mark the middle point of the line and label it 0.

   - To the right of 0, draw tick marks that are 1 centimeter apart. Label the tick marks 1, 2, 3... 10. This represents the positive side of your number line.

   - Fold your paper so that a vertical crease goes through 0 and the two sides of the number line match up perfectly.

   - Use the fold to help you trace the tick marks that you already drew onto the opposite side of the number line. Unfold and label the tick marks -1, -2, -3... -10. This represents the negative side of your number line.
2. Use your number line to answer these questions:
   
a. Which number is the same distance away from zero as is the number 4?

b. Which number is the same distance away from zero as is the number -7?

c. Two numbers that are the same distance from zero on the number line are called opposites. Find another pair of opposites on the number line.

d. Determine how far away the number 5 is from 0. Then, choose a positive number and a negative number that is each farther away from zero than is the number 5.

e. Determine how far away the number -2 is from 0. Then, choose a positive number and a negative number that is each farther away from zero than is the number -2.

Pause here so your teacher can review your work.

3. Here is a number line with some points labeled with letters. Determine the location of points P, X, and Y.

   ![Number Line Diagram]

   If you get stuck, trace the number line and points onto a sheet of tracing paper, fold it so that a vertical crease goes through 0, and use the folded number line to help you find the unknown values.

**Are you ready for more?**

At noon, the temperatures in Portland, Maine, and Phoenix, Arizona, had opposite values. The temperature in Portland was 18°C lower than in Phoenix. What was the temperature in each city? Explain your reasoning.
Lesson 2 Summary

Here is a number line labeled with positive and negative numbers. The number 4 is positive, so its location is 4 units to the right of 0 on the number line. The number -1.1 is negative, so its location is 1.1 units to the left of 0 on the number line.

---

We say that the *opposite* of 8.3 is -8.3, and that the *opposite* of $\frac{-3}{2}$ is $\frac{3}{2}$. Any pair of numbers that are equally far from 0 are called **opposites**.

Points $A$ and $B$ are opposites because they are both 2.5 units away from 0, even though $A$ is to the left of 0 and $B$ is to the right of 0.

---

A positive number has a negative number for its opposite. A negative number has a positive number for its opposite. The opposite of 0 is itself.

You have worked with positive numbers for many years. All of the positive numbers you have seen—whole and non-whole numbers—can be thought of as fractions and can be located on a number line.

To locate a non-whole number on a number line, we can divide the distance between two whole numbers into fractional parts and then count the number of parts. For example, 2.7 can be written as $2\frac{7}{10}$. The segment between 2 and 3 can be partitioned into 10 equal parts or 10 tenths. From 2, we can count 7 of the tenths to locate 2.7 on the number line.

All of the fractions and their opposites are what we call **rational numbers**. For example, 4, -1.1, 8.3, -8.3, $\frac{-3}{2}$, and $\frac{3}{2}$ are all rational numbers.
Unit 7 Lesson 2 Cumulative Practice Problems

1. For each number, name its opposite.
   a. -5
   b. 28
   c. -10.4

2. Plot the numbers -1.5, \( \frac{3}{2} \), \( -\frac{3}{2} \), and \( -\frac{4}{3} \) on the number line. Label each point with its numeric value.

   -2 -1 0 1 2

3. Plot these points on a number line.
   -1.5
   the opposite of -2
   the opposite of 0.5
   -2

4. a. Represent each of these temperatures in degrees Fahrenheit with a positive or negative number.

   ■ 5 degrees above zero
   ■ 3 degrees below zero
   ■ 6 degrees above zero
   ■ 2\( \frac{3}{4} \) degrees below zero

b. Order the temperatures above from the coldest to the warmest.

(From Unit 7, Lesson 1.)
Comparing Positive and Negative Numbers

Write < or > to make each comparison true.

1. 7 \(\bigcirc\) 10
2. 7 \(\bigcirc\) 10
3. 7 \(\bigcirc\) 10
4. \(\frac{2}{3}\) \(\bigcirc\) \(-1\frac{2}{3}\)
5. 50 \(\bigcirc\) 0.3
6. 12 \(\bigcirc\) 35
7. -5 \(\bigcirc\) 4.5
8. \(\frac{1}{2}\) \(\bigcirc\) -80
9. \(-\frac{1}{4}\) \(\bigcirc\) -1.4

Write each set of numbers in order from least to greatest.

10. 5, -2, -1, 4
11. 3.4, 7, -3.5, -3
12. -2.1, -2, -3, 0
13. -3\frac{3}{4}, -2, -\frac{1}{4}, 2
14. 5, 0, -6, -0.1
15. 7.5, -200, -1.5, -8
16. \(\frac{1}{2}\), -\(\frac{1}{2}\), -\(\frac{1}{3}\), \(\frac{1}{3}\)
17. 1.2, -2.1, -21, 0.12
18. 0.1, -0.2, 0.55, -0.31

19. Describe how to determine which of two negative numbers is greater. Give an example.
Lesson 2: Points on the Number Line

Cool Down: Positive, Negative, and Opposite

1. Put these numbers in order, from least to greatest. If you get stuck, consider using the number line.

3.5   -1   4.8   -1.5   -0.5   -4.2   0.5   -2.1   -3.5

2. Write two numbers that are opposites and each more than 6 units away from 0.
Lesson 6: Absolute Value of Numbers

6.1: Number Talk: Closer to Zero

For each pair of expressions, decide mentally which one has a value that is closer to 0.

\( \frac{9}{11} \) or \( \frac{15}{11} \)

\( \frac{1}{5} \) or \( \frac{1}{9} \)

1.25 or \( \frac{5}{4} \)

0.01 or 0.001
6.2: Jumping Flea

1. A flea is jumping around on a number line.

   a. If the flea starts at 1 and jumps 4 units to the right, where does it end up? How far away from 0 is this?

   b. If the flea starts at 1 and jumps 4 units to the left, where does it end up? How far away from 0 is this?

   c. If the flea starts at 0 and jumps 3 units away, where might it land?

   d. If the flea jumps 7 units and lands at 0, where could it have started?

   e. The **absolute value** of a number is the distance it is from 0. The flea is currently to the left of 0 and the absolute value of its location is 4. Where on the number line is it?

   f. If the flea is to the left of 0 and the absolute value of its location is 5, where on the number line is it?

   g. If the flea is to the right of 0 and the absolute value of its location is 2.5, where on the number line is it?

2. We use the notation \(|-2|\) to say "the absolute value of -2," which means "the distance of -2 from 0 on the number line."

   a. What does \(|-7|\) mean and what is its value?

   b. What does \(|1.8|\) mean and what is its value?
6.3: Absolute Elevation and Temperature

1. A part of the city of New Orleans is 6 feet below sea level. We can use "-6 feet" to describe its elevation, and "|6| feet" to describe its vertical distance from sea level. In the context of elevation, what would each of the following numbers describe?
   a. 25 feet
   b. |25| feet
   c. -8 feet
   d. |-8| feet

2. The elevation of a city is different from sea level by 10 feet. Name the two elevations that the city could have.

3. We write "-5°C" to describe a temperature that is 5 degrees Celsius below freezing point and "5°C" for a temperature that is 5 degrees above freezing. In this context, what do each of the following numbers describe?
   a. 1°C
   b. -4°C
   c. |12|°C
   d. |-7|°C

4. a. Which temperature is colder: -6°C or 3°C?
   b. Which temperature is closer to freezing temperature: -6°C or 3°C?
   c. Which temperature has a smaller absolute value? Explain how you know.
Are you ready for more?

At a certain time, the difference between the temperature in New York City and in Boston was 7 degrees Celsius. The difference between the temperature in Boston and in Chicago was also 7 degrees Celsius. Was the temperature in New York City the same as the temperature in Chicago? Explain your answer.

Lesson 6 Summary

We compare numbers by comparing their positions on the number line: the one farther to the right is greater; the one farther to the left is less.

Sometimes we wish to compare which one is closer to or farther from 0. For example, we may want to know how far away the temperature is from the freezing point of 0°C, regardless of whether it is above or below freezing.

The absolute value of a number tells us its distance from 0.

The absolute value of -4 is 4, because -4 is 4 units to the left of 0. The absolute value of 4 is also 4, because 4 is 4 units to the right of 0. Opposites always have the same absolute value because they both have the same distance from 0.

![Number line diagram]

The distance from 0 to itself is 0, so the absolute value of 0 is 0. Zero is the only number whose distance to 0 is 0. For all other absolute values, there are always two numbers—one positive and one negative—that have that distance from 0.

To say “the absolute value of 4,” we write:

$$|4|$$

To say that “the absolute value of -8 is 8,” we write:

$$|-8| = 8$$
Understanding Absolute Value

1. Answer the questions about this number line.

Which is greater, $-9$ or $-4$? Explain.

Which is greater, $|-9|$ or $|-4|$? Explain.

2. A football team tries to move the ball forward as many yards as possible on each play, but sometimes they end up behind where they started. The distances, in yards, that a team moves on its first five plays are 2, $-1$, 4, 3, and $-5$. A positive number indicates moving the ball forward, and a negative number indicates moving the ball backward.

Which number in the list is the greatest?

What is a better question to ask to find out which play went the farthest from where the team started?

The coach considers any play that moves the team more than 4 yards from where they started a "big play." Which play(s) are big plays?

3. When does it make sense to compare the absolute values of numbers rather than the numbers themselves?
8.2: Stories about 9

1. Your teacher will give you a set of paper slips with four stories and questions involving the number 9. Match each question to three representations of the solution: a description or a list, a number line, or an inequality statement.

2. Compare your matching decisions with another group's. If there are disagreements, discuss until both groups come to an agreement. Then, record your final matching decisions here.
   a. A fishing boat can hold fewer than 9 people. How many people \(x\) can it hold?

   ■ Description or list:
   ■ Number line:
   ■ Inequality:

   b. Lin needs more than 9 ounces of butter to make cookies for her party. How many ounces of butter \(x\) would be enough?

   ■ Description or list:
   ■ Number line:
   ■ Inequality:

   c. A magician will perform her magic tricks only if there are at least 9 people in the audience. For how many people \(x\) will she perform her magic tricks?

   ■ Description or list:
   ■ Number line:
   ■ Inequality:
Lesson 8 Summary

An inequality tells us that one value is less than or greater than another value.

Suppose we knew the temperature is less than 3°F, but we don't know exactly what it is. To represent what we know about the temperature \( t \) in °F we can write the inequality:

\[
 t < 3
\]

The temperature can also be graphed on a number line. Any point to the left of 3 is a possible value for \( t \). The open circle at 3 means that \( t \) cannot be equal to 3, because the temperature is less than 3.

Here is another example. Suppose a young traveler has to be at least 16 years old to fly on an airplane without an accompanying adult.

If \( a \) represents the age of the traveler, any number greater than 16 is a possible value for \( a \), and 16 itself is also a possible value of \( a \). We can show this on a number line by drawing a closed circle at 16 to show that it meets the requirement (a 16-year-old person can travel alone). From there, we draw a line that points to the right.

We can also write an inequality and equation to show possible values for \( a \):

\[
 a > 16 \\
 a = 16
\]
Lesson 9: Solutions of Inequalities

9.1: Unknowns on a Number Line

The number line shows several points, each labeled with a letter.

A    B    C    D    E    F
     0

1. Fill in each blank with a letter so that the inequality statements are true.

   a. _____ > _____
   b. _____ < _____

2. Jada says that she found three different ways to complete the first question correctly. Do you think this is possible? Explain your reasoning.

3. List a possible value for each letter on the number line based on its location.
9.2: Amusement Park Rides

Priya finds these height requirements for some of the rides at an amusement park.

<table>
<thead>
<tr>
<th>To ride the . . .</th>
<th>you must be . . .</th>
</tr>
</thead>
<tbody>
<tr>
<td>High Bounce</td>
<td>between 55 and 72 inches tall</td>
</tr>
<tr>
<td>Climb-A-Thon</td>
<td>under 60 inches tall</td>
</tr>
<tr>
<td>Twirl-O-Coaster</td>
<td>58 inches minimum</td>
</tr>
</tbody>
</table>

1. Write an inequality for each of the three height requirements. Use $h$ for the unknown height. Then, represent each height requirement on a number line.

   - High Bounce
   - Climb-A-Thon
   - Twirl-O-Coaster

Pause here for additional instructions from your teacher.

2. Han’s cousin is 55 inches tall. Han doesn’t think she is tall enough to ride the High Bounce, but Kiran believes that she is tall enough. Do you agree with Han or Kiran? Be prepared to explain your reasoning.

3. Priya can ride the Climb-A-Thon, but she cannot ride the High Bounce or the Twirl-O-Coaster. Which, if any, of the following could be Priya’s height? Be prepared to explain your reasoning.

   - 59 inches
   - 53 inches
   - 56 inches

4. Jada is 56 inches tall. Which rides can she go on?

5. Kiran is 60 inches tall. Which rides can he go on?
Lesson 9 Summary

Let's say a movie ticket costs less than $10. If $c$ represents the cost of a movie ticket, we can use $c < 10$ to express what we know about the cost of a ticket.

Any value of $c$ that makes the inequality true is called a solution to the inequality.

For example, 5 is a solution to the inequality $c < 10$ because $5 < 10$ (or “5 is less than 10”) is a true statement, but 12 is not a solution because $12 < 10$ (“12 is less than 10”) is not a true statement.

If a situation involves more than one boundary or limit, we will need more than one inequality to express it.

For example, if we knew that it rained for more than 10 minutes but less than 30 minutes, we can describe the number of minutes that it rained ($r$) with the following inequalities and number lines.

\[ r > 10 \]

\[ r < 30 \]

Any number of minutes greater than 10 is a solution to $r > 10$, and any number less than 30 is a solution to $r < 30$. But to meet the condition of “more than 10 but less than 30,” the solutions are limited to the numbers between 10 and 30 minutes, not including 10 and 30.

We can show the solutions visually by graphing the two inequalities on one number line.
Writing and Graphing One-Variable Inequalities

➤ Write an inequality to represent each situation.

1. A farmer weighs a dozen chicken eggs. The heaviest egg is 56 g.

2. A light bulb is programmed to turn on when the temperature in a terrarium is 72°F or cooler.

3. Martin is building a sandcastle at the beach. He pours no less than 5 cups of wet sand into each plastic mold.

4. The shortest tree in a park is at least 25.5 ft tall.

➤ Graph each inequality.

5. \( n \geq -2 \)

6. \( h \leq 5 \)

7. \( t \leq 7.1 \)

8. \( r \geq -\frac{2}{3} \)

9. What is the difference between the inequality \( x \leq 5 \) and the equation \( x = 5 \)?
Inequalities Assessment

1. Decide whether each inequality statement is true or false. Explain your reasoning.
   a. \(-5 > 2\)
   b. \(3 > -8\)
   c. \(-12 > -15\)

2. Diego's dog weighs more than 10 kilograms and less than 15 kilograms. Select all the inequalities that must be true if \(w\) is the weight of Diego's dog in kilograms.
   A. \(w > 10\)
   B. \(w < 10\)
   C. \(w > 11\)
   D. \(w < 11\)
   E. \(w > 15\)
   F. \(w < 15\)

5. a. Which temperature is warmer, -2 degrees Celsius, or -5 degrees Celsius?

   b. Write an inequality to express the relationship between -2 and -5.

   c. On this number line, graph all the temperatures that are warmer than -2 degrees Celsius.
11.2: The Coordinate Plane

1. Label each point on the coordinate plane with an ordered pair.

2. What do you notice about the locations and ordered pairs of $B$, $C$, and $D$? How are they different from those for point $A$?

