HMH

SAXON MATH

BETTER RESULTS. BRIGHTER FUTURES.

PROBLEM SOLVING

Problem Solving

Saxon Math provides a balanced math curriculum that emphasizes the importance of problem solving in our modern, global, and technological age.

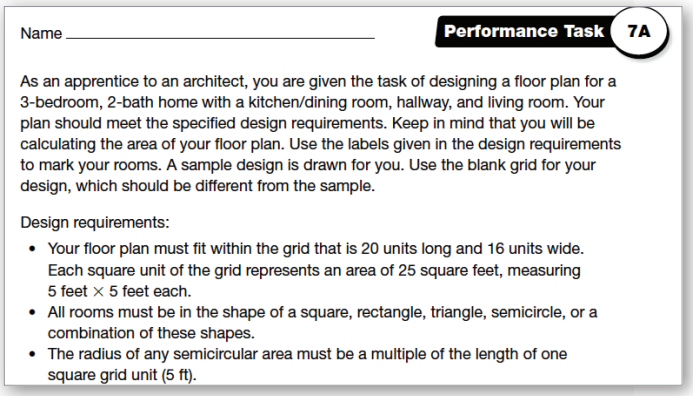
Today's society is facing energy, political, social, environmental, and economic struggles that rival those of any prior generation. The unnamed challenges of tomorrow will likely be similar in magnitude but different in kind. A mathematically literate populace is needed to work past our current struggles and to formulate the solutions for the problems of tomorrow. Will people be prepared by today's math instruction to handle these challenges? *Saxon Math™* can play a key role in preparing the next generation for the task of solving the difficult problems that lie ahead.

The foundation to problem solving is knowledge. The value of the storehouse of mathematical knowledge and skill in a student's long-term memory cannot be overemphasized. Without this resource, students will never become adept problem solvers. *Saxon Math* has always been recognized as a program committed to the fundamentals of math content knowledge. Yet, the key to problem-solving fluency and success is the proper application of that knowledge and skill in the content of particular problems. The National Council of Teachers of Mathematics (NCTM®) defines problem solving as "a task for which the solution is not known in advance."

Knowledge

The Saxon® curriculum exposes students to a wide variety of problems, from simple computation-oriented problems, to the open-ended, novel, and multi-step problems that more closely align to the processes employed by mathematicians in the real world.

Saxon Course 3 Performance Task 7A



Name _____ **Performance Task 7A**

As an apprentice to an architect, you are given the task of designing a floor plan for a 3-bedroom, 2-bath home with a kitchen/dining room, hallway, and living room. Your plan should meet the specified design requirements. Keep in mind that you will be calculating the area of your floor plan. Use the labels given in the design requirements to mark your rooms. A sample design is drawn for you. Use the blank grid for your design, which should be different from the sample.

Design requirements:

- Your floor plan must fit within the grid that is 20 units long and 16 units wide. Each square unit of the grid represents an area of 25 square feet, measuring 5 feet × 5 feet each.
- All rooms must be in the shape of a square, rectangle, triangle, semicircle, or a combination of these shapes.
- The radius of any semicircular area must be a multiple of the length of one square grid unit (5 ft).

Students are more apt to learn from the problems they are asked to solve if they can relate to them in their real-life experiences. The National Math Advisory Panel Final Report asserts that "instruction that features the use of 'real-world' contexts has a positive impact on certain types of problem solving" (page 49).

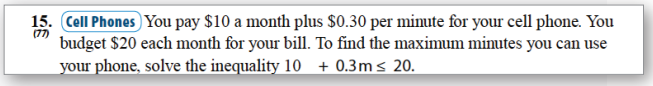
Saxon Grade 2: Lesson 75-2 problem of the day.

> On Monday, Nancy gave her cat 10 cat treats. Each day she gave the cat one fewer cat treat. How many treats will she give her cat on Wednesday?

