# Prealgebra Parent Study Guide

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## Chapter 1 Big Idea #1: Order of Operations

In an expression that uses more than one operation, the order of operations tells which operations must be done before the others.

1—Work through all grouping symbols (parentheses ( ), brackets [ ] { }, fraction bar) first from the inside out

2—Simplify all exponents

3—Do all multiplication and division in order from left to right

4—Do all addition and subtraction in order from left to right

**Example:**

$$10[8(15-7)-4\cdot 3]$$
$$10[8\cdot 8-4\cdot 3]$$
$$10[64-4\cdot 3]$$
$$10[64-12]$$
$$10\cdot 52$$
$$520$$

**Tip for helping students remember:** Please Excuse My Dear Aunt Sally (Parentheses, Exponents, Multiply & Divide, Add & Subtract) or PEMDAS

**Tip for helping students work through a problem:** Have them circle the step they are going to do next each time

**Common errors to watch for:**

1—Students often forget that multiplication & division (and addition & subtraction) are "equal" in importance and are done in the order they appear in the problem, many students think that multiplication always gets done before division (and the same with addition before subtraction) since they come first in the list. I tend to use the illustration that you can't say the words "multiplication" and "division" at the same time, but if you could, that is what you really mean.

2—Students do not always realize that a fraction bar has the same meaning as parentheses. The expression $\frac{5+7}{2}$ is another way of writing $(5+7)\div 2$. Either way, the addition must be done first because $5+7$ is within the grouping symbol, then the answer is divided by 2.

3—A number "smooshed" next to a grouping symbol means to multiply.

## Chapter 1 Big Idea #2: Variables

A variable can be thought of as a placeholder until you either are given a number to substitute for it (in an expression) or you determine what the value must be (in an equation).

**Example:** (In an expression) Evaluate 3 + m, when m = 6. 3 + 6 = 9
(In an equation) Solve 5y = 35. y = 7 because 5 times 7 equals 35.

**Common errors to watch for:**

1—Students often forget that a number "smooshed" next to a variable or two variables "smooshed" together mean to multiply. (This is just a shortcut that mathematicians use instead of writing the multiplication sign each time.) Typically the number is written first (9y rather than y9) and variables are written in alphabetical order (ab rather than ba). It is not incorrect to reverse the order, but it is more convenient and more accepted, and will make things easier as the expressions and equations get more complex later.

2—Generally variables are written as lowercase letters (except in some specific formulas). It is recommend not to use the letters "o," "i," "s," or "l" as variables when writing by hand because of their likeness to numbers.

**Note:** In chapter 3 we will get much more formal with the work that students are required to show as part of solving an equation.

## Chapter 1 Big Idea #3: Distributive Property

When an addition or subtraction expression is multiplied by a number, each term (part) of the expression must be multiplied by that number.

**Example:** Simplify $3(n+8)$. $3 \bullet n + 3 \bullet 8 = 3n + 24$

**Tip for helping a student remember:** When you eat French fries, do you put all of the salt on one fry or do you evenly DISTRIBUTE the salt to all of the fries? (Or chocolate chips in a batch of cookies, etc.)

**Common Errors to watch for:**

1—Students tend to remember to multiply by the first term, but not the others (and would get an answer like $3n + 8$ for the example above). Drawing an arrow from the number or variable to each term that it is to be multiplied by before doing anything else may help.

2—The distributive property is true for both addition and subtraction and is true whether the number to be multiplied is in front of the parentheses (as above) or behind them (for example: $(4 - y)6 = 4 \bullet 6 - y \bullet 6 = 24 - 6y$)

## Chapter 2 Big Idea #1: Addition of Integers (Positive & Negative Numbers)

Case 1: When adding two numbers with the same sign (both positive or both negative), ignore the signs, add the numbers, put the sign on the answer that was on both numbers.

Case 2: When adding two number with different signs (one positive, one negative), ignore the signs, subtract the smaller number from the larger number, put the sign of the larger number on the answer.

**Tip for helping students work through a problem:** Use a manipulative of some kind to help students see that one positive and one negative make a pair that equals zero and that their answer is whatever remains when the zeros are removed.

**Notes:**

1—When you "ignore the signs" you are really using the "absolute value" of the number. The absolute value of a number is its distance away from zero on the number line.

2—When adding more than two numbers, add the first two, then add the third to that answer, etc.

## Chapter 2 Big Idea #2: Subtraction of Integers

Subtraction means "add the opposite," so to do a subtraction problem, change the subtraction sign to an addition sign and change the number after the subtraction sign to its opposite (if it was positive, make it negative; if it was negative, make it positive). Now you have an addition problem and can follow the addition procedure that has already been learned.

**Examples:** $-5 - 4 = -5 + -4 = -9$ $\qquad$ $7 - -9 = 7 + +9 = 16$

**Tip for helping students work through a problem:** Require them to make two marks in a row on each problem (in a colored pencil or pen), one to change the subtraction sign to an addition sign and one to change the sign of the number after the subtraction sign to its opposite.

**Common error to watch for:**

Students tend to remember to change subtraction to addition but forget what else to change. Sometimes they don't change the number after the subtraction sign to its opposite and sometimes they change the number before the subtraction sign to its opposite instead. Using the tip above will help.