3. Plot a point at $( -2, 5 )$. Label it $E$. Plot another point at $( 3, -4.5 )$. Label it $F$.

4. The coordinate plane is divided into four quadrants, I, II, III, and IV, as shown here.

5. In which quadrant is point $G$ located? Point $H$? Point $I$?
6. A point has a positive $y$-coordinate. In which quadrant could it be?

### 11.3: Coordinated Archery

Here is an image of an archery target on a coordinate plane. The scores for landing an arrow in the colored regions are shown.

- Yellow: 10 points
- Red: 8 points
- Blue: 6 points
- Green: 4 points
- White: 2 points

Name the coordinates for a possible landing point to score:

1. 6 points
2. 10 points
3. 2 points
4. No points
5. 4 points
6. 8 points
Are you ready for more?

Pretend you are stuck in a coordinate plane. You can only take vertical and horizontal steps that are one unit long.

1. How many ways are there to get from the point (-3, 2) to (-1, -1) if you will only step down and to the right?

2. How many ways are there to get from the point (-1, -2) to (4, 0) if you can only step up and to the right?

3. Make up some more problems like this and see what patterns you notice.

Lesson 11 Summary

Just as the number line can be extended to the left to include negative numbers, the x- and y-axis of a coordinate plane can also be extended to include negative values.

The ordered pair \((x, y)\) can have negative \(x\)- and \(y\)-values. For \(B = (-4, 1)\), the \(x\)-value of -4 tells us that the point is 4 units to the left of the \(y\)-axis. The \(y\)-value of 1 tells us that the point is one unit above the \(x\)-axis.

The same reasoning applies to the points \(A\) and \(C\). The \(x\)- and \(y\)-coordinates for point \(A\) are positive, so \(A\) is to the right of the \(y\)-axis and above the \(x\)-axis. The \(x\)- and \(y\)-coordinates for point \(C\) are negative, so \(C\) is to the left of the \(y\)-axis and below the \(x\)-axis.
Understanding the Four-Quadrant Coordinate Plane

➤ For problems 1–6, plot and label each point in the coordinate plane. Name the quadrant or axis where the point is located.

1. \(A(-3, -2)\)
2. \(B(4, -4)\)
3. \(C(2, 3)\)
4. \(D(-2, 4)\)
5. \(E(3, -3)\)
6. \(F(4, 0)\)

7. If point \(E\) above is reflected across the \(x\)-axis, what would be the coordinates of the reflection? Explain.

8. Imagine that one of the points given in problems 1–6 has been reflected. The reflection is in Quadrant II. What are the possible coordinates of the reflected point? Explain.

9. Bradley says that if point \(B\) is reflected across the \(y\)-axis and its reflection is then reflected across the \(x\)-axis, the result is point \(D\). Is Bradley correct? Explain.
2. Write the coordinates of each point.

![Coordinate Plane Assessment](image_url)
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Family Consumer Science
All Grades
Covers week of May 4th – week of June 16th
**Family Consumer Sciences-Mrs. Kenton**

**Directions:**
- CHOOSE ONE chore/task to do each day that you have Family Consumer Sciences with Mrs. Kenton. With our new schedule that would be 2-3x per week.
- Read the information provided within each chore/task on the board.
- DOCUMENT your chore/task as you go! See each assignment for details on how.

<table>
<thead>
<tr>
<th>Wash the Car</th>
<th>Clean/Organize your Pantry</th>
<th>Find &amp; Make a New Recipe</th>
<th>Toilet &amp; Sink Cleaning</th>
<th>Learn to Tie a Tie!</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hand wash the outside of the family car.</td>
<td>Clean and organize your pantry. Check expiration dates and get rid of old food.</td>
<td>Find a new recipe and make it!</td>
<td>Scrub the toilets and sinks in your home. Have your parent/guardian sign off on the completion of this task. Share what you learned in a paragraph.</td>
<td>Watch a video or have someone teach you how to tie a tie. Practice until you can do it successfully at least 2 times. Have your parent/guardian sign off on the completion of this task. Share what you learned in a paragraph.</td>
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<tr>
<td>Be sure to check with the owner on any special instructions.</td>
<td>Have your parent/guardian sign off on the completion of this task. Share what you learned in a paragraph.</td>
<td>Tell us what you made. and share what you learned. Would you make this again.</td>
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<td>Take a before and after picture or have the owner sign off on the completion of this task. Share what you learned in a paragraph.</td>
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<thead>
<tr>
<th>Sew a button on</th>
<th>Act of Kindness</th>
<th>Write &amp; Send a Thank You Note</th>
<th>Make a Meal</th>
<th>Sweep &amp; Mop the Kitchen</th>
</tr>
</thead>
<tbody>
<tr>
<td>Repair a button that has fallen off OR sew a new one on a piece of fabric.</td>
<td>Plan and execute an act of kindness.</td>
<td>Write a sincere thank you note and mail it out if needed.</td>
<td>Using a recipe, make a well balanced meal for yourself or your family. Have your parent/guardian sign off on the completion of this task. Share the recipe you made.</td>
<td>Sweep &amp; Mop your kitchen floor. Be sure to ask your parents for any specific instructions. Have your parent/guardian sign off on the completion of this task. Share what you learned in a paragraph.</td>
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<td>Have your parent/guardian sign off on the completion of this task. Share what you learned in a paragraph. How did you feel</td>
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<td>Using Up Leftovers!</td>
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<td>Find something that needs to be used up in your refrigerator, freezer or pantry, and make something with it! Use recipe books, magazines, or ideas from parents/guardians for help.</td>
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<tr>
<th>Household or Outside Chore of Parent's Choice</th>
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<tbody>
<tr>
<td>Ask your parent/guardian what chore they'd like done... and you will do that!</td>
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<tr>
<th>Learn a New Recipe</th>
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<tbody>
<tr>
<td>Have a family member teach you a new recipe. Make it together and enjoy!</td>
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<th>Make a Treat &amp; Share</th>
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<tr>
<td>Make a baked good and share it with a neighbor (be conscious of social distancing of course!)</td>
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<tr>
<th>Vacuum the Car</th>
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<tr>
<td>Vacuum the interior of your family car (or someone else's)</td>
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<th>completing this task? How did the recipient feel?</th>
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<td>Have your parent/guardian sign off on the completion of this task. Share what you learned in a paragraph.</td>
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| Have your parent/guardian sign off on the completion of this task. Share the recipe you made. |
| Have your parent/guardian sign off on the completion of this task. Share what you learned. |

<table>
<thead>
<tr>
<th>Have your parent/guardian sign off on the completion of this task. Share the recipe you made.</th>
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**Family Consumer Sciences-Mrs. Kenton**

**Parent/Guardian Sign Off**

**Directions:** As you complete assignments from the board, have your parent or guardian sign off that the task was completed.

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<thead>
<tr>
<th>Assignment Completed:</th>
<th>Date Completed:</th>
<th>Parent/Guardian Signature:</th>
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<td>Wash the Car</td>
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<td>Find and Make a New Recipe</td>
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<td>Toilet and Sink Cleaning</td>
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<td>Learn to Tie a Tie</td>
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<td>Learn How to Sew a Button on</td>
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<td>Act of Kindness</td>
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<tr>
<td>Using up Leftovers</td>
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ASSIGNMENT!!!

Refrigerator Organization:

- Read the article provided.
- Clean/wash the inside and outside of your fridge. You do not need to clean the freezer.
- Take this time to also go through each food item and throw away outdated/bad food.
- **Create a list** of foods you threw out and why.
- Use the guide provided to safely reorganize your fridge.

Make sure you consult your parents BEFORE you throw anything away!

PANTRY CLEAN OUT

- Go through each food item and throw away outdated/bad food.
- Consider donating what you won’t use that is still good.
- **Create a list** of foods you threw out and why.
- Were there any foods you could donate? Create a list for donated food as well.

Make sure you consult your parents BEFORE you throw anything away!
How To Clean the Inside of Your Fridge in 30 Minutes or Less

BY SHIFRAH COMBITHS
PUBLISHED: APR 8, 2014

Last week, I was getting ready for my mother to come for a visit. So naturally, I had to clean out my fridge! I used the method she taught me, and 20 minutes later my fridge was mom-worthy clean. Here’s how I do it:

Empty the Fridge

You can do this all at once or in sections. I prefer to do it all at once. The thought of the food sitting out helps me do everything faster. Set aside two areas for setting items down: one area for things that need to be cleaned out (outdated leftovers in tupperware, for example) and another area for items that need to be put back into the fridge. Anything that needs to be discarded that’s not in a container you want to keep goes straight into the trash, of course.

Clean Contents

If your fridge is less than pristine, chances are that your milk carton and olive jar aren’t squeaky clean either. With a damp rag, wipe the bottoms of items and also clean any drips on the sides. If lid areas need a little TLC, tackle those too. You want everything you return to the fridge to be clean so you’re not spreading messes around. You can clean out leftovers containers now, or wait until you’re done with the fridge.

Clean the Inside of the Fridge

If you can remove shelves and drawers, do it. Spray the inside of the fridge with a solution of vinegar and water, concentrating on soiled areas and let it soak in. Wash the removed shelves and drawers with warm soapy water and set them aside to dry. Head back to the fridge and wipe everything down with a rag.

Return Contents

Dry shelves and drawers and return them to the fridge. Next, place all newly cleaned items back in the fridge in their respective areas. (I have my fridge sections labelled to help keep items where they belong, but that’s just me.)

Step back and admire your sparkling fridge!
**Freezer**
Frozen meats and other heat- or light-sensitive items that might go rancid.
Freeze soups, stocks, and sauces in plastic bags, and lay them flat to minimize freezer burn.

**Top Shelf**
Ready-to-eat prepared foods, condiments, pickled products, and fruits.

**Middle Shelf**
Leftovers, cheese, eggs in carton, cold cuts, and sandwich bread.

**Bottom Shelf**
Raw meats and poultry, fish (best cooked day of), milk, and other dairy products.

**Vegetable Crisper**
 Vegetables and herbs.

**Top Shelf**
Eggs, butter, and frequently used cheeses.
Store cheese wrapped up in wax paper or parchment paper.

**Middle Shelf**
Condiments and premixed vinaigrettes.

**Bottom Shelf**
All beverages.
13 Mental Health Benefits of Exercise!

By Sophia Breene

Many people hit the gym or pound the pavement to improve cardiovascular health, build muscle, and of course, get a rockin’ bod, but working out has above-the-neck benefits, too. For the past decade or so, scientists have pondered how exercising can boost brain function. Regardless of age or fitness level (yup, this includes everyone from mall-walkers to marathoners), studies show that making time for exercise provides some serious mental benefits. Get inspired to exercise by reading up on these unexpected ways that working out can benefit mental health, relationships and lead to a healthier and happier life overall.

1. Reduce Stress
Rough day at the office? Take a walk or head to the gym for a quick workout. One of the most common mental benefits of exercise is stress relief. Working up a sweat can help manage physical and mental stress. Exercise also increases concentrations of norepinephrine, a chemical that can moderate the brain’s response to stress. So go ahead and get sweaty -- working out can reduce stress and boost the body’s ability to deal with existing mental tension. Win-win!

2. Boost Happy Chemicals
Slogging through a few miles on the ‘mill can be tough, but it’s worth the effort! Exercise releases endorphins, which create feelings of happiness and euphoria. Studies have shown that exercise can even alleviate symptoms among the clinically depressed. For this reason, docs recommend that people suffering from depression or anxiety (or those who are just feeling blue) pencil in plenty of gym time. In some cases, exercise can be just as effective as antidepressant pills in treating depression. Don’t worry if you’re not exactly the gym rat type -- getting a happy buzz from working out for just 30 minutes a few times a week can instantly boost overall mood.

3. Improve Self-Confidence
Hop on the treadmill to look (and more importantly, feel) like a million bucks. On a very basic level, physical fitness can boost self-esteem and improve positive self-image. Regardless of weight, size, gender or age, exercise can quickly elevate a person’s perception of his or her attractiveness, that is, self-worth. How’s that for feeling the (self) love?

4. Enjoy The Great Outdoors
For an extra boost of self-love, take that workout outside. Exercising in the great outdoors can increase self-esteem even more. Find an outdoor workout that fits your style, whether it’s rock-climbing, hiking, renting a canoe or just taking a jog in the park. Plus, all that Vitamin D acquired from soaking up the sun (while wearing sunscreen, of course!) can lessen the likelihood of experiencing depressive symptoms. Why book a spa day when a little fresh air and sunshine (and exercise) can work wonders for self-confidence and happiness?

5. Prevent Cognitive Decline
It’s unpleasant, but it’s true -- as we get older, our brains get a little... hazy. As aging and degenerative diseases like Alzheimer’s kill off brain cells, the noggin actually shrinks, losing many important brain functions in the process. While exercise and a healthy diet can’t “cure” Alzheimer’s, they can help shore up the brain against cognitive decline that begins after age 45 Working out, especially between age 25 and 45, boosts the chemicals in the brain that support and prevent degeneration of the hippocampus, an important part of the brain for memory and learning.

6. Alleviate Anxiety
Quick Q&A: Which is better at relieving anxiety -- a warm bubble bath or a 20-minute jog? You might be surprised at the answer. The warm and fuzzy chemicals that are released during and after exercise can help people with anxiety disorders calm down. Hopping on the track or treadmill for some moderate-to-high intensity aerobic exercise (intervals, anyone?) can reduce anxiety sensitivity. And we thought intervals were just a good way to burn calories!

7. Boost Brainpower
Those buff lab rats might be smarter than we think. Various studies on mice and men have shown that cardiovascular exercise can create new brain cells (aka neurogenesis) and improve overall brain performance. Ready to apply for a Nobel Prize? Studies suggest that a tough workout increases levels of a
brain-derived protein (known as **BDNF**) in the body, believed to help with decision making, higher thinking and learning. Smarty (spandex) pants, indeed.

8. Sharpen Memory
Get ready to win big at Go Fish. Regular physical activity boosts memory and ability to learn new things. Getting sweaty **increases production of cells in hippocampus** responsible for memory and learning. For this reason, research has linked children’s **brain development** with level of physical fitness (take that, recess haters!). But exercise-based brainpower isn’t just for kids. Even if it’s not as fun as a game of Red Rover, working out can boost memory among grown-ups, too. A study showed that **running sprints improved vocabulary retention** among healthy adults.

9. Help Control Addiction
The brain releases **dopamine**, the “reward chemical” in response to any form of pleasure, be that exercise, sex, drugs, alcohol or food. Unfortunately, some people become addicted to dopamine and dependent on the substances that produce it, like drugs or alcohol (and more rarely, food and sex). On the bright side, **exercise can help in addiction recovery**. Short exercise sessions can also effectively distract drug or **alcohol addicts**, making them de-prioritize cravings (at least in the short term). Working out when on the wagon has other benefits, too. Alcohol abuse disrupts many body processes, including **circadian rhythms**. As a result, alcoholics find they can’t fall asleep (or stay asleep) without drinking. Exercise can help reboot the **body clock**, helping people hit the hay at the right time.

10. Increase Relaxation
Ever hit the hay after a long run or weight session at the gym? For some, a moderate workout can be the equivalent of a **sleeping pill**, even for people with insomnia. Moving around five to six hours before bedtime raises the body’s **core temperature**. When the body temp drops back to normal a few hours later, it signals the body that it’s time to sleep.