As students become older, their experiences expand across many domains. In Saxon's newest high school editions, special care was given to create problems that would interest older students and help them more clearly envision the type of math required within various careers. In addition, cross-curricular problems and problems that incorporate math-to-math connections are prominent in our Saxon textbooks.

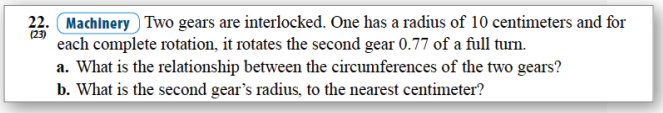
The Saxon curriculum provides a framework to aid students in their problem-solving proficiency. The framework rises from the core content knowledge that is so strongly developed within the curriculum.

Saxon Algebra 1: Lesson 82 Problem 15



15. (77) **Cell Phones** You pay $10 a month plus $0.30 per minute for your cell phone. You budget $20 each month for your bill. To find the maximum minutes you can use your phone, solve the inequality 10 + 0.3m ≤ 20.

Saxon Geometry Lesson 32 Problem 22

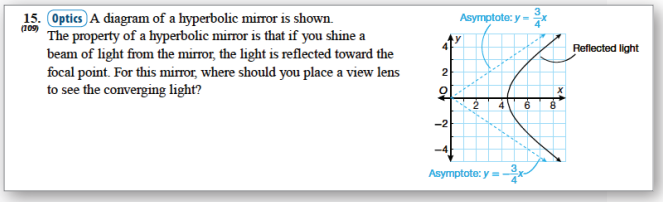


22. (23) **Machinery** Two gears are interlocked. One has a radius of 10 centimeters and for each complete rotation, it rotates the second gear 0.77 of a full turn.

a. What is the relationship between the circumferences of the two gears?

b. What is the second gear's radius, to the nearest centimeter?

Saxon Algebra 2: Lesson 116 Problem 15



15. (109) **Optics** A diagram of a hyperbolic mirror is shown. The property of a hyperbolic mirror is that if you shine a beam of light from the mirror, the light is reflected toward the focal point. For this mirror, where should you place a view lens to see the converging light?

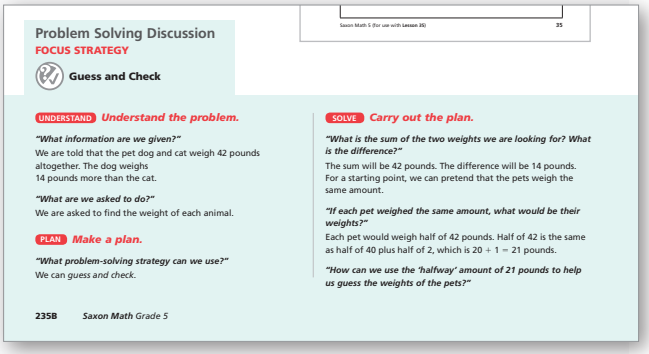
There are four posts from which this proficiency is constructed. These posts form an explicit approach to problem-solving instruction lauded by the National Math Advisory Panel First Report:

"Explicit systematic instruction was found to improve the performance of students with learning disabilities in computation, solving word problems, and solving problems that require the application of mathematics to novel situations" (page 48).

The first post is a collection of **problem-solving strategies**. NCTM stresses the point that "math curriculums should apply and adapt a variety of appropriate strategies to solve problems." Each Saxon textbook lesson requires students to employ a strategy from a vast collection of possible strategies in order to solve a novel problem.

For the problem illustrated below, the strategy of guess-and-check is suggested. In all, at least ten different strategies—from acting it out, to making an organized list, to working backward—are introduced, practiced, and reinforced.

Saxon Grade 5: Lesson 35 Teacher's Manual
Problem Solving Discussion



Problem Solving Discussion
FOCUS STRATEGY
Guess and Check

UNDERSTAND *Understand the problem.*

"What information are we given?"
We are told that the pet dog and cat weigh 42 pounds altogether. The dog weighs 14 pounds more than the cat.