## Chapter 2 Big Idea #3: Multiplication and Division of Integers

Multiplication and Division use the same "rules."
Case 1: If the numbers have the same sign, the answer will be positive.
Case 2: If the numbers have different signs, the answer will be negative.

**Example:** POSITIVE times/divided by POSITIVE is POSITIVE
POSITIVE times/divided by NEGATIVE is NEGATIVE
NEGATIVE times/divided by POSITIVE is NEGATIVE
NEGATIVE times/divided by NEGATIVE is POSITIVE

**Tip for helping students remember:**
Signs match = positive
Signs don't match = negative
(Similar to randomly pulling two socks out of your sock drawer—do they match and make a pair or not?)

**Common error to watch for:**
Students tend to get confused with the addition and subtraction rules and focus on the size of the numbers rather than the matching of the signs.

## Chapter 3 Big Idea #1: Solving Equations

When a variable is acting as a placeholder in a linear equation (a linear equation has only one variable and the variable does not have an exponent other than 1) there is only one possible value for that equation. We must solve the equation to determine the value of the variable (we need to end up with the variable by itself on one side of the equal sign with a number on the other side of the equal sign). To maintain the integrity of the equals sign, we must use various mathematical properties and apply the same procedures on each side of the equal sign.

**Example:**

Solve f + 31 = 5. To get the f by itself where we now have f + 31, we must undo that addition by doing its opposite/inverse operation, subtraction. So to solve this equation we would subtract 31 from f + 31 and to maintain the integrity of the equal sign, we would also subtract 31 from 5. The result is the solution f = -26. A teacher would expect to see the following work from the student:

f + 31 = 5
-31 -31 (some teachers may want to see this as + -31 instead of -31)
f = -26

Additional examples of what the teacher may expect to see:

| | | | |
|---|---|---|---|
| m – 3 = -10 | 16 = h – (-4) | 14x = 224 | $\frac{c}{6} = -29$ |
| +3 +3 | + -4 + -4 | 14 14 | |
| m = -7 | 12 = h | x = 16 | $6 \bullet \frac{c}{6} = -29 \bullet 6$ |
| | | | c = -174 |

**Tip for helping students remember:**

1—An equation can be thought of as a teeter-totter with the = sign being the balance point in the middle. Whatever you do to one side, you must do to the other (or you have caused your friend to be flown off the teeter-totter). You must keep the equation in balance by always doing the same things to both sides of the = sign.

2—Most teachers look for four things when they check the work for an equation.

1. Work shown on the left side of the equal sign
2. Work shown on the right side of the equal sign
3. "x =" in the solution line (or whatever the variable is for the equation)
4. The correct answer

If the student gets in the habit of checking that all four of these things are in place, that should really help.

**Tip for helping students work through a problem:** Most errors in solving equations come from the students trying to take short cuts and not write out every step. Encourage them to write every single step down, that will help them stay focused. (Also see note below.)

**Common errors to watch for:**
1—Not undoing the equation with the correct operation. If the equation is written with addition, you must subtract. If the equation is written with subtraction, you must add. If the equation is written with multiplication, you must divide. If the equation is written with division, you must multiply.
2—Not showing enough work and getting confused (or simply losing points for not following directions).
3—Students sometimes get confused if the variable is on the right side of the equal sign rather than the left. They think the process must be different because of the location, but it is not different at all.

**Note:** Much of the work that students will do over the next few years of their math careers will involve solving (a.k.a. balancing) equations, so it is important that they learn this process now. Teachers will require students to show all of the work involved in balancing the equation, even on equations that students could solve in their heads. Teachers may even assign points to an assignment or quiz or test item based on the correct work being shown in addition to or instead of ending up with the correct solution. Learning how to reason through the problem and show their work are key to later being able to solve more complex equations. Please help us reinforce that they are learning a process, not just trying to get the right answer.

## Chapter 3 Big Idea #2: Solving Inequalities

An inequality looks just like an equation except that instead of containing an =, it contains one of the inequality symbols ($<, >, \leq, \geq$). The process for solving an inequality is the same as for solving an equation, with the following exceptions:

1—The solution should contain the inequality sign rather than the equals sign

2—If the inequality is written with the variable on the right side rather than the left and the student switches it to make it more comfortable for them to solve, they must also remember to switch the inequality symbol so that it keep "pointing" at the variable correctly (we DO NOT recommend using this strategy, it adds one more place for a student to make a mistake).

3—If you must multiply or divide both sides by a negative number to arrive at the solution, then you MUST flip the inequality symbol around (change less than to greater than or vice-versa).

**Example:**

| | | | |
|---|---|---|---|
| $x - 2 < -14$ | $4 > y + 23$ | $\frac{72}{-4} \geq \frac{-4k}{-4}$ | $\frac{144}{9} < \frac{9k}{9}$ |
| $+2 \quad +2$ | $-23 \quad -23$ | | |
| $x < -12$ | $-19 > y$ | $-18 \leq k$ | $16 < k$ |
| | | (Divided by -4, so the sign had to flip) | |

**Tip for helping students remember: Have students check through the four-point checklist again.**

1. Work shown on the left side of the equal sign
2. Work shown on the right side of the equal sign
3. Variable and correct inequality symbol in the solution line
4. The correct answer

**Tip for helping students work through a problem:** Continue to reinforce showing all work. Usually if a student shows all of the work, they will remember how to correctly do the problem.