11. Get More Done
Feeling uninspired in the cubicle? The solution might be just a short **walk** or jog away. Research shows that workers who take time for exercise on a regular basis are **more productive and have more energy** than their more sedentary peers. While busy schedules can make it tough to squeeze in a gym session in the middle of the day, some experts believe that **midday** is the ideal time for a workout due to the body’s **circadian rhythms**.

12. Tap Into Creativity
Most people end a tough workout with a hot shower, but maybe we should be breaking out the colored pencils instead. A heart-pumping gym session can **boost creativity** for up to **two hours** afterwards. Supercharge post-workout inspiration by exercising **outdoors** and interacting with nature (see benefit #4). Next time you need a burst of creative thinking, **hit the trails for a long walk** or run to refresh the body and the brain at the same time.

13. Inspire Others
Whether it’s a pick-up game of soccer, a group class at the gym, or just a run with a friend, exercise rarely happens in a bubble. And that’s good news for all of us. Studies show that most people perform better on aerobic tests when **paired up with a workout buddy**. Pin it to inspiration or good old-fashioned competition, nobody wants to let the other person down. In fact, being part of a team is so powerful that it can actually **raise athletes’ tolerances for pain**. Even fitness beginners can inspire each other to push harder during a sweat session, so find a workout buddy and get moving!

Working out can have positive effects far beyond the gym (and beach season). Gaining self-confidence, getting out of a funk, and even thinking smarter are some of the motivations to take time for exercise on a regular basis.
Assignment: After reading the article, choose a physical activity to get your body moving for at least 30 minutes! This could be playing a sport, taking the dog for a walk, completing rigorous cleaning tasks, etc.

Answer the following questions:

1. What did you do? For how long?

2. How did you feel before? During? After?

3. What did you notice about how it affected your mood?
Reflections on Random Acts of Kindness

So, what is Random Acts of Kindness, better known to me as “RAK”?

A little bit about Random Acts of Kindness

It is an unplanned act whose goal is to bring kindness and spread kindness to those we know and those we do not know. It’s a practice that offers hope to unsuspecting people to provide a ray of light in someone’s life. It brings a smile to a frown; it can create a positive emotion when none was expected; it can be the beginning of a new start; and it has the capability to change how we treat one another.

I’ve been fortunate to witness “RAK” first hand many times. However, I know my experience is not the norm.

The first thing to understand about RAK is that it can’t be about you, it is about bringing joy to others.

Random Acts of Kindness in Action

Let me share a great example: Last week, while doing a presentation to middle & high school students from three surrounding counties, a powerful RAK showed up.

It wasn’t planned. It just happened.

So, here’s a little backstory, a student bravely shared how she is being bullied at her current school. She shared how challenging everyday life can be without a friend to sit with or talk to and how painful it is to not have someone to support you. She courageously explained how being different than the status quo makes her a target. She shared how a friendly smile, a hug, or compliment could brighten someone’s day.

The beauty of what we do at STARS, and with the MOVE2STAND training, is that we can be the nudge, the voice that says “take some sort of action to be of support to someone else.”

When young people or adults decide they want to support positive change, incredible acts of courage and kindness occur.

As facilitators, we often don’t get to see all the change that comes from our work. We know the seeds have been planted and, with a little sunlight and water, the message will grow.

In this case, only hours after leaving the training, I received a picture from a teacher stating, “Today was a wake-up call for them, an eye opening experience for many and that they could and needed to do more”.

The teacher shared with me during our last break, one student from another school went up to the student who is isolated and being bullied, reached out to her to give her that friendly smile, that hug and that compliment she needed so much. I found out they exchanged numbers and have begun a new friendship.

There is comfort knowing, in the words of the Archbishop Oscar Romero Prayer, “We can’t do everything and there is a sense of liberation in that but we can all do something.”

My challenge to everyone reading this is to do “something” that brings joy and kindness to others.
Random Acts of Kindness!

1. Read this article provided.
2. Perform a random act of kindness
3. Reflect on how it made the person feel and how you felt doing this.

Date:

Parent/Guardian Signature:

Describe the random act of kindness you completed:

Reflection: How did you feel? How did the person receiving the act of kindness feel?
Science
Grade 6
Covers week of May 4th –
week of June 16th
<table>
<thead>
<tr>
<th>Session</th>
<th>Concept/Main Idea</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Describing Motion-Position, Speed &amp; Velocity</td>
</tr>
<tr>
<td>2</td>
<td>Describing Motion-Reference Frames &amp; Acceleration</td>
</tr>
<tr>
<td>3</td>
<td>Forces &amp; Interactions-Forces</td>
</tr>
<tr>
<td>4</td>
<td>Forces &amp; Interactions-Newton’s 3rd Law</td>
</tr>
<tr>
<td>5</td>
<td>Effects of Forces-Net Force &amp; Newton’s 1st Law</td>
</tr>
<tr>
<td>6</td>
<td>Effects of Forces-Newton’s 2nd Law</td>
</tr>
<tr>
<td>7</td>
<td>Noncontact Forces-Gravitational Fields</td>
</tr>
<tr>
<td>8</td>
<td>Noncontact Forces-Electric Charge &amp; Forces and Strength of Electrical Forces</td>
</tr>
<tr>
<td>9</td>
<td>Noncontact Forces-Electrical Fields</td>
</tr>
<tr>
<td>10</td>
<td>Noncontact Forces-Magnetic Forces &amp; Fields</td>
</tr>
<tr>
<td>11</td>
<td>Noncontact Forces- Electromagnetic Forces</td>
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<td>Session</td>
<td>Concept/Main Idea</td>
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<tr>
<td>---------</td>
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<tr>
<td>12</td>
<td>Energy-Energy &amp; 2 Forms of Energy</td>
</tr>
<tr>
<td>June 8</td>
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<tr>
<td>June 10</td>
<td></td>
</tr>
<tr>
<td>14</td>
<td>Engineering Challenge-The Penny Boat Challenge</td>
</tr>
<tr>
<td>June 12</td>
<td></td>
</tr>
<tr>
<td>15</td>
<td>Last Student Day-Science A-Z Puzzle</td>
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<tr>
<td>June 16</td>
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Position

Suppose that you are learning to drive. As you drive the instructor’s black car down the road, your instructor asks where the white van is. “The white van is about four car-lengths behind us,” you say.

When you describe the distance and direction to the white van, you are describing its position. An object’s position is its current distance and direction from a reference point.

A reference point is an object or place you use to describe the locations of other objects. The reference point that you used to describe the location of the white van was your black car. Observe Figure 1. When you describe the distance from a reference point, you can think of the reference point as the 0 point on an imaginary number line. The number line extends from the reference point to the object whose position you are describing. You described the position of the white van as four car-lengths behind your car. “Four car-lengths” is the distance measured from the reference point (your car). “Behind” is the direction from the reference point.

Figure 1 The position of an object is described as distance and direction away from a reference point. If the front of the black car is used as a reference point, an imaginary number line extends in front of and behind that point on the black car. Using this number line, you see that the front of the red car is 15 m away from the front of the black car, and the front of the white van is ~21 m away from the front of the black car.
Car-lengths is a useful unit when you are driving a car, but it is not as useful in other situations, such as if you were trying to describe how far a tennis ball traveled. Most of the time, the distance part of position is given using standard units of length, such as meters (m).

You can use positive or negative numbers to indicate the direction an object is in when describing its position. For example, the red car is +15 m from the black car, meaning it is 15 m in front of the car. On the other hand, the white van is −21 m away from the black car, meaning it is 21 m behind the black car.

**Check for Understanding:**
1. If the front of the red car is used as a reference point, how far away is the white van?

2. What information can the positive and negative numbers on a number line provide?

**Speed and Velocity**

The red car in front of you exits the highway, and the road ahead is clear. You press on the gas pedal to go faster. "It can be tempting to drive too fast when no one is in front of you," says your instructor. "How fast are you going?"

When your instructor asks how fast you are going, he wants to know how quickly the position of the car is changing. In other words, he wants to know how far the car moves in a given amount of time, such as a second or an hour. How far the car moves in a given amount of time is an example of a rate. A rate is an amount of something measured per unit of something else.

Many rates describe changes or events that happen over time. Suppose that a man in an eating contest eats 60 hot dogs in 10 minutes. His rate of eating is 6 hot dogs per minute. However, not all rates involve
time. A grocery store may sell watermelon at a rate of $0.70 per pound, which means that a 10-pound watermelon costs $7.00.

**Speed** The rate that describes the distance an object moves over time is that object's **speed**. Speed is one way that the motion of an object can be described. Speeds can be measured in various units, but all speeds are measured in units of distance per a unit of time. For example, a car's speed is often measured in kilometers per hour (km/h) or miles per hour (mi/h or mph). Scientists often describe speeds using meters per second (m/s).

Figure 2A shows you how the same speed can be represented different ways. In 1 second, the bowling ball rolls 3 meters. In 2 seconds it rolls 6 meters, and in 4 seconds it rolls 12 meters. In all of these cases, its speed is 3 m/s.

<table>
<thead>
<tr>
<th>Describing the Speed of an Object Using a Rate</th>
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<tbody>
<tr>
<td><img src="image_url" alt="Diagram" /></td>
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</table>

Figure 2A The speed of an object is a rate that describes how far the object moves in a certain amount of time. Arrows can be used to illustrate rates. Each arrow represents an object traveling 3 m in 1 s. So, the object's speed is 3 m/s. After 4 s, the object travels a total of 12 m.

**Velocity** Speed is one way of describing how fast an object is going, but it does not tell you what direction the object is moving in. **Velocity** is an object's speed and direction of motion.

Like speed, velocity can be measured in different units. Car velocity is usually expressed as kilometers per hour (km/h) in a given direction. You could describe velocity of a runner as 4 m/s toward the finish line, and the velocity of a snail is about 1.5 cm/min to the east.
An object’s velocity can change from moment to moment. Instead of trying to calculate an object’s velocity at a given moment, you can calculate the object’s average velocity. You calculate the average velocity of an object by dividing the distance it traveled by time needed to travel that distance. To find the distance an object traveled, you subtract the object’s starting position from its ending position. So, the equation for average velocity is:

$$\text{average velocity} = \frac{\text{end position} - \text{start position}}{\text{time}}$$

In Figure 2B, the yellow car moves from -70 m to 20 m from the white line in 3 seconds. Additionally, the yellow car is moving in the positive direction along the number line to the east. Using the equation above, you can calculate its average velocity as:

$$\text{average velocity} = \frac{20 \text{ m} - (-70 \text{ m})}{3 \text{ s}} = 30 \text{ m/s east}$$

Figure 2B The velocity of an object is the object’s speed and direction of motion. The yellow car’s speed is 30 m/s, and its direction of motion is east. Therefore, the yellow car’s velocity is 30 m/s east. The red car’s speed is 25 m/s, and its direction of motion is west. Therefore, the red car’s velocity is 25 m/s west.

To fully describe the velocity of the car, you have to look at a situation to find and name the direction the car is going. Whether the velocity is positive or negative tells you if the object is moving forward or backward. In the same amount of time, the red car moves from 50 m to -25 m from the white line in 3 seconds. It is moving in the negative direction to the west. Its average velocity is:
average velocity = \(-\frac{25 \text{ m} - 50 \text{ m}}{3 \text{ s}}\) = \(-25 \text{ m/s west}\)

Check for Understanding:
1. What does velocity measure?

2. Review the information in the table below. Use the information to calculate the speed of the bicyclist. The first calculation has been done for you.

<table>
<thead>
<tr>
<th>Distance (km)</th>
<th>Time (h)</th>
<th>Speed (km/h)</th>
</tr>
</thead>
<tbody>
<tr>
<td>10</td>
<td>1</td>
<td>10 km/h</td>
</tr>
<tr>
<td>30</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>33</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>40</td>
<td>5</td>
<td></td>
</tr>
</tbody>
</table>
3. If the yellow car travels from -70 m to 20 m in 5 seconds, what is its velocity?

4. If the red car travels from 50 m to -25 m in 5 seconds, what is its velocity?
Reference Frames

After completing your driving practice for the day, you switch places with one of the other students in your driver’s education class. She gets into the driver’s seat, and you climb into the back seat and start to read your driver’s manual. After riding for a while, you feel a touch of motion sickness. To get rid of the queasy feeling, you look out the window and watch the scenery go by. Why did you feel woozy when you were looking down, but not when you looked outside?

Motion sickness often happens when what you feel does not match with what you see. As the car moved, your body vibrated with the engine, swayed during turns, and bounced when going over bumps. When you looked down at the book, the book and everything you could see inside the car stayed in place. Your eyes told your brain that you were not moving because you could not see anything changing positions. Your body felt like it was moving, but your eyes did not see any motion, and you got motion sickness.

When you looked out the car window, you could see trees and buildings go by. The inside of the car still looked stationary, but you saw objects outside moving relative to the car. Your eyes saw that you were moving, which matched with what your body was feeling, and the motion sickness went away.

Without changing your position, you saw the car in two different reference frames. A reference frame is a point of view on the speed and direction that objects are moving and what reference point they are moving relative to. When you sit inside the car, the car seems still. So the speed of the car is 0 km/h from your point of view. The road, buildings, and trees might be moving at ~90 km/h, zipping by backwards. You might call this the “car reference frame.” When you stand on the road, the road does not seem to be moving. So the road, buildings, and trees are all moving at 0 km/h, while the car is zipping by forward at 90 km/h. You might call this the “road reference frame.”

Motion looks different when viewed from different reference frames. In the car reference frame on the left, the bushes are moving backward and the car mirror is not moving. In the road reference frame on the right, the car is moving forward and the bushes are not moving.
Reference frames are arbitrary, which means that you are free to choose which reference frame you use to describe position or motion. But you have to stick to that reference frame if you want to describe the motion of multiple objects together. Most often, you likely use a reference frame where you are not moving, because it makes it easy to describe things as you see it. However, other people tend to use their own point of view as reference frames, so they describe position and motion differently.

For example, suppose that your teacher is walking from the front of the room to the back as shown in Figure 3. You and your classmates all see him move, but you see different things. Why?

The reference frame you use can determine how you describe position or motion. Your friend in the back of the room sees the teacher walking in front of her and toward her. From her reference frame, the teacher is moving in a forward direction and has speed of 1 m/s. But from the front row, you see the teacher walking away from you and behind you. From your reference frame, the teacher is walking with a velocity of -1 m/s. Your teacher is not moving in a different way, but you and your friend describe it differently because you are describing it using different reference frames.

Because reference frames are arbitrary, you have to specify which reference frame you are using to share information about position or motion with other people. For example, suppose you and your friend are facing each other and you want him to look at a car nearby. You could say either "look at the car to my right" or "look at the car to your left." When you say "my right" or "your left" you are stating which reference frame you are using to describe the car's position.
Check for Understanding:
1. Describe the motion of objects that are viewed from your reference frame both inside and outside while you travel inside a moving vehicle.

2. Why is it important to describe the reference frame you are using when sharing information about position and motion?

Acceleration

Car ads sometimes brag that a car can go "from 0 to 60" in just a few seconds. What does that mean? Why is it better for a car to go from 0 to 60 in 5 seconds than for it to go from 0 to 60 in 10 seconds?

The phrase "from 0 to 60" is a statement about a car's acceleration. Acceleration is the rate of change of an object's velocity. When the speed of a car increases from 0 mph to 60 mph, its velocity is changing, so it is accelerating. An object accelerates whenever its velocity changes. Recall that velocity is the speed and direction that an object travels. So, acceleration can take three forms.