"What are we asked to do?"
We are asked to find the weight of each animal.

PLAN *Make a plan.*

"What problem-solving strategy can we use?"
We can *guess and check.*

SOLVE *Carry out the plan.*

"What is the sum of the two weights we are looking for? What is the difference?"
The sum will be 42 pounds. The difference will be 14 pounds. For a starting point, we can pretend that the pets weigh the same amount.

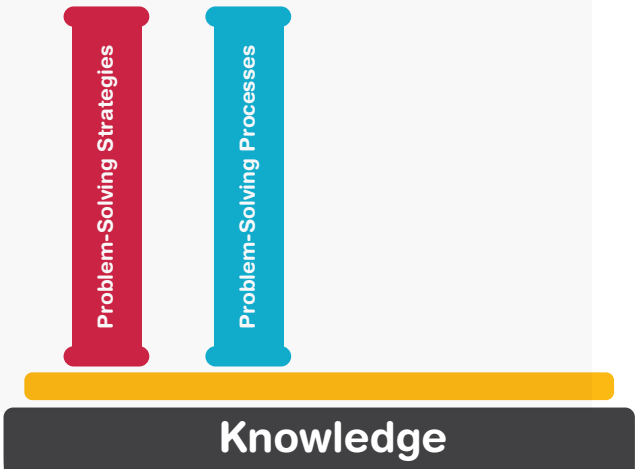
"If each pet weighed the same amount, what would be their weights?"
Each pet would weigh half of 42 pounds. Half of 42 is the same as half of 40 plus half of 2, which is 20 + 1 = 21 pounds.

"How can we use the 'halfway' amount of 21 pounds to help us guess the weights of the pets?"

235B *Saxon Math Grade 5*

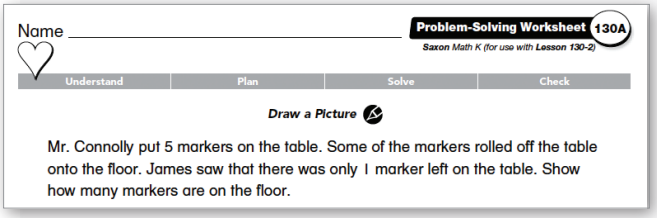
The second post of this framework is a consistent four-step problem-solving process: understand, plan, solve, check. The process promotes the metacognition suggested by NCTM:

"Math curriculums should monitor and reflect on the process of mathematical problem solving." It also promotes the role of estimating in mathematics.



This structure begins in our Math K kit and continues through our Algebra 2 textbook.

Saxon Grade K: Lesson 130-2 Problem-Solving Worksheet 130A



Name _____

Problem-Solving Worksheet 130A

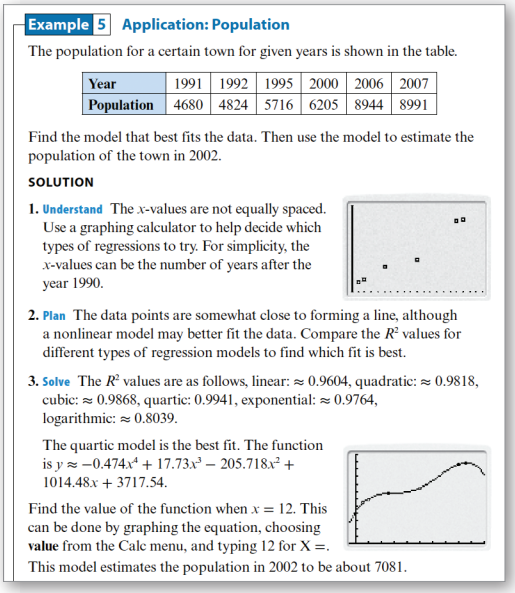
Saxon Math K (for use with Lesson 130-2)

Understand	Plan	Solve	Check

Draw a Picture

Mr. Connolly put 5 markers on the table. Some of the markers rolled off the table onto the floor. James saw that there was only 1 marker left on the table. Show how many markers are on the floor.