**Common errors to watch for:**

1—Students may need reminders that solving an inequality is the same process as solving an equation.

2—Students get confused about when to flip the inequality sign around and flip it when they shouldn't and forget to flip it when they should.

## Chapters 5 Big Idea #1: Rational Number Vocabulary (Lesson 5.1)

One of the indicators in the $8^{th}$ grade Kansas Math Standards (and therefore the Kansas Math Assessment) is that students can correctly classify numbers as Rational Numbers, Integers, Whole Numbers and Natural Numbers.

| Term | Definition | Examples |
|---|---|---|
| Rational Number | Any number that can be written as a fraction | 4, -8, 2.5, -14.9, 0, $\frac{4}{3}, \frac{23}{28}$ |
| Integer | Any number, positive or negative or 0, that does not have a decimal or fraction "attached to it" | {…-3, -2, -1, 0, 1, 2, 3, …} |
| Whole Number | Any number, beginning with 0, that does not have a decimal or fraction "attached to it" | {0, 1, 2, 3, 4, …) |
| Natural Number | Any number, beginning with 1, that does not have a decimal or fraction "attached to it," they are also called the "Counting Numbers" because they are the numbers we use to count | {1, 2, 3, 4, 5, …} |

**Common errors to watch for:**

The various groups are subsets of each other. Students need to realize that a number can be (and usually is) in multiple groups.

**Tip for helping students remember:**

(Created by Kathy Zigeler, Mission Valley Middle School)

# <u>N</u>OW <u>W</u>E <u>I</u>NDEED <u>R</u>EMEMBER

Real Numbers

**N** Natural Numbers = No Zero

**W** Whole Numbers = With Zero

**I** Integers = - |←——————→| +

**R** Rational Numbers = ~~F~~ra~~c~~tional

**IR** means NOT = **IRRATIONAL** = Not any of the above

## Chapters 5 & 6 Big Idea #2: Arithmetic with Fractions

Even thought they have worked on adding, subtracting, multiplying and dividing fractions for several years, they still have trouble with it—and we make it much more complicated in prealgebra!

**What's the difference this year?**

1—The fractions can now be negative or positive (which means they have to combine what they know about fractions and negative numbers into the same problem)

2—The fractions can now be attached to variables (which means they have to combine what they know about fractions and combining like terms to simplify expressions)

3—They will be expected to solve equations containing fractions (which means they have to combine what they know about fractions and solving equations)

4—It is generally ok to have improper fractions as answers (in Algebra students need to use improper fractions rather than mixed numbers and they have a difficult time changing their mindset from elementary school)

## Chapters 5 & 6 Big Idea #3: Measures of Central Tendency (Lesson 6.6)

The term "measures of central tendency" is the umbrella term for any statistic that will tell you something about the middle of a set of data. **Mean**, **median** and **mode** are all measures of central tendency (there are others, but this is all we focus on in middle school).

| Term | Definition | Example | Commonly referred to (way to easily remember) |
|---|---|---|---|
| Mean | The sum of the data divided by the number of pieces of data. | 4, 5, 7, 7, 9, 10, 12<br>4+5+7+7+9+10+12=54<br>54/7 ≈ 7.71 | Average* |
| Median | The number in the middle when the data are arranged in order. When there are two middle numbers, the median is their mean. | 4, 5, 7, 7, 9, 10, 12<br>7 is the middle<br><br>2, 3, 6, 7, 9, 10, 13, 15<br>7 and 9 are the middle<br>Mean of 7 and 9 is 8<br>So median is 8 | Middle |
| Mode | The number or item that appears most often | 4, 5, 7, 7, 9, 10, 12<br>7<br><br>2, 4, 6, 8, 9, 12, 14<br>No number appears more than others so there is no mode<br><br>3, 4, 5, 7, 9, 9, 10, 11, 11<br>9 and 11 both appear twice, so 9 and 11 are both modes of this data | Most often |

* Note: Technically mean, median and mode are all "averages." We commonly refer to mean as the average, but on the Kansas Assessment the term "average" can be used to refer to any of the three, not necessarily the mean. This is something of which students need to be aware.

**Common error to watch for:**

When finding the median, students often forget to be sure that the data is in order before finding the number in the middle of the list.

**"We've done this since third grade, what's the difference this year?"**
In middle school our focus is not so much on being able to find the mean, median or mode for a set of data, but rather to be able to use the statistics appropriately and to study the effect of one piece of data on the mean, median and/or mode for the data set. Below are examples of the types of questions students will be asked:

(page 304 #3) Arrange 50 pennies from oldest to newest.

a. Find the mean, median and mode for the year the coins were minted.
b. Based on your sample of pennies, what can you say about all pennies in circulation?
c. Compare your results with the rest of the class and check your conclusion in part b.

(page 306 #28) The table at the right shows the earnings for women for every $100 earned by a man in the same occupation for two years.

a. Find the mean, median and mode of the earnings for each year.
b. Compare the averages for the two years. What might you conclude about the changes in women's employment situations from Year 1 to Year 2? Explain.

(page 305 #20) (Students are given a chart of student test scores.)

a. What is Colleen's mean on the five tests?
b. How does Colleen's mean affect the class mean?