Speed Increasing When the speed of an object increases over time, the object accelerates. For example, when a car moves after stopping at a stop sign such as in Figure 4A, it accelerates. A runner that starts sprinting at the end of a long race also accelerates by increasing her speed.
**Figure 4A** Acceleration is the rate of change of an object’s velocity. This car is accelerating because its velocity is increasing over time. As each second passes, its velocity increases by 2 m/s, so the rate that the car’s velocity changes is 2 m/s per second.

**Speed Decreasing** Any change in speed is a change in velocity, so an object that is slowing down is also accelerating. You might think it is weird to say that a car accelerates to stop at a stoplight, as shown in Figure 4B, but that statement is true! Sometimes people call slowing down *deceleration*.

**Figure 4B** When an object slows down, it has negative acceleration. The velocity of this car decreases by 2 m/s as each second passes. Its acceleration is \(-2 \text{ m/s}^2\).
This multiple exposure image shows that a ball accelerates as it rolls down a ramp. The exposures were taken 0.025 seconds apart, and the ball moves farther during each time interval. It moves farther because its velocity keeps increasing.

**Changing Direction** Because velocity includes the direction that an object travels, an object accelerates when it changes direction. So, a car turning a corner while keeping the same speed is accelerating. An object can also accelerate by changing direction and speed at the same time, such as a car slowing down while turning.

**Acceleration as a Rate** Acceleration is more than just changing velocity. It is a rate that measures the change in velocity per unit of time. This rate tells you how quickly (or how slowly) an object's velocity changes over time. The more quickly an object changes speed or direction, the greater its acceleration.

An object's acceleration can change from moment to moment, just like its velocity can. However, you can calculate an object's average acceleration. First subtract its starting velocity from its ending velocity. Then divide that result by the time over which the change in velocity happened. Written as an equation, acceleration is:

\[
\text{average acceleration} = \frac{\text{ending velocity} - \text{starting velocity}}{\text{time}}
\]

When you look at the equation, you can see that acceleration has units of velocity divided by units of time. A common unit of velocity is meters per second (m/s) and a common unit of time is seconds (s). Thus, a common unit of acceleration is meters per second per second ((m/s)/s), which is also written as meters per second squared (m/s²).
The car in Figure 4A starts with a velocity of 0 m/s and reaches a velocity of 6 m/s in 3 seconds. Its acceleration is:

\[
\text{average acceleration} = \frac{6 \text{ m/s} - 0 \text{ m/s}}{3 \text{ s}} = 2 \text{ m/s}^2
\]

The car's speed increases by 2 m/s every second. The car in Figure 4B starts with a velocity of 6 m/s and slows to a velocity of 0 m/s in 3 seconds. So the second car's acceleration is:

\[
\text{average acceleration} = \frac{0 \text{ m/s} - 6 \text{ m/s}}{3 \text{ s}} = -2 \text{ m/s}^2
\]

The car's speed decreases by 2 m/s every second until it comes to a complete stop.

Check for Understanding:

1. What three forms can acceleration take?

2. What does acceleration measure?
Forces

The word *force* is used in different ways in everyday language. A storm may have a lot of force, someone may speak forcefully, and a door may be forced open. In science, the word *force* has a specific meaning. What is the scientific meaning of *force*, and what do forces do?

In science, a *force* is a push or a pull on an object. When a force is exerted on an object, the force can cause the object to accelerate. The word *exert* means "to put forth" or "to apply." You push on a soccer ball when you kick it, so your foot exerts a force on the ball. That force can make the ball start moving or can make it change directions. You can even exert a force to stop the ball. Forces can cause other changes, too. The shape of a sponge changes when you exert a force on it by squeezing it.

Forces always occur when two objects interact. Look at Figure 2. When you kick a soccer ball, your foot is only exerting a force on the ball while it is touching the ball. Your foot is not exerting a force on the ball before you touch it, and it stops exerting a force on the ball as soon as the ball leaves your foot.

Figure 2 A force is a push or a pull by one object on another object. A force can cause an object to accelerate. When a person exerts a force on the ball, the ball accelerates in the direction of his or her force.
Forces are described using both strength and direction. The strength of a force is how strong or weak the push or pull is. The strength of forces is measured in a unit called the **newton** (N), which was named in honor of Isaac Newton. To lift a banana, you need an upward force of about 2 N to lift. You would need about 120 N of upward force to lift a 12-kilogram (27-pound), 2-year-old child.

Forces can be modeled using arrows. The length of the arrow represents the strength of the force. An arrow modeling a 100 N force would be twice as long as an arrow modeling a 50 N force. The direction that an arrow points models the direction of the force.

**Check for Understanding:**
1. What is a force and what happens when it is exerted on an object?

2. When do forces occur?

3. How are forces described?

4. How are forces measured and modeled?
Newton's Third Law of Motion

A swimmer turns around in a pool. You, and many people, may recognize that this swimmer is exerting a force on the pool wall with her feet. But Newton would identify a force that a lot of people don't realize exists. What force is that?

Newton would identify a force exerted by the wall on the swimmer, which is described by Newton's third law of motion. **Newton's third law of motion** states that when an object exerts a force on a second object, the second object exerts a force with equal strength on the first object, but in the opposite direction. The third law describes a system of interacting objects in which each object exerts a force on the other object. When two objects interact, two forces are exerted on different objects. The third law is sometimes stated as, "For every action there is an equal and opposite reaction." However, that phrase does not mention that the forces act on different objects.

Because each force acts on different objects, each force affects the motion of only one object. Figure 3A shows that the swimmer exerts a force on the wall; the wall is much heavier than the swimmer, so it does not move. At the same time, the wall exerts a force of the same strength on the swimmer; the swimmer is much lighter than the wall, so the force accelerates her away from the wall. In this system, two forces were exerted and they were exerted on different objects.

**Figure 3A** Newton's third law states that when an object exerts a force on a second object, the second object exerts a force with equal strength on the first object, but in the opposite direction. So, when a swimmer pushes against a pool wall, the wall pushes against the swimmer with an equal and opposite force.
When a car strikes a wall, the car exerts a force on the wall and the wall exerts an equal force in the opposite direction on the car. The force on the wall dents the wall, and the force on the car crumples its front end.

Newton's third law of motion also explains what happens when a car collides with a wall. The moving car exerts a force on the nonmoving wall, while the wall exerts a force of equal strength on the car. The force of the car on the wall damages the wall, and the force of the wall on the car stops the car from moving forward which causes the car to crumple. In this system, both interacting objects were affected by the same amount of force, but the car got the worst of it!

The two interacting forces described by Newton's third law are sometimes called a force pair. The forces in every force pair act on different objects. Often, one force of a force pair is easy to identify because its effect is easily seen. The other force of the force pair can be more difficult to identify because it may not have a great effect. Recall the airboat at the beginning of this lesson. The fan on the airboat is pushing a lot of air backward. At the same time, the air is pushing the fan forward. Because the fan is attached to the boat, the fan and the boat move forward.

In certain situations, however, the effects of both forces in a force pair can be seen. For example, think about two identical pendulums hanging side by side. If you move each pendulum outward by the same amount and let go, the pendulums will collide as shown in Figure 3B. When they collide, the blue pendulum will exert a force on the gold pendulum, and the gold pendulum will exert a force on the blue pendulum. The forces obey Newton's third law and are equal in strength and opposite in direction. The force exerted by the blue pendulum pushes the gold pendulum to the right. At the same time, the force exerted by the gold pendulum pushes the blue pendulum to the left. The two forces cause the pendulums to swing away from each other in the same way and at the same time.
Figure 3B  Newton’s third law of motion can be observed using two pendulums. When the pendulums collide, the pendulums exert forces on each other. The two pendulums move outward by the same amount because the forces on them are equal in strength.

This experiment with pendulums is similar to experiments that Newton used to verify that his third law of motion was correct. Newton collided pendulums of different sizes and made of different materials. Knowing how far the pendulums moved was evidence that allowed Newton to measure the force on each pendulum. The evidence showed that the size of the force on one pendulum was always the same as the size of the force on the other pendulum.

Check for Understanding:
1. Explain how Newton’s third law of motion applies to a system of objects.

2. What is a force pair? Are they easy to identify?
3. Identify the forces in the force pair by circling the forces.

4. How does the force pair in the previous image demonstrate Newton’s third law of motion?
6th Grade Science Materials for Session 5

Net Force

Iditarod mushers have constraints on the number of dogs they can use. Each musher can start the race with as many as 16 dogs pulling the sled and must finish the race with at least five dogs pulling the sled. Mushers take very good care of their dogs to keep them from becoming ill or injured during the race. If a dog gets sick or is injured during the race, mushers can leave their dogs with veterinarians and continue the race with their remaining dogs. Why do mushers want to finish the race with as many dogs as possible?

Each dog in a dog sled team exerts a force on the sled. A musher wants as many dogs as possible because the forces exerted by the dogs add up to a large force on the sled. In fact, when more than one force acts on any object, the effect of those forces can be found by adding the forces. The sum of all forces acting on an object is the net force on the object.

The net force on an object is the combination of all forces acting on that object. If the forces act in the same direction, the strengths of the forces are added together. The net force on the van is 425 N because the strengths of the forward forces on the van add up to 425 N.

The net force is found by combining all the forces on an object. Recall that forces have both strength and direction. Whether you add or subtract forces depends on the directions that the forces act. If the forces on an object act in the same direction, the strengths of the forces are added. For example, when three people push a van that has run out of gas, they all push in the forward direction. If the people push with forces of 100 N, 125 N, and 200 N, the net force is:

\[ 100 \text{ N} + 125 \text{ N} + 200 \text{ N} = 425 \text{ N} \]

Because all the forces on the van are in the forward direction, the net force is also in the forward direction.
Figure 1 When forces act in opposite directions, the net force is found by subtracting the strengths of the forces. The dog pulls the leash with a force of 75 N in the forward direction, and the girl pulls the leash with a force of 50 N in the backward direction. Thus, the net force is 25 N in the forward direction.

On the other hand, forces are subtracted to find the net force if the forces act in opposite directions. The leash in Figure 1 has forces acting on it in opposite directions. The dog jumps forward, pulling the leash with him. The girl pulls back on the leash, but is dragged forward by the dog. If the dog pulls with a force of 75 N and the girl pulls with a force of 50 N, the net force on the leash is:

$$75 \text{ N} - 50 \text{ N} = 25 \text{ N}$$

Sometimes the net force on an object is equal to a single force acting on the object. At the end of a roller coaster ride, the only force acting on the car is the backward force of the brakes. This backward force causes the car to slow to a stop.
When forces are subtracted to find the net force, the direction of the net force is the same direction as the larger force. So the force on the leash is 25 N in the forward direction. As a result the leash, along with the dog and the girl, accelerate forward.

Sometimes the net force on an object is simply equal to one force on the object. Think about a train of cars on a roller coaster car coming to a stop at the end of a ride. Brakes are applied to slow the train down. The brakes exert a backward force on the train. Because all forward or backward forces on the train are very small, the net force on the train is, practically, just the force of the brakes. If the direction the train is traveling is positive, then the force of the brakes is in the negative direction. So, the net force on the train is negative, the train’s acceleration is negative, and the train slows down.

Finding the net force is useful because you can use the net force to predict the effect of all the forces on an object at once. Once you find the net force you can predict if and how the object’s motion will change.

**Check for Understanding:**
1. What is generally the net force on an object?

2. Calculate the following net forces.
   a. Two people push a couch across a room. One pushes with 30 N. The other pushes with 50 N.

   b. An uncle plays tug-of-war with his niece and nephew. The uncle pulls one side of the rope with a force of 95 N. The niece and nephew pull the other side of the rope with a force of 40 N and 45 N.

   c. Two friends push their friend on a swing with a combined force of 15 N and 20 N.
Newton’s First Law

Suppose that you are pushing a luggage cart in an airport or a train station. By pushing with different strengths, you can make the cart speed up, slow down, or move at a constant velocity. How can net force and Newton’s first law of motion be used to predict how the luggage cart—or any object—will move?

An object’s motion is determined by the net force on it. When you find the net force, you also find whether the forces are balanced or unbalanced. **Balanced forces** are forces that have a net force equal to 0 N. **Unbalanced forces** are forces that have a net force not equal to 0 N. Newton’s first law of motion describes what happens to an object when the forces on it are balanced.

**Newton’s first law of motion** states that an object at rest stays at rest, and an object in motion stays in motion with a constant velocity unless acted on by unbalanced forces. This means that an object is stable, or does not change its behavior, unless an unbalanced force acts on it. The statement of the first law is long, but you can separate it into parts to fully understand the law.

“An Object at Rest” The first part of the first law of motion says that an object at rest stays at rest if the forces on it are balanced. When an object is “at rest” it is stationary, or not moving. So the first part of the first law says that, if the forces on a stationary object are balanced, the object will not move. This makes sense. If a luggage cart is standing still, and the net force on it is 0 N, such as in Figure 2A, the cart will stay still.

![Figure 2A](image)

**Figure 2A** Newton’s first law of motion describes the motion of an object when the forces on it are balanced. If the forces on a stationary cart are balanced, the cart will stay still. Also, if the cart is already moving and the forces on it are balanced, the cart will keep moving with the same velocity—that is, at the same speed and in the same direction.

"An Object in Motion" The second part of the first law of motion says that an object in motion will stay in motion with a constant velocity if the forces on it are balanced. This means that, if the net force on a moving object is 0 N, the object will keep moving with the same speed and in the same direction. In other words, the object’s motion will not change.
When a luggage cart moves forward, friction between the wheels and the floor push backward on the cart. If you push the moving cart forward with a force equal in strength to the force of friction pushing backward, the forces on the cart are balanced. As a result, the cart will continue moving at a constant velocity.

"Unless Acted on by an Unbalanced Force" The first law describes what happens to the motion of an object when the forces on it are balanced, but it only hints at what happens when the forces on an object are unbalanced. When an unbalanced force acts on an object, the object will accelerate, which means that the object will change its speed and/or direction.

![Unbalanced Forces on Moving Objects](image)

**Figure 2B** If the forces on an object are unbalanced, the object will accelerate. If the net force on a moving cart acts in the direction that the cart is moving, the cart will speed up. If the net force on a moving cart is in the direction opposite to the cart’s motion, the cart will slow down.

For example, if you push the luggage cart with a force stronger than the force of friction, the net force on the cart will be greater than 0 N and in the forward direction. This unbalanced force will cause the cart to speed up. On the other hand, if you pull back on the cart, your pulling force and friction will be in the same direction, so the net force will be greater than 0 N in the opposite direction. In this case, the cart slows down.

**Check for Understanding:**
1. What does Newton’s first law of motion say about balanced and unbalanced forces?

2. Are the forces on a stationary object balanced? Why or why not?
Newton's Second Law

When a musher wants the sled to go faster, the musher might yell a command to encourage the dogs to pull harder. The stronger pull of the dogs will make the sled accelerate. However, this is not the only way a musher can account for acceleration. What else determines how much the sled will accelerate?

Newton's second law of motion describes the factors that determine an object's acceleration. **Newton's second law of motion** states that an object's acceleration is equal to the net force on the object divided by its mass. This law is easier to understand by looking at the different relationships between acceleration, force, and mass.

**Acceleration and Force** One factor that determines how much an object accelerates is the strength of the net force on the object. For an object with a given mass, the greater the net force acting on the object is, the greater the acceleration of the object is.