Saxon Algebra 2: Lesson 116 Example 5



Example 5 **Application: Population**

The population for a certain town for given years is shown in the table.

Year	1991	1992	1995	2000	2006	2007
Population	4680	4824	5716	6205	8944	8991

Find the model that best fits the data. Then use the model to estimate the population of the town in 2002.

SOLUTION

1. **Understand** The x-values are not equally spaced. Use a graphing calculator to help decide which types of regressions to try. For simplicity, the x-values can be the number of years after the year 1990.

2. **Plan** The data points are somewhat close to forming a line, although a nonlinear model may better fit the data. Compare the R^2 values for different types of regression models to find which fit is best.

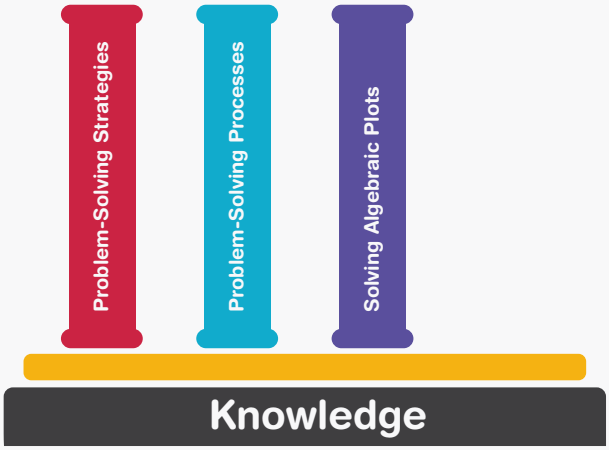
3. **Solve** The R^2 values are as follows, linear: ≈ 0.9604, quadratic: ≈ 0.9818, cubic: ≈ 0.9868, quartic: 0.9941, exponential: ≈ 0.9764, logarithmic: ≈ 0.8039.

The quartic model is the best fit. The function is $y \approx -0.474x^4 + 17.73x^3 - 205.718x^2 + 1014.48x + 3717.54$.

Find the value of the function when $x = 12$. This can be done by graphing the equation, choosing **value** from the Calc menu, and typing 12 for X =.

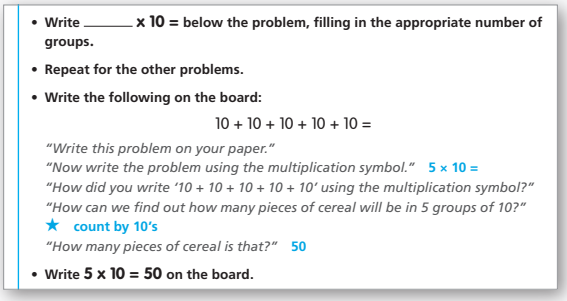
This model estimates the population in 2002 to be about 7081.

The third post is the categorization of problem-solving situations into algebraic plots. These plots allow students to see general formats within the problem data so that they can understand the big picture of the situation instead of being overwhelmed by problem details.



For example, the understanding of "equal groups" problems in the primary grades provides the cognitive basis for the ratio box graphic organizers in the middle school textbooks. This unique tool is then the avenue for a deeper understanding of proportionality, a key ingredient for algebraic success.

Saxon Grade 2 Lesson 92 New Concept



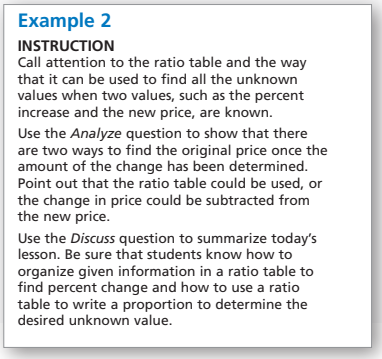
- **Write _____ x 10 = below the problem, filling in the appropriate number of groups.**
- **Repeat for the other problems.**
- **Write the following on the board:**