## Chapter 7 Big Idea #1: Solving Multiple-Step Equations

This unit combines solving equations (chapter 3) with the order of operations (chapter 1) and throws in some work with integers, fractions and decimals (chapters 5 and 6). *Attention to detail and careful work will be key to success in this unit.*

Students will solve equations such as the following:

$4a - 10 = 42$ $\qquad$ $12 - 6y = 2y + 36$ $\qquad$ $3(z-2) + 6 = 5(z+4)$

**Key points:**

- To solve an equation, you must "undo" what was done in the equation by using the inverse operation (if 10 was subtracted in the equation, you must add 10; if 6 was multiplied in the equation, you must divide by 6).
- If the expressions that make up the equation can be simplified, simplify them before trying to solve the equation ( 3(z-2) can be simplified to 3z-6 before working through the equation).
- When the equation involves more than one operation, you must work through the operations in the reverse order of the order of operations. First, undo any addition and subtraction; then undo multiplication and division.

**What the teacher will probably expect to see:**

| | | |
|---|---|---|
| $4a - 10 = 42$ | $12 - 6y = 2y + 36$ | $3(z - 2) + 6 = 5(z + 4)$ |
| $\underline{\quad +10 \quad +10}$ | $\underline{\quad +6y \quad +6y}$ | $3z - 6 + 6 = 5z + 20$ |
| $\frac{4a}{4} = \frac{52}{4}$ | $12 = 8y + 36$ | $3z = 5z + 20$ |
| $a = 13$ | $\underline{-36 \qquad -36}$ | $\underline{-5z \quad -5z}$ |
| | $\frac{-24}{8} = \frac{8y}{8}$ | $\frac{-2z}{-2} = \frac{20}{-2}$ |
| | $-3 = y$ | $z = -10$ |

Requiring students to write all of their work down is not just our way of being mean! Writing each step down will help students keep straight what they have done and what needs to be done next. As the equations get more complicated the need to track what has been done will be increasingly important. (And they are more likely to end up with incorrect answers if they do not write each step!)

## Chapter 8 Big Idea #1: Graphing Linear Equations

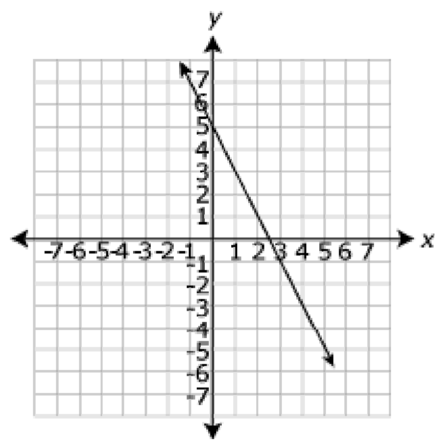
All equations with two variables (usually x and y) that do not have exponents on the variable are called **linear equations** because when graphed on a coordinate plane (grid) they are straight lines. Examples are $x - y = 3$, $4x + y = -10$, $x + 8y = 32$. These equations have an infinite number of solutions. Visually those solutions are represented as points on the line when the equation is graphed.

**Graphing Lines:**

- Students will use a t-chart (a.k.a. table) of values to graph a line.
- They will be given an equation, such as $y = -2x + 5$ and asked to make a table showing three or four solutions to the equation. For example:

| x | y |
|---|---|
| -1 | 7 |
| 0 | 5 |
| 1 | 3 |
| 2 | 1 |

- Then they will plot the points shown in their table and connect the points with a line.




- They will be expected to know that points that lie on the line are solutions to the equation and points that do not lie on the line are not solutions to the equation.
- They will also be expected to use their graphs to solve real-world problems.

**Common errors to watch for:**

Silly mistakes like ignoring negative signs, plotting points incorrectly (counting up for the x value instead of over), being sloppy when drawing their lines, etc.

# Chapter 8 Big Idea #2: Slope of Lines

The slope of a line describes the direction and the steepness of the line.

**Formula for Slope**

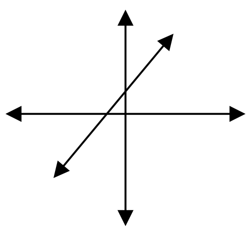
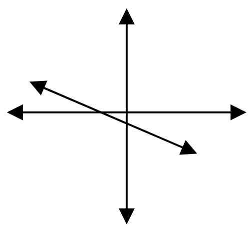
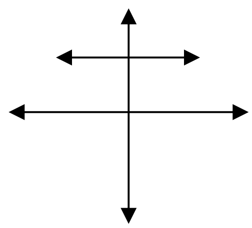
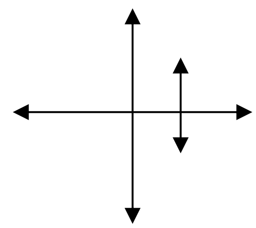
$$Slope = \frac{rise}{run} = \frac{change-y}{change-x} = \frac{y_1 - y_2}{x_1 - x_2}$$

The abbreviation for slope is *m*

(In other words, for each "step" <u>up</u> to move from one point to the next, how much do I move <u>over</u>?)