The net force on a dog sled depends on the number of dogs pulling the sled, and the net force affects the acceleration of the sled. Observe Figure 4A, where each sled dog pulls with a force of 50 N. If three dogs pull on a sled, the net force on the sled will be 150 N in the forward direction. If six dogs pull the sled, the net force will be 300 N in the forward direction. Six dogs pull the sled with twice the net force as three dogs do. So the sled will have twice the acceleration as when the sled is pulled by three dogs. This explains why Iditarod mushers want to have as many dogs as possible pulling their sleds. More dogs mean a greater net force, which means a greater acceleration. A greater acceleration on the sled means that the musher will finish the race faster.

**Figure 4A** Newton's second law of motion says that the acceleration of an object increases as the net force on that object increases. The net force of six dogs pulling a sled is twice as strong as the net force of three dogs pulling the sled. So, the acceleration of the sled pulled by six dogs is twice the acceleration of the sled pulled by three dogs.
Acceleration and Mass The other factor that affects how much an object accelerates is the object’s mass. If identical net forces act on two objects that have different masses, the object that has the larger mass will have a smaller acceleration.

The mass of an Iditarod sled depends on the amount of supplies carried on the sled, and the mass of the sled affects its acceleration. Iditarod mushers have to carry enough food and water to survive between checkpoints. However, supplies increase the mass of the sled. A heavier sled has a smaller acceleration when pulled by the same number of dogs than a lighter sled. For example, a sled with a mass of 300 kg will have half the acceleration of a sled with a mass of 150 kg when both sleds are pulled by the same net force.

The Second Law Equation Newton’s second law allows the relationships between acceleration (a), force (F), and mass (m) to be written as an equation. The equation for the second law is:

\[ a = \frac{F}{m} \]

Figures 3.4A and 3.4B show how the second law equation is used to calculate acceleration in different situations. When mass stays the same, any change in force will result in a proportional change in acceleration. Six dogs pull a sled with twice the force of three dogs. The force doubles, so the acceleration of the sled also doubles.

![Figure 3.4A](image)

**Figure 4B** Newton’s second law of motion also says that the acceleration of an object decreases as the mass of the object increases. The mass of the heavy sled is twice the mass of the light sled, and both sleds are pulled by the same net force. As a result, the acceleration of the heavy sled is half the acceleration of the light sled.

When force stays the same, any change in mass will result in an inverse change in acceleration. If a sled has 2 times the mass of another sled, the heavier sled will have 1/2 the acceleration of the lighter sled. If a sled has 3 times the mass of another sled, the heavier sled will have 1/3 the acceleration.
Check for Understanding:
1. What does Newton's second law of motion state?

2. For an object with a given mass, which of the following net forces would determine the greatest acceleration: a force of 5 N, 50 N, or 500 N?

3. If the forces acting on two objects are the same, which object has greater acceleration? An object that is 200 kg or an object that is 400 kg?

4. Explain the following equation: \( a = \frac{F}{m} \).
Gravitational Fields

Newton's model of gravity is sometimes summarized as "what goes up, must come down." For people on Earth, "down" is toward the center of Earth. If you drop anything, it falls toward the center of Earth. However, if an astronaut drops anything on the moon, it falls toward the moon's center. What would happen to an object dropped between Earth and the moon? Which "down" direction would it fall?

Gravitational fields are maps of force fields that can be used to predict which way gravitational forces will pull objects. A model called a force field will describe what the force on an object would be if the object were placed in any location in space. Force fields are used to predict the strength and direction of all noncontact forces.

The gravitational field around Earth is represented by arrows pointing toward Earth. An object placed in the force field will be pulled toward Earth in the same direction as the gravitational field arrows. In Figure 4, the gravitational field is represented by light gray arrows, while the gravitational forces are represented by black arrows. Remember, the gravitational field arrows are not forces—they are part of the model you can use to predict what the gravitational forces on an object will be. The spacing of the arrows shows how strong the forces will be. The forces will be stronger where the arrows are closer together, and weaker where the arrows are farther apart.
Figure 4 A gravitational force field is like a topographical map that describes what the gravitational forces on an object would be at any point in space. The gravitational force fields of Earth and the moon show the direction that an object would be pulled when placed in the fields near them.

The strength of a gravitational field decreases with distance. Earth’s gravitational field is strong near Earth’s surface. The field is weaker 10 km above Earth’s surface. An object placed between Earth and the moon is in both Earth’s and the moon’s gravitational fields. It is in a tug-of-war as it is being pulled toward Earth and the moon. The object’s position will determine the winner of the tug-of-war. At a certain distance from the moon, the moon’s gravitational field is stronger than Earth’s. At that spot, the object is pulled toward the moon in the direction dominated by the moon’s gravitational field.

Check for Understanding:
1. What is the purpose of a gravitational field model?

2. How is the strength of the gravitational field represented in a gravitational field diagram?

3. How would you expect the arrows in the gravitational field lines to appear close to Earth? Farther away?
6th Grade Science Materials for Session 8

Electric Charge and Forces

You and your friends are decorating the school gym for a dance. As you blow up balloons, you decide to do a magic trick. You rub a balloon on your hair and then place the balloon on the wall where it sticks. How could you explain this trick?

The explanation for the sticking balloon starts with charged particles. All matter is made of particles that are too small to see. Some of these particles have electric charge. **Electric charge** is a property of matter that causes electrical phenomena. Particles with electric charge interact with other particles with electric charge.

Two kinds of electric charge exist. These kinds of charges are called **positive** and **negative**, names chosen to show that the charges have opposite effects.

As demonstrated in Figure 1A, objects may have either equal or unequal numbers of positively charged particles and negatively charged particles. Objects that have equal numbers of positively charged particles and negatively charged particles are called **neutral** because they have no overall charge. Most objects you regularly encounter are neutral.

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**How an Object’s Charge Is Determined**

<table>
<thead>
<tr>
<th>Positively (+) charged balloon</th>
<th>Negatively (−) charged balloon</th>
<th>Neutrally charged balloon</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="image" alt="Diagram of positively charged balloon" /></td>
<td><img src="image" alt="Diagram of negatively charged balloon" /></td>
<td><img src="image" alt="Diagram of neutral charged balloon" /></td>
</tr>
</tbody>
</table>

- More particles with (+) charge than (−) charge
- More particles with (−) charge than (+) charge
- Equal number of particles with (+) charge and (−) charge
**Figure 1A** All objects contain positively charged particles and negatively charged particles. If an object has equal numbers of positively and negatively charged particles, the object is neutral. If an object has unequal numbers of positively and negatively charged particles, the object has an overall charge.

**Figure 1B** The electric force is an attractive or repulsive force between charged objects. The electric force pushes objects apart if they have the same charge, but pulls objects together if they have opposite charges. No electric force exists between neutral objects.

Most of the time, your hair and a balloon have equal numbers of positively charged and negatively charged particles and are neutral. However, when you rub a balloon on your hair, negatively charged particles from your hair are transferred to the balloon. Your hair now has more positively charged particles than negatively charged particles, and has an overall positive charge. The balloon, on the other hand, has more negatively charged particles and has an overall negative charge.

Charged objects can interact through electric forces. **Electric forces** are attractive or repulsive noncontact forces between charged particles. Recall that an attractive force pulls objects together. On the other hand, a **repulsive** force pushes objects apart. Whether an electric force is attractive or repulsive depends on the charges of the objects. You can investigate this in an experiment similar to the one shown in Figure 1B. It shows two balloons hanging side by side on strings to explore the cause-and-effect relationships involved. Neutral objects, such as the first pair of balloons, not experience electric forces.

The electric forces between two objects are repulsive when they have the same kind of charge. In Figure 1B, pairs of balloons with the same kind of charge are pushed apart. In
another example, when your friend pulls a wool sweater over his head, negatively charged particles from the sweater transfer to each hair on his head. As a result, each strand of hair has more negatively charged particles and therefore, is negatively charged. Because all strands of hair have the same charge, the electric force between them is repulsive. The strands of hair push each other away.

On the other hand, when two objects have opposite charges, the electric forces between them are attractive. Figure 18 shows how pairs of balloons will behave. Now recall the balloons for the school dance. Rubbing a balloon on your hair will give the balloon a negative charge. When you hold the balloon close to the wall, the negatively charged balloon pushes the negatively charged particles in the wall away, giving the area near the balloon a positive charge. The balloon and the area of wall near the balloon have opposite charges, so the electric force between them is attractive. As a result, the balloon and the wall pull together and the balloon sticks to the wall.

Check for Understanding:
1. What types of electric charge exist?

2. What happens when an object has an equal number of positive and negative charges?

3. Draw an object with a positive charge.
4. Draw an object with a negative charge.

5. Draw an object with a neutral charge.

The Strengths of Electric Forces

Suppose that you have a positively charged balloon hanging between two negatively charged balloons. The positively charged balloon is attracted to both negatively charged balloons, so how can you predict which way it will move?

To answer this, you need to know the strengths of the electric forces between the balloons. Like gravitational forces, electric forces can vary in strength. The strengths of electric forces depend partly on the amount of charge on the interacting objects. The more charge an object has, the stronger the electric force it exerts. You can use this cause-and-effect relationship to make your prediction. Look at Figure 2. A positively charged balloon will be attracted by a stronger force to a balloon that has a more negative charge than it would to a balloon that has a less negative charge. The positively charged balloon will be repelled with a stronger force from a balloon with a greater positive charge.
The strength of the electric force also depends on the distance between interacting objects. This dependence is similar to the way that the gravitational force depends on distance. As Figure 2 shows, the closer together charged objects are, the stronger the electric force between them. When you want to stick a balloon to the wall using an electric force, you have to hold the balloon close to the wall. The electric force is only strong enough to attract the balloon to the wall when they are close together.

**Check for Understanding:**

1. What does the strength of electric forces depend on?

2. For each box, draw the strength of electric charge for objects with a negative charge. Label the boxes with one of the following: weak charges, strong charges, short distance, long distance.
6th Grade Science Materials for Session 9

Electric Fields

Think about walking into a school’s cafeteria and getting a whiff of the day’s meal. It smells good, and you head toward the counter. As you move closer, the yummy scent becomes stronger. It’s pizza! You walk faster because you cannot wait to get your lunch. How can the delicious scent of pizza help you understand electric forces?

The scent of a pizza surrounds the pizza, and the scent is stronger the closer you are to the pizza. Just as a pizza can be detected by the scent that surrounds it, a charged object can be detected by something that surrounds it. An **electric field** is a force field surrounding an electrically charged object. It can be used to predict the electric force exerted on a positively charged test object.

What is a test object? When discussing electric fields, a test object is an imaginary object with exactly 1 C of charge (the units of electric charge are coulombs, abbreviated C). So, the strength of the field tells you how strong the force would be if you put a particle with 1 C of charge in it. A particle with 2 C of charge would experience twice as much force. Similarly, a particle with 0.5 C of charge would experience half as much force.

Electric fields that surround charged objects are similar to gravitational fields that surround objects that have mass. Recall that gravitational fields predict which way gravitational forces will pull an object. Look at Figure 3A. Electric fields also predict the force on an object—specifically a positively charged test object. However, because electric forces can be attractive or repulsive, electric fields predict which way electric forces will pull or push an object.

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**Figure 3A** In diagrams, electric fields are represented by arrows. A positively charged test object moves in the same direction as the field. A negatively charged test object will move in the opposite direction of the field.
All charged objects create electric fields, and the electric fields exist whether or not a test object is present. Similarly, all objects that have mass are surrounded by gravitational fields whether or not another mass is close enough to experience it.

Remember that in a diagram showing a gravitational field, the field was represented by arrows. An electric field is also represented by arrows in diagrams. In a gravitational field diagram, the arrows always pointed toward the object that created the field. That’s because other objects would always be pulled toward the object in the diagram. But in an electric field diagram, the arrow can point toward or away from the object that created the field. The arrows point toward the object if it is negatively charged. The arrows point toward the object because a positively charged test object will be pulled toward a negatively charged object. On the other hand, the arrows point away from an object if it is positively charged because a positively charged test object will be pushed away from another positively charged object.

Another similarity between gravitational fields and electric fields is that the amount of space between arrows in an electric field diagram shows how strong the field is. Arrows that are close together indicate that the field is strong. Arrows that are far apart indicate that the field is weak. The electric field diagrams in Figure 3B show that the arrows are close together near charged objects and grow farther apart as the distance from the charged object increases. As the distance from the charged object increases, the strength of the electric field decreases. This confirms that the electric force of an object decreases with distance as well.

**Figure 3B** All charged objects create an electric field. The arrows point toward negatively charged objects and point away from positively charged objects. The amount of space between arrows shows the strength of the electric force on a test object.
Check for Understanding:
1. How does an electric field help to predict the behavior of an object?

2. Draw an electric field diagram that includes a weak field with a positively charged test object inside the field lines.

3. Draw an electric field diagram that includes a strong field with a negatively charged test object inside the field lines.
Magnetic Forces

You know refrigerator magnets can hold papers to a refrigerator door, but those magnets are weak compared to magnets used in industry and science. For example, junkyard magnets lift cars and can be 200 times stronger than refrigerator magnets. How do magnets pull things together?

Magnets keep things together using magnetic forces. Magnetic forces are attractive or repulsive forces between magnets or attractive forces between a magnet and certain materials. Common materials that are pulled by magnetic forces may include iron, nickel, cobalt, and certain mixtures of metals. Objects that contain any of these materials are attracted to magnets. For example, some paperclips contain iron, so they are attracted to magnets.

Magnetic forces are noncontact forces, which means that they can act at a distance. If you hold a magnet near a paperclip, the paperclip will be pulled toward the magnet. The magnet is able to attract the paperclip without touching it because the magnetic forces acted at a distance and pulled the clip to the magnet.

Recall that you have already learned about two other noncontact forces: electrical forces and gravitational forces. Magnetic forces are similar to electrical forces because both forces can be either attractive or repulsive. Gravitational forces are only attractive.

You can predict whether magnetic forces between two magnets will be attractive or repulsive based on how the magnets are positioned, as seen in Figure 1A. Every magnet has two magnetic poles, which are the regions where magnetic forces exerted by the magnet are the strongest. A magnet's poles are called its north pole and south pole and are usually on opposite ends (or opposite sides) of the magnet.

Figure 1A. Magnetic forces are noncontact forces that can be attractive or repulsive between magnets. Magnetic forces are repulsive between similar poles of two magnets but are attractive between opposite poles of magnets.
The magnetic forces between opposite poles of two magnets are attractive. That means that magnetic forces pull the north pole of one magnet and the south pole of another magnet together. Some everyday objects contain magnets that take advantage of these attractive forces. What examples can you find around your home?

The magnetic forces between similar poles of two magnets are repulsive. In other words, magnetic forces push the north poles of magnets apart or push the south poles of magnets apart. You can feel repulsive magnetic forces when you try to push similar poles of two magnets together. In fact, as you push the poles closer together, you will feel that the forces pushing them apart are stronger. If you aren’t holding the magnets tightly, the repulsive force can be so strong that the magnets may flip so that the opposite poles are next to each other.

The strengths of magnetic forces depend on the distance between a magnet and the object it acts on. Look at Figure 1B. When similar poles of two magnets are close together, the forces of repulsion are strongest. As the distance between the magnets increases, the forces of repulsion decrease. Similarly, an increase in distance affects magnetic forces between opposite poles. As the distance between the magnets increases, the forces of attraction decrease. A magnet will not stick to a refrigerator door until the magnet is held close to the door. If it is too far away, magnetic forces will not be strong enough to pull it to the door.

![Magnetic Forces Vary with Distance](image)

**Figure 1B** The strengths of magnetic forces depend on the distance between a magnet and the object it acts on. The repulsive force between the north poles of these two magnets decreases as the magnets are moved farther apart.