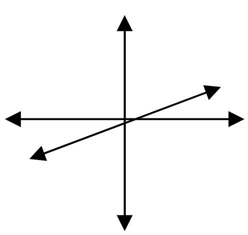
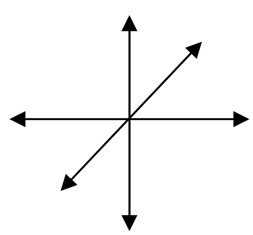
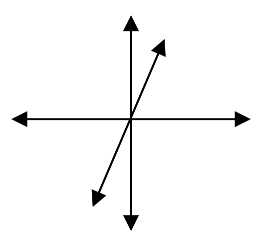
**Slope as Direction**

The slope of a line can be positive, negative, zero or undefined (no slope).

| Positive Slope | Negative Slope | Zero Slope | Undefined Slope |
|---|---|---|---|
|  |  |  |  |
| A line that goes up from left to right has positive slope | A line that goes down from left to right has negative slope | A horizontal line has a slope of zero because there is no "rise" (giving you a fraction with zero in the numerator) | A vertical line has an undefined slope because there is no "run" (giving you a fraction with zero in the denominator, which is impossible) |

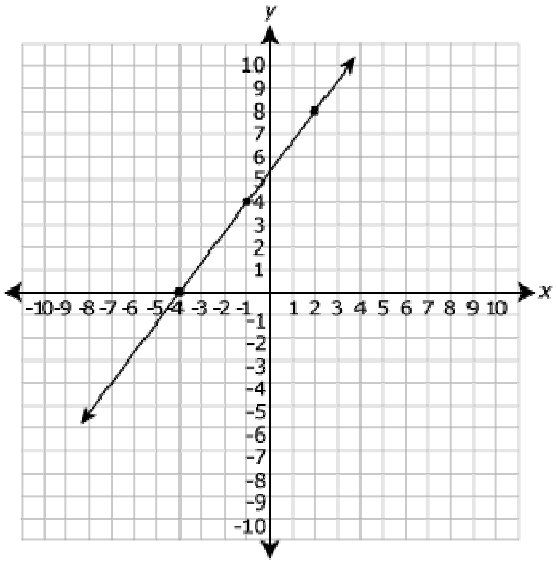
**Slope as Steepness**

The greater the number (absolute value) of the slope, the steeper the line will be.

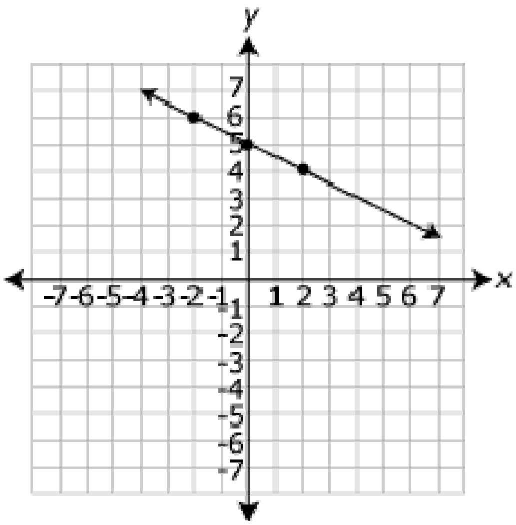
| m=$\frac{1}{2}$ | m=1 | m=2 |
|---|---|---|
|  |  |  |

**Finding the Slope of a Line**

- **Method 1: Count from a Graph**




Slope = m = $\frac{rise}{run} = \frac{up4}{right3} = \frac{+4}{+3} = \frac{4}{3}$




Slope = m = $\frac{rise}{run} = \frac{down1}{right2} = \frac{-1}{+2} = -\frac{1}{2}$

- **Method 2: Use the Formula**

Find the slope of the line that passes through (-2, 3) and (4, 6).

$$Slope = \frac{rise}{run} = \frac{change - y}{change - x} = \frac{y_1 - y_2}{x_1 - x_2} = \frac{3-6}{-2-4} = \frac{-3}{-6} = \frac{1}{2}$$

Find the slope of the line that passes through (5, -2) and (7, -6).

$$Slope = \frac{rise}{run} = \frac{change - y}{change - x} = \frac{y_1 - y_2}{x_1 - x_2} = \frac{-2-(-6)}{5-7} = \frac{4}{-2} = -2$$

## Chapter 9 Big Idea #1: Proportions

A proportion is an equation that says two ratios are equal. In common terms: two fractions are equal to each other. A proportion must be "solved" when one of the pieces is unknown.

**Example:**

Solve the proportion: $\frac{b}{6} = \frac{5}{30}$

Proportions are generally solved by using the "cross-product property" which states that if two ratios are equal, the products of the diagonals are equal.

In the proportion, $\frac{b}{6} = \frac{5}{30}$, the cross-products are $b \bullet 30 = 5 \bullet 6$, which simplifies to 30b=30. This is a one step equation that can be solved by dividing both sides by 30: $\frac{30b}{30} = \frac{30}{30}$, so b=1.

The cross-product method works no matter where in the proportion the variable is located—after finding the cross-products there will always be a one-step equation to solve.

**Applications of Proportions: Percents**

Most problems involving percents can be solved by setting up and solving a proportion.

Percent problems generally fall in to one of the following three categories:

- The portion and the whole are known, but the percent is unknown: 5 out of 25 is what percent?
- The percent and the whole are known, but the portion is unknown: 20% of 16 is what number?
- The portion and the percent are known, but the whole is unknown: 8 is 30% of what number?