The strengths of magnetic forces also depend on the materials involved. For example, a particular magnet may only be able to hold two sheets of paper to a refrigerator door because the magnetic materials exert weak forces. However, a different magnet may be able to hold ten or more sheets of paper up because its materials exert stronger forces.

**Check for Understanding:**

1. Explain how magnetic forces cause magnets and other objects to behave.
2. How are magnetic forces noncontact forces?

3. Draw an image of attractive magnetic forces between two magnets.

4. Draw an image of repulsive magnetic forces between two magnets.

Magnetic Fields

On a hike with your friends, you reach a fork in the trail, and don't know which way to go. One friend pulls out a map and a compass. She holds the compass flat, waits for it to point north, aligns north on the map with the compass, and tells you which way to go. Why does the compass always point north?

A compass needle is a magnet, and like all magnets, it can be attracted or repelled by magnetic forces. The needle points north because magnetic forces cause it to turn until it points north. How magnetic forces will move a compass needle can be described by a magnetic field. A magnetic field is a force field created by a magnet.
Recall that diagrams of gravitational and electrical fields used arrows to represent force fields. Similarly, magnetic field diagrams use arrows to represent a magnetic field, as shown in Figure 2A. The arrows in a magnetic field diagram form loops. Part of each loop is inside the magnet, where the arrow points from the south pole to the north pole. The rest of the loop is outside of the magnet, where it circles from the north pole back to the south pole. The loops in a magnetic field diagram never cross.

![Magnetic Field Lines Describe the Magnetic Field](image)

*Figure 2A* A magnetic field is a force field created by a magnet. The field can be detected by compass needles. Regions where lines are close together in the diagram indicate places where the magnetic field is strongest.

Like gravitational and electrical field diagrams, the spacing of the arrows in a magnetic field diagram represents the strength of the field. Arrows are close together where the magnetic field is strong. The magnetic field is strongest inside the magnet and at the poles, so the magnetic field arrows are closest together at those places. Arrows are far apart where the magnetic field is weak. The magnetic field arrows are farther apart away from its poles.

The arrows in a magnetic field diagram show how magnetic forces on a magnet will act. A magnet placed at a particular spot in a magnetic field will spin to align with the field arrow at that spot. Using Figure 2A, you can do a thought experiment to predict how a compass needle would behave in a magnetic field. A compass needle has a north pole (often painted red) and a south pole. When the compass is in a magnetic field, magnetic forces cause it to spin until it aligns with the magnetic field arrows. Remember that the north pole of a magnet—such as the painted end of a compass needle—is attracted to the south poles of other magnets. So, a compass needle spins to align with the magnetic field, such that the painted end points to the south pole of the magnet.

If a compass needle aligns with magnetic field arrows, what magnetic field is a compass in when you are on a hike? The magnetic field that the compass and you are in is Earth's magnetic field.

Earth's magnetic field is similar to the magnetic field around a bar magnet. Recall that a compass needle points toward the south pole of a magnet. So, when a compass needle is in Earth's magnetic field, it points
toward Earth's magnetic south pole. However, Earth's magnetic south pole is near Earth's geographic North Pole as seen in Figure 2B. So, when you use a compass to tell direction, it points to the north. That also means that Earth's magnetic north pole is near Earth's geographic South Pole. Thanks to Earth's magnetic field, a compass can always help you find Earth's geographic north.

![Earth's Magnetic Field](image)

**Figure 2B Earth** has a magnetic field that is similar to a bar magnet's magnetic field. Compasses always point north because Earth's magnetic south pole is near Earth's geographic North Pole.

**Check for Understanding:**
1. What is a magnetic field?

2. Draw a model of a magnetic field around a magnet with two poles.
Electromagnetic Forces

If you are using a compass to find north, be sure that no one holds an electronic device near the compass. Electronic devices can change the direction compasses point to. Why does this happen?

Electronic devices interfere with compasses because the devices cause magnetic fields. However, these magnetic fields are not caused by magnets. Instead, the magnetic fields are caused by moving particles with electric charge. Charged particles move as electric currents in the devices’ circuits as you learned in the previous lesson.

Can you predict how a magnetic field created by a current will affect compasses? On the left in Figure 3A, the wire in the center of the compasses does not carry a current. Because no magnetic field surrounds the wire, there is no effect on the compasses. All the needles point north to align with Earth’s magnetic field. However, when the wire carries a current, there is an effect on the compass as seen on the right in Figure 3A. The compass needles align with the stronger magnetic field caused by the current. The needles form a circle, lining up with the magnetic field around the wire.

Figure 3A Moving electric charges can cause a magnetic field. The compass needles in the image on the left all point north because of Earth’s magnetic field. But when the wire carries a current, the current causes a magnetic field around the wire, and the compass needles turn to align with the field.

The compass needles are turned by magnetic forces caused by the electric current. The magnetic forces caused by an electric current are one kind of electromagnetic forces. Another kind of electromagnetic force is the force on electric charges caused by a changing magnetic field. How can a magnetic field change? You can change the magnetic field around charges in a wire in two ways. You can either move a magnet near the wire or you can
move the wire near a magnet. Either way, the electromagnetic forces on the charges in the wire cause the charges to move and form a current.

The electromagnetic forces from a current-carrying wire are strong enough to move the compass needles. The forces can be made stronger by forming loops to make a coil out of the wire, as seen in Figure 3B. The more loops formed in the coil, the stronger the magnetic forces exerted by the coil. The forces can be made even stronger by wrapping the current-carrying wire around a piece of iron.

![Increasing the Strength of Electromagnetic Forces](image)

**Figure 3B** The electromagnetic forces exerted by a current-carrying wire can be strengthened by forming loops to make a coil. Increasing the number of loops in the coil increases the wire's electromagnetic forces.

A magnet made with a current-carrying wire whose strength can be varied and turned on and off is called an **electromagnet**. Electromagnets are different from refrigerator magnets and the other magnets you use in everyday life. Refrigerator magnets and other everyday magnets are permanent magnets. A **permanent magnet** is a magnet that is always surrounded by its magnetic field.

Electromagnets differ from permanent magnets in several ways. First, electromagnets can be turned on and off. Second, the strength of an electromagnet's force can be changed by changing the amount of current in the wire or by changing the number of loops in the coil. Third, an electromagnet's poles can be changed. The direction the current travels determines which end of the electromagnet is the north pole and which is the south pole. If the current's direction is switched by switching the wires on a battery or by rewiring the circuit, the poles of the electromagnet switch places.

The properties of electromagnets make them useful in industry. For example, an electromagnet can be used to move metal objects in junkyards. A current-carrying wire is wrapped around an iron core, increasing the magnetic forces of the electromagnet. The electromagnet is turned on, and a magnetic force lifts the objects. A crane moves the electromagnet and the objects to a different location. Once the electromagnet is turned off, the objects are no longer attracted to the electromagnet and will fall to a new place.
Check for Understanding:
1. What causes the magnetic fields in electronic devices?

2. What determines the strength of an electromagnet?

3. Explain the difference between an electromagnet and a permanent magnet.
Energy

It's Monday morning, and your alarm has just woken you up. You stumble out of bed and into the kitchen, yawning. "Eat your breakfast," your dad says. "It will give you energy." What is energy and how can your breakfast give it to you?

Energy is the ability to cause motion or change. Everything around you has energy. For example, a rolling bowling ball has energy and can knock over bowling pins. A hot frying pan has energy and can change a raw egg into a cooked egg. Food, including your breakfast, has stored energy. When you digest food, the energy is released and your body uses this energy to do things like breathe and move around. Energy is not made of matter, but all matter has energy.

Energy is the ability to cause motion or change. Understanding changes and transfers of energy are important in all fields of science. How is energy important in each of these photos?

Energy is a concept that scientists use to construct explanations about motion and change. It can be used to predict how much change can occur in a particular system, given evidence such as measurements of the motion and positions of the system's components. For example, scientists studying the phenomena shown in the photos may ask questions like why do healthy ecosystems have more prey than predators? How fast will the wind blow in a hurricane? How much electricity can solar panels produce? How bright will fireworks be?

Scientists track the energy in each part of the system, and use it to predict the motion and change that can occur in other parts of the system. For example, they could add up all the energy available from eating prey in an ecosystem, and use that to determine how many predators could survive using that amount of energy.
Scientists can use the concept of energy to explain complex interactions such as those that happen in ecosystems and hurricanes. But energy can also explain simpler events, such as the one shown in Figure 1. Look closely at the image of the hammer hitting a nail. What is happening? You might describe the scenario using forces. You exert a force on the hammer to make it move. Then, the hammer exerts a force on the nail to make it move. Finally, the nail exerts a force on the wood to change its shape.

Figure 1 Energy changes can explain why motion happens. A person transfers energy to a hammer to make it move. When the hammer hits the nail, it transfers energy to the nail, which drives the nail into the wood.

The force of the water moves in the opposite direction of the canoe, so the canoe loses energy over a distance.

However, you can also describe this scenario using energy. When you swing the hammer, your hand and the hammer have energy because they are moving. When the hammer hits the nail, some of the energy is transferred to the nail, and the nail moves down. As the nail moves, it transfers some energy to the wood as it pushes the wood out of its way.

Although you can use either energy or forces to explain what happens when objects interact, the two concepts are actually related. When one object exerts a force on a second object, and the second object moves in the direction of the force, the force adds energy to the second
object. Think about paddling a canoe. The paddle pushes the canoe forward, so the force of the paddle on the water adds energy to the canoe.

However, if an object exerts a force on a second object, and the second object moves in the opposite direction as the force acts, the force subtracts energy. Water pushes back on a canoe when it moves forward. The force of the water on the canoe is in the opposite direction as the canoe is moving, so the force subtracts energy from the canoe. The canoe gains energy from the force of the paddle but loses energy from the force of the water. Note that when a force acts on an object over some distance, the object either gains or loses energy. You can describe this as forces causing changes in energy.

**Check for Understanding:**

1. What is energy? Give an example of energy on a small scale, a medium scale, and a large scale.

2. Why do scientists track the energy in a system?

3. In the system of a hammer and nail, how would you use forces to describe the interaction of the objects? How would you use energy to describe the interaction of the objects?
The Two Forms of Energy

A snowboarder stands at the top of a hill and looks down. She sees a second snowboarder gliding on a flat area at the bottom of the hill. Which snowboarder has energy?

Both snowboarders have energy; they just have different forms of energy. Energy exists in two forms. The form of energy stored in a system due to the positions of objects interacting at a distance is potential energy. The second form of energy is kinetic energy, which is the energy an object has due to its motion.

Potential Energy Potential energy exists when objects within the system are interacting in a force field. The positions of the objects determine how much potential energy there is. For example, look at the snowboarder at the top of the hill in Figure 2A. She is located high in Earth’s gravitational field. As a result of her position relative to Earth, there is potential energy. Now, observe her when she is halfway down the hill. At this location, she is lower in Earth’s gravitational field. As a result, there is less potential energy. As she descends the hill and approaches the bottom, her potential energy decreases.

Figure 2A Potential energy is energy stored in a system due to the position of objects in the system. For objects positions near Earth, the higher they are, the larger their gravitational potential energy is. A snowboarder at the top of a hill has potential energy because she is positioned high above the defined zero energy point within Earth’s gravitational field.

How can you determine how much potential energy there is in a given system? Recall how reference points determine the speed and direction in which an object is moving. Similarly, reference points determine how much potential energy there is. The position of the objects is relative to a reference point that is defined as having zero potential energy. Once the snowboarder reaches the bottom of the hill, she cannot move farther down. So, you might define the bottom of the hill as the point that has zero potential energy. But what if you designated the
middle of the hill as the point with zero potential energy? Then, at the bottom of the hill, the snowboarder would have negative potential energy!

**Kinetic Energy** Of course, a snowboarder is not going to stay at the top of a hill. She will eventually go down the hill on her board, as seen in Figure 2B. When she moves, she has kinetic energy. All moving objects and particles have kinetic energy because they have the ability to move another object or particle and cause it to move or change. The snowboarder gliding along at the bottom of the hill also has kinetic energy because he is moving.

**Both Forms of Energy** A system may have only potential energy, only kinetic energy, or both. The system with the snowboarder standing still at the top of the hill has only potential energy. She is not moving, so she does not have kinetic energy. The system with the snowboarder gliding at the bottom of the hill has only kinetic energy because we defined the bottom of the hill as the reference point for the potential energy. A system with a snowboarder going down a hill has both potential energy and kinetic energy. The system has potential energy because the snowboarder is in Earth's gravitational field and she is above the point in the system defined as having zero potential energy. The system also has kinetic energy because the snowboarder is moving.

![Kinetic Energy](image)

**Figure 2B** Kinetic energy is the energy an object has that is due to its motion. This snowboarder has kinetic energy because she is moving.

**Check for Understanding:**
1. Energy exists in which two forms? What is the difference?

2. Draw a picture of a system in which objects have both potential energy and kinetic energy.
Tracing Energy Transformation in a System

Recall that a snowboarder experiences different amounts of potential energy and different amounts of kinetic energy at different points along the hill. As she travels down the hill, the amount of potential energy and kinetic energy she has changes. How can you track these energy changes?

Scientists use models to describe energy changes within a system to make predictions about how much energy an object has at a given time. A system is made of components, inputs, processes, and outputs. The components interact in processes that cause changes in the form of energy; inputs and outputs are energy that enter and leave the system.

What are the components of the system shown in Figure 3? The snowboarder has energy, so it is the component. To get to the top of the hill, the snowboarder rides a chairlift to the top of the hill. This input results in the system of the snowboarder and Earth having potential energy.

Figure 3 Changes in energy in a system from one form to another can be described using the model of a snowboarder going downhill. When a snowboarder goes down a hill and makes a jump, potential energy is converted into kinetic energy, back into potential energy, and then into kinetic energy again.
The snowboarder starts going downhill, losing potential energy and gaining kinetic energy. This process converts the potential energy gained from the input into kinetic energy.

As the snowboarder continues moving, she undergoes other processes that change the energy's form. Kinetic energy is changed into potential energy at one moment as the snowboarder jumps up into the air. Then, the potential energy is converted to kinetic energy again as she descends and lands. As she slides to the bottom of the hill, the kinetic energy is used to overcome friction with the snow. This output results in energy leaving the components of the system—the snowboarder.

**Check for Understanding:**
Use the following image to answer the questions.

1. Explain the transformation of energy in the system of the snowboarder and the mountain.

2. At what point does the snowboarder have the most potential energy? The most kinetic energy?
Conservation of Energy

A game of pool starts when a player uses a cue stick to push a cue ball into an arrangement, or “rack,” of 15 colored pool balls. The cue ball hits the colored balls, which go rolling in all directions. How does the energy input compare to the kinetic energy of the rolling balls?

Observe Figure 4. What are the components of the system? All the objects that have energy are components of the system: the cue stick, the cue ball, and the pool balls. But what are the processes, inputs, and outputs of the system?

Figure 4 Conservation of energy is a scientific law stating that energy cannot be created or destroyed. In the system of pool balls, the amount of energy input by the player is equal to the energy of the rolling balls.

Believe it or not, the total energy of all the rolling balls does not change. The break of a rack of pool balls demonstrates a scientific law about energy. The law of conservation of energy is a scientific law that states the total energy of an isolated system always remains the same. An isolated system is a system that does not have any energy inputs or outputs. This law means that that energy cannot be created or destroyed. It does not mean that a given form of energy always remains the same. The energy of an object can be converted. The law also does not mean that a single object always has the same amount of energy. An object’s energy can be transferred to another object in the isolated system when the two objects exert forces on each other.