**Solving Percent Problems with Proportions**

The textbook's explanation of using a proportion to solve percent problems can be confusing and uses a lot of specialized vocabulary that can get in the way of being able to solve the problem. Many teachers will break it down this way:

1. Turn your problem into a question in the format: __ is __ percent of ___?

2. Substitute the values in your question into the proportion $\frac{is}{of} = \frac{percent}{100}$

   (use a variable where "what" appears in the question).

3. Solve the proportion.

**Examples**

| Original Problem | Question | Proportion | Cross-Products | Solution |
|---|---|---|---|---|
| What is 40% of 5? | What is 40% of 5? | $\frac{x}{5} = \frac{40}{100}$ | 100x = 200 | 2 |
| 19 is what percent of 25? | 19 is what percent of 25? | $\frac{19}{25} = \frac{x}{100}$ | 1900 = 25x | 76% |
| 60% of the 200 students surveyed said their favorite food is pizza. How many students like pizza? | What is 60% of 200? | $\frac{x}{200} = \frac{60}{100}$ | 100x = 12000 | 120 students |

**Memorization of the percents that are equivalent to common fractions** is very helpful when working with real-life percent problems (and as a life skill!). The pairs that students should have memorized are:

| | | |
|---|---|---|
| $\frac{1}{8} = 12.5\%$ | $\frac{1}{6} = 16.7\%$ | $\frac{1}{10} = 10\%$ |
| $\frac{1}{4} = 25\%$ | $\frac{1}{3} = 33.3\%$ | $\frac{1}{5} = 20\%$ |
| $\frac{3}{8} = 37.5\%$ | $\frac{1}{2} = 50\%$ | $\frac{3}{10} = 30\%$ |
| $\frac{1}{2} = 50\%$ | $\frac{2}{3} = 66.7\%$ | $\frac{2}{5} = 40\%$ |
| $\frac{5}{8} = 62.5\%$ | $\frac{5}{6} = 83.3\%$ | $\frac{1}{2} = 50\%$ |
| $\frac{3}{4} = 75\%$ | | $\frac{3}{5} = 60\%$ |
| $\frac{7}{8} = 87.5\%$ | | $\frac{7}{10} = 70\%$ |
| | | $\frac{4}{5} = 80\%$ |
| | | $\frac{9}{10} = 90\%$ |

## Chapter 10 Big Idea #1: Stem and Leaf Plots

A stem and leaf plot is similar to a bar graph, but more detailed because you still see each piece of data.

**Example:**

Test Scores

| | |
|---|---|
| 9 | 2 3 3 6 7 |
| 8 | 0 0 1 5 6 7 8 8 9 |
| 7 | 2 4 6 |
| 6 | 5 |
| 5 | 9 |

5|9 = 59

Translation

92, 93, 93, 96, 97
80, 80, 81, 85, 86, 87, 88, 88, 89
72, 74, 76
65
59

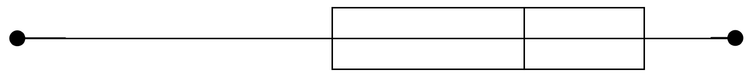
**Sample questions:**

What was the highest score? [97]
What was the lowest score? [59]
How many students earned B's? [9]
What was the range of scores? [97-59=38]
How many students scored at least 80%? [14]
How many students took the test? [19]

## Chapter 10 Big Idea #2: Box and Whisker Plots

A box and whisker plot uses a number line to show how data is distributed.

**Example:**
(Using the same data as in the stem and leaf plot example)



[θ0%ωθ5%ωθ0⊥ωθ5⊥ωθ0&ω θ5&ωθ0∗ωθ5∗ωθ0(ωθ5(ωθ0)]

| | | | |
|---|---|---|---|
| 25% of the data falls in this range | 25% of the data falls in this range | 25% of the data falls in this range | 25% of the data falls in this range |
| | 50% of the data falls in this range | | |

The narrower a section of the graph is, the more tightly clustered the data is.

**Vocabulary:**
***Minimum***—smallest data point (dot on the left)
***Maximum***—largest data point (dot on the right)
***Median***—middle data point (vertical line in the box)
***Lower Quartile*** (sometimes called First Quartile)—data point half-way between minimum and median (vertical line at the left end of the box)
***Upper Quartile*** (sometimes called Third Quartile)—data point half-way between maximum and median (vertical line at the right end of the box)
***Interquartile Range***—Upper Quartile minus Lower Quartile
***Outlier***—if difference between the Minimum and the Lower Quartile is more than 1.5 times the Interquartile Range, the Minimum is called an Outlier (same with the Maximum and the Upper Quartile)

**Sample questions:**
What is the range? [97-59=38]
What is the median? [86]
What is the upper quartile? [92]
What is the lower quartile? [76]
What is the minimum? [59]
What is the maximum? [97]
What is the interquartile range? [16]

What are the outliers, if any? [none, the difference of 97 and 92 is less than 24 and the difference of 76 and 59 is less than 24]

## Chapter 10 Big Idea #3: Misleading Statistics

"Statistics don't lie, but liars use statistics." In middle school, students are expected to have the reasoning skills to recognize when statistics and graphs and other data displays are misleading.