The kinetic energy of a rolling cue ball can be transferred to a pool ball when they collide. Some or all of the kinetic energy may be transferred. Then when that pool ball hits another pool ball, some or all of the first ball’s energy may be transferred to the second ball. During the start of a pool game, kinetic energy is transferred from ball to ball, which sends the balls rolling in various directions. If you could add up all the kinetic energy of all the
balls at any moment in time, you would find that the total amount always remains the same and is equal to the starting energy of the cue ball.

After a rack of pool balls is hit by a cue ball, the balls roll around for a while, bouncing off each other and the sides of the pool table. Eventually, the balls all come to a stop, and once they all stop moving, the system no longer has kinetic energy. Where does the energy go? Does this mean that energy is not conserved? No, energy is always conserved, but some energy seems to be lost. This is energy that is output from the system.

Energy can be lost in several ways. The sound made by the balls hitting each other is one way that energy is lost. Some of the kinetic energy is converted to the kinetic energy of vibrating air particles to create sound waves. As a result, the balls slow down. However, the most common process in losing energy is through friction. Friction happens when objects rub against each other, such as when pool balls roll on a pool table. The force of friction causes the molecules of the table to move faster. When the particles move faster, the temperature of the objects increases. Since the particles are moving faster, their kinetic energy has increased. How? Kinetic energy from the moving objects (such as the rolling pool balls) is transferred to the particles. Because kinetic energy is transferred away from the moving objects, the objects slow down.

Although the energy of the cue ball is converted into kinetic energy—a result of vibrating particles in sound waves and vibrating particles of objects whose temperature increased—energy is still conserved. The sum of the particles’ energy plus all the other energy in a system will always be the same.

Check for Understanding:
1. What is the law of conservation of energy?

2. How might a system seem to lose energy?
**Penny Boat Challenge**

**Problem:** Can the shape of a boat affect the amount of buoyancy it has?

**Research:** Buoyancy is the upward force that keeps things afloat. When placed in water, an object will float if its buoyancy is greater than its weight. And it will sink if its weight is greater than its buoyancy.

"People have been aware of objects floating on water (or sinking) since before recorded history. But it was not until Archimedes of Syracuse came along, that the theory of flotation and the buoyancy principle were defined." Archimedes was a mathematician born in 287 BCE, in the city of Syracuse on the island of Sicily. Archimedes is best remembered for a discovery involving the crown of King Hiero II.

**Procedure:**
- Cut three pieces of 15 cm by 15 cm (square) aluminum foil.
- Think up a boat design and construct your boat using only one piece of the heavy duty aluminum foil.
- Pennies are the only item you may add to your boat. Your boat cannot be attached to anything.
- Slowly add pennies to your boat. Once water enters the boat, or any part of the boat touches the bottom of the container, your boat is considered sunk! (The boat must remain floating for 5 seconds before it is considered a successfully added penny... after 5 seconds you may then add another penny)
- The last penny added (that sunk the boat) will not count in the total amount held.
- Use the chart below to make sketches of your boat and to keep track of your trials, errors, and successes.

<table>
<thead>
<tr>
<th>Trial 1</th>
<th>Trial 2</th>
<th>Trial 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Prediction:</td>
<td>Prediction:</td>
<td>Prediction:</td>
</tr>
<tr>
<td>Number of pennies:</td>
<td>Number of pennies:</td>
<td>Number of pennies:</td>
</tr>
<tr>
<td>Sketch 1</td>
<td>Sketch 2</td>
<td>Sketch 3</td>
</tr>
</tbody>
</table>

**Outcome:** Successful? (Y/N)  
Actual # of pennies:  

Trial 1:  
Outcome: Successful? (Y/N)  
Actual # of pennies:  

Trial 2:  
Outcome: Successful? (Y/N)  
Actual # of pennies:  

Trial 3:  
Outcome: Successful? (Y/N)  
Actual # of pennies:  


Penny Boat Challenge
(continued)

After the competition:
• My most successful boat held __________________________ pennies.

• If each penny had the mass of 2.5 grams*, my most successful boat held
____________________ grams total.

• The independent variable is what you changed in the experiment: What is the independent
variable? ____________________________________________________________

• The dependent variable is what changed as a result of your boat design: What is the
dependent variable? __________________________________________________

• Constants are things that remained the same through each trial. Think of two things that
remained the same for each boat:
_____________________________________________________________________

• What are steps do scientists’ use in making experiments? (remember PRHEAC?)
_____________________________________________________________________

Did we use all the steps? _______

Reflection/Conclusion: Write about the strategies you used to solve this problem. What worked,
what didn’t and what would you change if you did this again?

_____________________________________________________________________
_____________________________________________________________________
_____________________________________________________________________
_____________________________________________________________________
_____________________________________________________________________
_____________________________________________________________________
_____________________________________________________________________
_____________________________________________________________________

Idea from: www.middleschoolscience.com
Session 16
Science A to Z Puzzle

| ASTRONOMY | F | I | MAERTSTE | J |
| NOFLE | HUIUC | T | G | KSERPLC |
| E | I | H | J | PRHHTI |
| R | NARIMEYRT | F | O | WBORSAE |
| ERQUAMP | I | VN | R | AHLTKECI |
| ESVOITO | SOK | NAMCOEKPLM | CUEYNRR | R | TEA |
| EQTGS | CIE | TB | JRSOCXB | MRI |
| MKYLWOIUAO | EQSOANMIY | L | X | UROTANRSO |
| PFAZKCPTRG | EXLJHLSTV | Y |
| RCOEAOYBA | IASULVOJ | UR |
| MZLISOFJX | EDEAGHDNGO | NBNKLEKNSR |
| TNMBUDEBMN | EUKTMGFIO | P |
| RIRVYR | HI | TR |
| POCXHPS | JOI | NBOGDGURKOT |
| YNRFREV | V | NN |
| GMQFC | X | C | CNLR |
| OZIVRETA | WK | LDCHEMNQTJ |
| OWARSDOCAX | EDUTILATELO |
| GYRTSIMEH | C |

Can you find 26 science terms in the puzzle?

| A | B | C | D | E | F | G | H | I | J* |
| K | L | M | N | O | P | Q | R | S* | T |
| U* | V | W | X | Y | Z |

* Indicates two words!

Challenge: Research 3 terms from the puzzle and create a trivia question for each to share with your classmates!
6th Grade
Special Education Practice
## Special Education Support

<table>
<thead>
<tr>
<th><strong>Subject</strong></th>
<th><strong>Strategy</strong></th>
</tr>
</thead>
</table>
| **Reading Fluency**    | 1. Day 1: Cold Read: Set a timer for 1 minute, ask the student to read for one minute and mark the text where they stop. After they have marked where they stopped, read the passage aloud to the student.  
2. Day 2: Choral Read: Have the student and another person read the passage together.  
3. Day 3: Practice: Set the timer for 1 minute and ask the student to read the passage for marking where they stop.  
4. Day 4: Practice: Repeat the steps for Day 3.  
5. Day 5: Hot Read: Set the timer for 1 minute, ask the student to read for one minute and mark the text where they stopped. After multiple days of practice, the student should see that they can read farther and with less errors. |
| **Reading Comprehension** | 1. Ask the student to read the text and use a writing tool to code the text using the symbols below.  
   - ! - surprising facts  
   - ? - questions they had about the event  
   - * - important information  
   - L - information that tells the location of the event  
   - P - information that describes the place of the event  
2. Ask students to share with you what they coded and why.  
3. Ask students to reread the text.  
4. Read aloud the questions to the students. Ask students to use what they read to answer the multiple choice questions. |
| **Writing**            | After reading the text, use the steps below to answer the short answer questions.  
**K-5**  
a. R: Restate the question  
b. A: Answer all parts of the questions  
c. C: Cite evidence from the text to support your answer.  
d. E: Explain how the evidence from the text supports your answer  
**6-12**  
a. Claim  
b. Support  
c. Evidence  
d. Tie-in |
| Math Calculation | Encourage students to use the following to solve math problems:  
|                 | - Number lines  
|                 | - 100 charts  
|                 | - 200 charts  
|                 | - Multiplication charts  
|                 | - Formula sheets  

Choose the tool that students are most comfortable with and apply to their problems.

| Math Problem Solving | 1. Read word problems to the student.  
|                     | 2. Ask the student to highlight or underline the important information in the problem that is needed to solve the problem.  
|                     | 3. Write a number sentence or equation to solve the problem.  
|                     | 4. Use the math tool necessary to solve the problem.  
|                     | - Number lines  
|                     | - 100 charts  
|                     | - 200 charts  
|                     | - Multiplication charts  
|                     | - Formula sheets  

Garry Golden sits in a small cafe in Brooklyn, New York. In front of him, sheets of paper with diagrams litter the table. He rapidly sketches trains, cars and highways as he explains his ideas. Garry Golden has one passion: transportation. The science of how to move people from place to place fascinates him. He spends his days studying the relationships between cars, subways, and trains. But he's most excited about imagining the way these relationships will change in the next 20 years.

Golden is a futurist. Futurists are scientists who analyze the way the world is today and use that information to make predictions about what the world will be like in the future. In this way, they are the opposite of historians, who try to better understand the present through studying the past. Futurists hope that by making scientific predictions about the future, we can make better decisions today.

Some futurists study the environment. Some study human society. Golden focuses on the study of transportation. He earned his graduate degree in Future Studies from the University of Houston. Living in Houston for those two years changed the way he viewed transportation in the United States.

Many public transportation advocates dislike Houston. They argue the city is too sprawling (it can take more than three hours to drive from one side of the city to the other during rush hour) and that there aren't enough buses and subways. However, Houston was a source of inspiration for Golden.

"Houston is a really interesting place, and their transportation is a fascinating story—it's worth watching. When you think about it, what is the U.S. like? It's more like Houston. So you need to understand how Houston approaches things to understand the country as a whole. New York City is the exception," said Golden in an interview with The New York Times.
Golden points out that people in New York City own fewer cars and walk much more than anywhere else in the United States. "It's a unique environment," says Golden. "Very different from the rest of the country."

However, Golden believes American cities will become more similar to New York City in several ways over the next 20 years. He sees a trend toward fewer cars in the future. He explains, "Cities have a cost of car ownership that is a challenge. All these vehicles cost the city: in services, in having to repair roads and all of the other things." Cars also take up a lot of space. Houston, for example, has 30 parking spaces for every resident. That's 64.8 million parking spaces in only one city.

Golden points out that having so many parking spaces is inefficient. Much of the time the parking spaces sit empty. At high-use times—for example, Saturday afternoon when everyone is running errands—every parking space at a shopping center is full. But at 3 a.m. on a Monday, no one is at the shopping center. What is the solution? "I think cities are going to start to legislate cars in very new ways," says Golden. He explains that cities will make new laws to limit the number of cars people can have within city limits. Instead, people will use taxis, subways and buses. New technology, like smartphones, can make these forms of public transportation even better.

Buses have the same problem of inefficiency as parking spaces, explains Golden. Sometimes they are full, and sometimes they are empty. But imagine if everyone had a smartphone and used them to signal when they wanted to ride the bus. Buses could change their route, depending on who wanted to ride.

How soon would these changes come? Golden admits that it will take several years. Cities can be slow to change. Also, new systems of transportation can be expensive. "But it's coming," he says. "The trend of the empowered city will be here soon."

The other trend that excites Golden is electric cars. "We need to reduce the amount of fuel we consume," says Golden. "Everyone agrees on this. The question is how to do it." Golden especially believes in the future of electric cars that have sensors to understand the world around them. "If we have cars that can communicate with one another, they can adjust speeds to eliminate traffic jams," he says. Rush hour in Houston would suddenly be much less painful.

One challenge related to the production of electric cars is that it is hard to cheaply produce batteries that are strong enough for these cars. This is partially because cars are so heavy. But Golden argues you could also make cars out of strong plastic composites. The cars would then be much lighter and much cheaper to make. "This could revolutionize the highways," he says. When could electric smart cars become the norm? Golden argues as soon as 2030.

As a futurist, Golden shares his predictions with other scholars at conferences across the country. He also provides advice to companies that want to know what the future will be like so that they can make better strategies. Golden remains optimistic about the future. "There are so many exciting developments," he says. "In thirty years we will live a very different world."
1. What is Gary Golden's one passion?
   A. Houston, Texas
   B. the environment
   C. human society
   D. transportation

2. One problem with electric cars is that they require very strong batteries. Part of the reason the batteries have to be so strong is that cars are so heavy. What solution does Golden propose for this problem?
   A. build cars out of strong plastic composites so that they are lighter
   B. find an easier and faster way to produce strong batteries for cars
   C. build cars out of lighter weight metals so they don’t need as many batteries
   D. create a way for cars to communicate with each other and adjust their speeds

3. Cars require a lot of space in cities. What evidence from the passage best supports this conclusion?
   A. Cities have to build parking spaces and repair roads for cars.
   B. Cities may limit the number of cars people can have within the city.
   C. In Houston, there are 30 parking spaces for every resident.
   D. Parking lots at shopping centers are not full all of the time.

4. Based on Garry Golden's predictions, how can transportation systems of the future best be described?
   A. expensive and complicated
   B. high-tech and efficient
   C. high-tech yet impractical
   D. inexpensive yet outdated
5. What is this passage mostly about?
   A. how one futurist thinks transportation will change in the coming years
   B. reasons why cars cost the city money and are an inefficient use of resources
   C. how to improve electric cars so that they are more widely used and available
   D. a comparison of public transportation systems across the United States

6. Read the following sentences: "Houston, for example, has 30 parking spaces for every resident. That's 64.8 million parking spaces in only one city. Golden points out that having so many parking spaces is inefficient. Much of the time the parking spaces sit empty. At high-use times—for example, Saturday afternoon when everyone is running errands—every parking space at a shopping center is full. But at 3 a.m. on a Monday, no one is at the shopping center."

   As used in this sentence, what does the word "inefficient" most nearly mean?
   A. productive without wasting time and materials
   B. successful and effective
   C. imaginative and creative
   D. wasteful of space and materials

7. Choose the answer that best completes the sentence below.

   Historians study the past in order to better understand the present. ___________, futurists analyze the present in order to make scientific predictions about the future.

   A. In particular
   B. Such as
   C. In contrast
   D. Ultimately
8. What does Garry Golden spend most of his days studying?


9. Buses are currently inefficient. According to Golden, how could this type of transportation be improved?


10. Explain how communications technology (such as smartphones and sensors) could help improve transportation in the future. Support your answer using information from the passage.


Into the Wilderness Alone

Shauna looked forward to the camping trip. She and the other campers had spent weeks preparing for the trip by learning how to survive in the wilderness. They had practiced the different skills needed for surviving forty-eight hours alone while avoiding hypothermia, dehydration, and hunger.

Shauna and the other campers sat down with their camp leaders, Jill and Maria, to discuss priorities in the wilderness. Shauna was hoping that she would not need to trap any animals because she hadn’t yet mastered tracking or trapping.

As the Sun set over the camp, the campers boarded the van that would deliver them to a remote area far from even the nearest house. Maria dropped Shauna at the first stop and said, “Here are a small knife, a wool blanket, and an empty water bottle.” She put her hand on Shauna’s shoulder and added, “I know you can do this.”

Shauna smiled nervously and nodded. Then she turned away to head into the forest and sprinkle shells to mark a trail.
“Well, I’d better find a clearing to build a fire.” A chill crept up Shauna’s spine. “Feels like it may be cool tonight.”