**Graphs and Data Displays can usually be misleading in the following ways:**

- Titles and labels are not included or are not sufficiently detailed to explain the whole story
- An inappropriate scale is used
- The width of the graph is stretched and makes data look more "flat" (or compacted to appear more "steep")
- The height of the graph is stretched or compacted
- The scale contains a "break" (rather than including all numbers) which makes the change appear more dramatic
- Parts of the graph can be colored or decorated to emphasize certain points

**Summary Statistics can be misleading by using an inappropriate measure of central tendency.**

Example (page 505, Example 2)

After a semester exam in science, Mr. Myers displayed the results to the class. The scores are shown in the stem and leaf plot. Mr. Myers told the principal that the average grade on the exam was 77. Ryan told his parents that the class average was 93. Tai told her grandmother the class average was 80. How can all three people think they are correct?

Scores

| | |
|---|---|
| 9 | 0 1 3 3 3 |
| 8 | 0 1 2 3 4 5 |
| 7 | 0 2 3 |
| 6 | 0 1 2 3 5 7 9 |

Each person used a different measure of central tendency to describe the average class grade. Mr. Myers used the mean and Tai used the median. Ryan's use of the mode is misleading because 93 is also the highest score on the semester exam.

**Students are also expected to be able to describe circumstances in which someone would want to use misleading data to support their point.** (For example, if the class mean allowance was higher than the median or mode allowance, a child would want to use the mean to advocate with his/her parents for a higher allowance. If third quarter sales were low, a CFO might want to use a data display that did not make the change appear so dramatic in a meeting with shareholders.)

## Chapter 10 Big Idea #4: Probability

Probability is the chance of an event occurring.

Theoretical probability is based on using the mathematical formula. Experimental probability is based on conducting an experiment. Mathematicians deal in theoretical probability ("the perfect world"); scientists deal in experimental probability ("the real world").

**Basic Probability Formula:** $\dfrac{\text{Possible ways to get what you want}}{\text{Total possibilities}}$

**Example:** What is the probability of getting heads when you flip a coin? There is one way to get what you want and two possible outcomes, so the probability is $\frac{1}{2}$ (or 0.5 or 50%, but we usually keep the fraction).

**Example:** In your closet are 3 red shirts, 5 black shirts, 2 green shirts and 1 white shirt. What is the probability that if you close you eyes and pick a shirt it will be black?
There are 5 ways to get what you want (5 black shirts) and a total of 11 possibilities (11 total shirts in the closet), so the probability is $\frac{5}{11}$. (What does that mean in real-life? Every 11 times you randomly pick a shirt out of the closet you *should* get 5 blacks shirts.)

**What makes probability different in prealgebra?** (They have been learning about probability since fourth grade.) Now they need to find the probability of two events occurring together. The two events can be independent or dependent.

(continued on next page)

**Probability of Independent Events:** The outcome of the first event has no effect on the outcome of the second event.

**Example:** What is the probability of getting heads when you flip a coin and getting 4 when you roll a die?

Find the probability of each event separately and then multiply the probabilities.

P(heads)= $\frac{1}{2}$ P(4)= $\frac{1}{6}$ so, P(heads, 4)= $\frac{1}{2} \cdot \frac{1}{6} = \frac{1}{12}$

(What does that mean in real-life, every twelve times you flip and coin and roll a die, you *should* get the combination of heads and a four.)

**Probability of Dependent Events:** The outcome of the first event has an effect on the outcome of the second event.

**Example:** You have two quarters, four dimes, six nickels and five pennies in your pocket. What is the probability of pulling out a quarter and a nickel (without putting back the first coin before selecting the second coin)?

Find the probability of the first event, then the probability of the second event (considering that the total possibilities are now different), and multiply.

P(quarter)= $\frac{2}{17}$ P(nickel)= $\frac{6}{16} = \frac{3}{8}$ (there are only 16 coins left when you draw the second coin)

So, P(quarter, nickel)= $\frac{2}{17} \cdot \frac{3}{8} = \frac{3}{68}$

## Chapter 11 Big Idea #1: Geometry

**Vocabulary, Vocabulary, Vocabulary!!!!**
See attached vocabulary list

**Major categories of topics and the emphasis in prealgebra:**
Basic geometry vocabulary
Knowing not only the definitions, but also the symbols for the terms

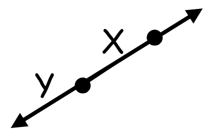
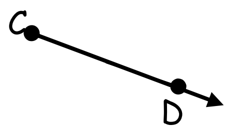
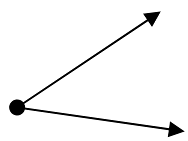
Triangles
Being able to classify a triangle according to its sides and its angles
Properties of triangles (such as the angles add up to 180°)

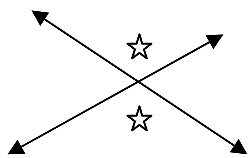
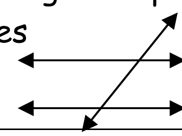
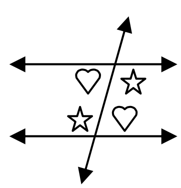
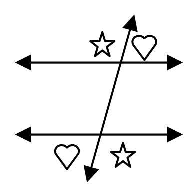
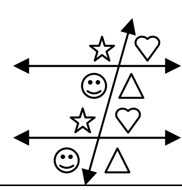
Quadrilaterials
Being able to classify a quadrilateral according to its sides and angles
Properties of quadrilaterals (such as the angles add up to 360°, opposite sides and angles in parallelograms are congruent, etc.)