Shauna walked a bit farther and noticed an opening in the forest and a small, slow-moving creek. She gathered kindling and dry wood and searched carefully for a piece of flint. “Gotcha!” she said, reaching down.

Shauna methodically scraped some shavings with her knife to make a nest. She knelt down and began to strike the flint against her knife. Her eyes focused on the flint and blade as she worked diligently—she needed them to spark. After what seemed like an hour, she felt defeated. “Why is this so hard? I’ve started at least a dozen campfires this summer.”

Shauna began to panic as the dark and chill set in. Finally, sparks flew and hit the shavings, and smoke began to rise.

Shauna smiled, admired her accomplishment, and wiped the sweat from her forehead. Sweat and cold air would have been a dangerous combination with no fire. Shauna stood and approached the creek. She crouched and scooped up water in her hand. She tested the water
Identifying True and False Ratio Statements

Determine which statement or statements are true. If none write 'none'.

1) diet sodas = 2, regular sodas = 9
   A. The ratio of diet sodas to regular sodas sold is 2:9
   B. The ratio of diet sodas to regular sodas sold is 9:2
   C. For every 2 diet sodas sold there are 9 regular sodas sold
   D. The ratio of regular sodas to diet sodas sold is 9:2

2) large popcorons = 6, small popcorons = 9
   A. The ratio of large popcorons to small popcorons sold is 9:6
   B. For every 6 large popcorons sold there are 9 small popcorons sold
   C. For every 6 small popcorons sold there are 9 large popcorons sold
   D. The ratio of small popcorons to large popcorons sold is 9:6

3) nails used = 6, bird houses built = 2
   A. The ratio of bird houses built to nails used was 2:6
   B. For every 6 nails used there were 2 bird houses built
   C. The ratio of nails used to bird houses built was 6:2
   D. For every 2 bird houses built there were 6 nails used

4) pushups = 4, sit-ups = 5
   A. For every 5 sit-ups done there were 4 pushups done
   B. The ratio of pushups done to sit-ups done is 5:4
   C. The ratio of sit-ups done to pushups done is 5:4
   D. The ratio of pushups done to sit-ups done is 4:5

5) texts sent = 8, calls made = 5
   A. The ratio of texts sent to calls made was 8:5
   B. The ratio of texts sent to calls made was 5:8
   C. For every 5 texts sent there were 8 calls made
   D. For every 8 calls made there were 5 texts sent

6) cats = 2, dogs = 8
   A. For every 8 cats there are 2 dogs
   B. The ratio of cats to dogs is 2:8
   C. The ratio of dogs to cats is 8:2
   D. The ratio of cats to dogs is 8:2
<p>| | | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>$\frac{29}{5} + 9 \frac{1}{2}$</td>
<td>2</td>
<td>$\frac{2}{3} \div 7 \frac{1}{2}$</td>
</tr>
<tr>
<td>4</td>
<td>$\frac{3}{4} \div \frac{3}{5}$</td>
<td>5</td>
<td>$\frac{17}{3} + \frac{14}{5}$</td>
</tr>
<tr>
<td>7</td>
<td>$\frac{23}{3} \div 6 \frac{2}{5}$</td>
<td>8</td>
<td>$\frac{1}{3} + \frac{1}{4}$</td>
</tr>
<tr>
<td>10</td>
<td>$6 \frac{1}{2} + \frac{34}{4}$</td>
<td>11</td>
<td>$7 \frac{1}{2} \div 26 \frac{5}{6}$</td>
</tr>
</tbody>
</table>

**Answers**

1. 
2. 
3. 
4. 
5. 
6. 
7. 
8. 
9. 
10. 
11. 
12. 

Math  
www.CommonCoreSheets.com
Dividing Fractions

Answer as a mixed number (if possible).

1) \(\frac{29}{5} \div \frac{9}{2} = \) \(\frac{26}{3} \div \frac{7}{2} = \)
   \(\frac{2}{3} \div \frac{2}{4} = \)
   \(\frac{29}{5} \cdot \frac{2}{19} = \frac{58}{95} \)
   \(\frac{26}{3} \cdot \frac{2}{15} = \frac{52}{45} \)
   \(\frac{2}{3} \cdot \frac{4}{2} = \frac{8}{6} \)

2) \(\frac{3}{4} \div \frac{9}{5} = \)
   \(\frac{17}{3} \div \frac{14}{5} = \)
   \(\frac{17}{2} \div \frac{14}{3} = \)
   \(\frac{3}{4} \cdot \frac{5}{3} = \frac{15}{12} \)
   \(\frac{17}{3} \cdot \frac{5}{14} = \frac{85}{42} \)
   \(\frac{17}{2} \cdot \frac{3}{14} = \frac{51}{28} \)

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4) \(\frac{6}{2} \div \frac{34}{4} = \)
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7th Grade Special Education Practice
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| Reading Fluency      | 1. Day 1: Cold Read: Set a timer for 1 minute, ask the student to read for one minute and mark the text where they stop. After they have marked where they stopped, read the passage aloud to the student.  
2. Day 2: Choral Read: Have the student and another person read the passage together.  
3. Day 3: Practice: Set the timer for 1 minute and ask the student to read the passage for marking where they stop.  
4. Day 4: Practice: Repeat the steps for Day 3.  
5. Day 5: Hot Read: Set the timer for 1 minute, ask the student to read for one minute and mark the text where they stopped. After multiple days of practice, the student should see that they can read farther and with less errors. |
| Reading Comprehension| 1. Ask the student to read the text and use a writing tool to code the text using the symbols below.  
   - ! - surprising facts  
   - ? - questions they had about the event  
   - * - important information  
   - L - information that tells the location of the event  
   - P - information that describes the place of the event  
2. Ask students to share with you what they coded and why.  
3. Ask students to reread the text.  
4. Read aloud the questions to the students. Ask students to use what they read to answer the multiple choice questions. |
| Writing              | After reading the text, use the steps below to answer the short answer questions.  
**K-5**  
   a. R: Restate the question  
   b. A: Answer all parts of the questions  
   c. C: Cite evidence from the text to support your answer.  
   d. E: Explain how the evidence from the text supports your answer  
**6-12**  
   a. Claim  
   b. Support  
   c. Evidence  
   d. Tie-in |
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<tr>
<th>Math Calculation</th>
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<tr>
<td>Encourage students to use the following to solve math problems:</td>
<td>1. Read word problems to the student.</td>
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<tr>
<td>• Number lines</td>
<td>2. Ask the student to highlight or underline the important information in the problem that is needed to solve the problem.</td>
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<td>• 100 charts</td>
<td>3. Write a number sentence or equation to solve the problem.</td>
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<td>• 200 charts</td>
<td>4. Use the math tool necessary to solve the problem.</td>
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Choose the tool that students are most comfortable with and apply to their problems.
Dennis and Mac had been driving for almost a week, and they hadn't seen a single soul. They were worried. When they'd left the ranch, they'd thought maybe they'd run into someone, another survivor. But there was no one. The roads were almost empty. There was the occasional abandoned car, but that was it. They drove mostly on highways, to make better time. Mac wondered if they might not have better luck on the smaller country roads, but Dennis wouldn't have it. Those roads had curves and were thick with trees. There was no way of seeing danger coming. If someone wanted to spring a surprise on you, you wouldn't know it until it was too late.

When the plague came, Dennis and Mac had been working as ranch hands on a cattle farm. Both had just finished their first year of college. Dennis went to school on the East Coast, Mac on the West. They found that they were very similar people. They both studied hard and read a lot of books. But they also both liked being outdoors. At the end of a good day, they came home smelling of sweat and dirt. They quickly became friends.

The ranch was a small, family-run operation, with only about 50 head of cattle. The family that ran it, the Greersons, would advertise in college newspapers in the spring. There were plenty of ranch hands in the area who needed work, but Bucky Greerson felt city kids could benefit from an exposure to country life. Young men would apply, and then the Greersons would hire about a half-dozen hands every spring to help them run cattle. It was tough work, but Dennis and Mac felt lucky to be picked.

The farm didn't have a TV or the Internet or a telephone. As a result, the first they heard of the plague was on the radio. Every night, the ranch hands liked to gather in the mess hall and play cards. While they played, they listened to the radio. The ranch was so far up in the hills that the radio only got one station. At night they listened to the station's best DJ, Petey "The Muskrat" Coltrain, who spun old bluegrass records. Sometimes, between records, The Muskrat told stories. Dennis and Mac thought he was hilarious.

One night, though, The Muskrat's radio show was very different. It couldn't have been more than six months ago, but to Dennis and Mac, thinking back on it now, it felt like another lifetime. The Muskrat had been playing a cheery Bill Monroe song, "Footprints in the Snow," when he cut out the record halfway through the chorus. The ranch hands stopped their game of Gin Rummy. They turned and looked at the radio. The Muskrat always played a record all the way through. What could be wrong?

"Folks," said the Muskrat. "I don't know how to tell you this, but I'm going to ask you to stay very calm."
asking us radio folks to tell you, our listeners, that... well, a disease is spreading."

The ranch hands put down their cards. Dennis and Mac exchanged a glance.

"Now," The Muskrat said, his rich voice sounding uncharacteristically shaky, "they don't quite know what this disease is, but it's real bad. It's very contagious, and people who get it don't have a lot of luck recovering. Now, doctors are trying to figure out a cure, but there's been no luck yet. So, in the meantime, we're asking that you stay in your homes as much as possible and avoid public places until the disease dies down."

One of the ranch hands, a big, cocky boy named T.J., laughed. "Like heck I'm not going into town," T.J. chuckled. "I got a date." The other ranch hands stared at him. T.J. stopped laughing.

"Please, folks, do what the doctors say," The Muskrat pleaded. "I'm sure it'll just be for a few days." He was quiet for a moment. Then the ranch hands heard the sound of a turntable needle hitting the record, and an old Earl Scruggs song came on.

That was the beginning of it. For the next few days, the ranch went about its business. The Greersons told the boys not to worry, that this would all be over soon. They had enough food on the ranch to last months. In the meantime, there were plenty of new calves that needed branding. At night, everyone gathered around the radio and listened to updates. The news seemed only to get worse. More and more people were getting sick. The symptoms were strange. People would become violently ill, then fall into a long, deep sleep. The big cities - New York, Los Angeles, Chicago - had become like ghost towns. No one would go out into the street for fear of catching the disease.

The news kept getting worse until, finally, the radio station stopped transmitting. The Greersons called a meeting in the dining room of the main house. Everyone sat around the big dining room table where Ann Greerson served Sunday supper. After everyone was seated, Bucky Greerson stood up. He was a short, plump man with a droopy handlebar mustache. You wouldn't think it looking at him, but his voice boomed.

"Now," he said, "I know you're worried about your families, and I don't feel right chaining you here while you don't know what's become of your people. So, anyone who wants to leave is free to go. Ann and I will make do."

Dennis and Mac looked at each other. They'd talked about leaving but had tried to pretend they wouldn't need to. They had hoped the plague would be over soon, that the world would return to the way it was, that it had all been a strange hallucination. Now that they had the option to venture out into the world, to see how bad things really were, they weren't sure they wanted to know.

"By a show of hands," Bucky Greerson asked, "how many of you want to leave?"

Mac and Dennis looked around. They were the only two with their hands up.

The Greersons gave them enough food to last a couple weeks - corn bread and apples and cured ham and syrupy peaches in mason jars. Mac and Dennis packed up their things and loaded everything into Mac's truck, a sputtering old pickup. The Greersons and the ranch hands gathered around to see them off.

"Be safe, boys," said Ann Greerson, kissing them each on the cheeks and hugging them hard. "And
remember your manners." As Mac and Dennis pulled away, they saw her husband holding her, her body shaking with sobs.

A week later, Mac and Dennis had zigzagged through dozens of small towns and a few larger cities. What they found frightened them: every place was empty. Not a person was out. Sometimes, they would stop and knock on doors. No one would answer. If they went inside, they wouldn't find a single soul home. Sometimes they'd find the dinner table set, plates piled high with molding food. Every time they entered a new room, they both winced, thinking they'd find a dead body. But they never did. It was indescribably eerie.

Sometimes, if the place still got electricity, they'd try to use the phone. Every time, no matter what number they dialed, the same recorded message came on: "The number is not in service. Please check the number and try again."

Finally, the young men decided to make tracks to the nearest big city. It would be a full day of driving, but there had to be someone there. You can't abandon a whole city.

Dusk had come, and Mac was at the wheel. Dennis had been driving for the last eight hours and was taking a nap in the passenger seat. They were passing through a long, flat piece of pastureland when Mac saw a flicker of movement in the distance. He stopped the car, turned off the engine and shook Dennis awake.

"Look," Mac said excitedly. "I think someone's coming."

Dennis squinted his eyes. The flicker of movement was becoming larger. What had been a dot of motion became a long line, stretching across the horizon. Mac and Dennis strained to see.

"I think it's some people," said Dennis. "Let me get my binoculars."

He rustled in his backpack and pulled out his pair. Dennis put them to his eyes and looked through them. Mac heard him gasp.

"My gosh," whispered Dennis.

What he saw was people. Thousands of people. Hundreds of thousands, maybe a million. A swarm of people like the world had never seen. And the people were all running. They were running as fast as they could go, like something was chasing them, or like they were chasing something. As they grew closer, Dennis could just make out the people's faces. Their eyes were wild.

"Start the car," said Dennis.

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Ed.: The tale continues in Part 2, "Refueling."
1. What news do Dennis and Mac hear on the radio while at the ranch?
   A. There is a cattle farm that hires young men to work over the summer.
   B. Thousands of people are running as fast as they can across the country.
   C. There is a bad disease spreading among people.
   D. Food is getting moldy on dinner plates because people are not staying at home.

2. What is the sequence of events at the beginning of this story?
   A. The story begins after the disease has struck and then takes the reader back in time to a point before the disease.
   B. The story begins before the disease has struck and then takes the reader forward in time to a point after the disease has ended.
   C. The story begins as the disease is striking and then takes the reader back in time to a point before the disease.
   D. The story begins as the disease is striking and then takes the reader two years into the future.

3. The Muskrat says that the disease is "real bad."

   What evidence in the story supports his statement?
   A. T.J. wants to go into town even though The Muskrat has advised people to stay in their homes.
   B. After The Muskrat warns people about the disease, an old Earl Scruggs song comes on the radio.
   C. The Greersons tell the boys not to worry, saying that the disease will end soon.
   D. The disease is very contagious, and doctors have not been able to figure out a cure.

4. Why do Dennis and Mac decide to drive to the nearest big city?
   A. They want to find a person.
   B. They are running out of food and need more.
   C. They see thousands of people running.
   D. They both like being outdoors.
5. What is this story mainly about?
   
   A. a married couple who own a ranch, the young men they hire to work for them one summer, and the music they listen to together
   
   B. two young men, a mysterious disease, and what happens when they go out to explore after the disease hits
   
   C. a radio DJ, the music he Likes to play, and the effect that his song choices have on the people who listen to them
   
   D. a long line of people running through a flat piece of pastureland and what happens when two young men see them

6. Read the following sentence: "More and more people were getting sick. The symptoms were strange. People would become violently ill, then fall into a long, deep sleep."

What does the word symptoms mean?

   A. fears of getting sick
   
   B. signs of a disease
   
   C. serious injuries
   
   D. suggestions that doctors give to patients

7. Choose the answer that best completes the sentence below.

Dennis and Mac are frightened after leaving the ranch _______ the towns and cities they visit have no people in them.

   A. although
   
   B. as a result
   
   C. because
   
   D. however