Parallel lines and relationships of angles
Knowing names of special pairs of angles and how they are related (are the congruent, supplementary, etc.)

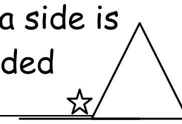
Similar figures and scale drawings
Being able to use proportions to find the missing measurement in a problem (especially related to scale drawings such as maps)

Measurement
Being able to calculate the area and perimeter or circumference of two-dimensional shapes and composite figures
Being able to calculate the surface area and volume of cubes and rectangular prisms/solids

| Term | Definition or Diagram | Term | Definition or Diagram |
|---|---|---|---|
| Line |  | Vertex (of an angle) | The common endpoint of the two rays that form an angle |
| Ray |  | Sides (of an angle) | The two rays that form an angle |
| Line Segment |  | Degree | Unit of measurement for an angle |
| Angle |  | Protractor | The tool for measuring angles |
| Plane | A flat surface with no edges or boundaries | Compass | The tool for drawing circles |
| Acute Angle | An angle that measures less than 90° | Obtuse Angle | An angle that measures between 90° and 180° |
| Right Angle | An angle that measures exactly 90° | Straight Angle | An angle that measures exactly 180° |

| Term | Definition or Diagram | Term | Definition or Diagram |
|---|---|---|---|
| Intersect | Two or more lines or line segments meeting at a common point | Perpendicular Lines | Two lines or line segments that intersect at right angles (Symbol: ⊥ ) |
| Parallel Lines | Two or more lines in the same plane that will never intersect (Symbol: ∥ ) | Skew Lines | Two lines that do not intersect but are not in the same plane |
| Vertical Angles |  | Transversal | A line that crosses through two parallel lines  |
| Congruent | Having the same measurement (the geometry term for equal) | Adjacent Angles | Two angles that share a side |
| Complementary | Two angles whose measurements add up to $90^\circ$ | Supplementary | Two angles whose measurements add up to $180^\circ$ |
| Alternate Interior Angles |  | Alternate Exterior Angles |  |
| Corresponding Angles |  | | |

| Term | Definition or Diagram | Term | Definition or Diagram |
|---|---|---|---|
| Acute Triangle | A triangle with three acute angles | Equilateral Triangle | A triangle with three congruent sides |
| Right Triangle | A triangle with one right angle | Isosceles Triangle | A triangle with two congruent sides |
| Obtuse Triangle | A triangle with one obtuse angle | Scalene Triangle | A triangle with all sides different lengths |
| Congruent Figures | Figures that have the same size and shape | Similar Figures | Figures that have the same shape but not necessarily the same size |
| Corresponding Parts | Parts of congruent or similar figures that "match" | Triangle | A polygon with three sides |
| Quadrilateral | A polygon with four sides | Rectangle | A parallelogram with right angles |
| Parallelogram | A quadrilateral whose opposite sides are parallel (& opposite angles are congruent) | Square | A parallelogram with right angles and congruent sides |

| Term | Definition or Diagram | Term | Definition or Diagram |
|---|---|---|---|
| Trapezoid | A quadrilateral with one pair of parallel sides | Rhombus | A parallelogram with congruent sides |
| Scale Drawing | A drawing that is similar to the actual object (map, blueprint) | Sides (of a polygon) | The line segments that connect to form a polygon |
| Diagonal | A line segment that connects two non-consecutive vertices of a polygon | Vertices (of a polygon) | The endpoints where the line segments that form a polygon intersect |
| Regular Polygon | A polygon with congruent sides and congruent angles | Composite Figure | A two-dimensional figure that is a combination of at least two smaller shapes |
| Interior Angles | The angles inside a polygon | Exterior Angles | The angle formed outside a polygon when a side is extended  |
| Area (definition) | The space inside a two-dimensional shape | Surface Area (definition) | The amount of material it would take to cover a three-dimensional shape |
| Perimeter | The distance around a polygon | Volume (definition) | The amount of space inside a three-dimensional shape |

| Term | Definition or Diagram | Term | Definition or Diagram |
|---|---|---|---|
| Pythagorean Theorem (definition) | The formula used to find the lengths of the sides of a right triangle | Pythagorean Theorem (formula) | $a^2+b^2=c^2$ where a and b are the legs and c is the hypotenuse of a right triangle |
| Legs | The two shorter sides of a right triangle | Hypotenuse | The side of a right triangle opposite the hypotenuse (the longest side) |
| Area of a Rectangle (formula) | length x width | Area of a Triangle (formula) | $\frac{1}{2}$ x base x height |
| Area of a Trapezoid (formula) | $\frac{1}{2}$ h(a + b) (where h=height, a=base a and b=base b) | Area of a Parallelogram (formula) | base x height |
| Surface Area of a Cube (formula) | $6s^2$ (where s=side) | Volume of a Rectangular Prism (formula) | lwh (where l=length, w=width and h=height) |
| Surface Area of a Rectangular Prism (formula) | 2lw+2lh+2hw (where l=length, w=width and h=height) | Circumference (definition) | The distance around a circle |
| Area of a Circle (formula) | $\pi r^2$ (where r=radius) | Circumference of a Circle (formula) | $2\pi r$ or $\pi d$ (where r=radius and d=diameter) |