10 + 10 + 10 + 10 + 10 =

"Write this problem on your paper."
"Now write the problem using the multiplication symbol." **5 × 10 =**
"How did you write '10 + 10 + 10 + 10 + 10' using the multiplication symbol?"
"How can we find out how many pieces of cereal will be in 5 groups of 10?"
★ **count by 10's**
"How many pieces of cereal is that?" **50**

- **Write 5 x 10 = 50 on the board.**

Saxon Course 3 Lesson 67 New Concept Example 2



Example 2

INSTRUCTION

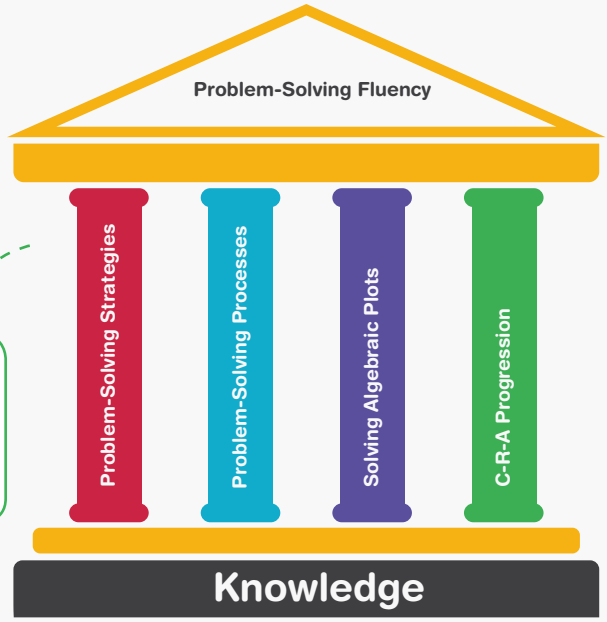
Call attention to the ratio table and the way that it can be used to find all the unknown values when two values, such as the percent increase and the new price, are known.

Use the *Analyze* question to show that there are two ways to find the original price once the amount of the change has been determined. Point out that the ratio table could be used, or the change in price could be subtracted from the new price.

Use the *Discuss* question to summarize today's lesson. Be sure that students know how to organize given information in a ratio table to find percent change and how to use a ratio table to write a proportion to determine the desired unknown value.

The final post is the gradual and purposefully managed progression of mathematical approaches, from the concrete, to the representational, to the abstract (C-R-A).

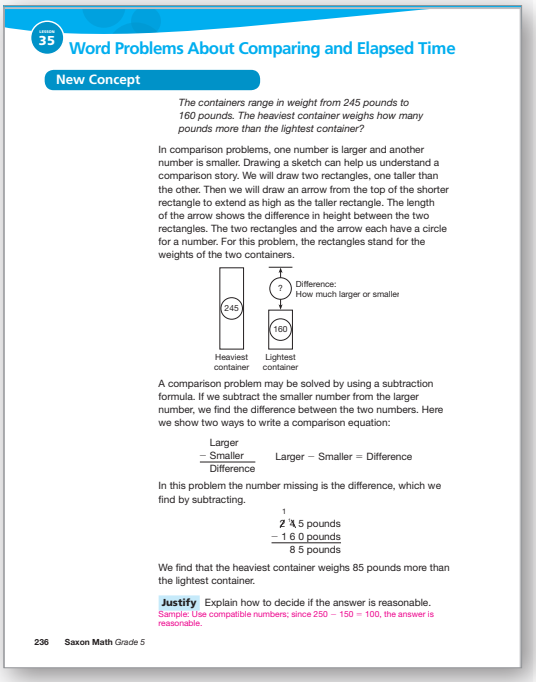
This balanced approach carefully reflects an understanding of cognitive development and the nature of today's student population.



The *Saxon Math* programs offer practice using multiple representations and utilizes modeled drawings beginning as early as kindergarten. These increase in complexity as students move through the grade levels.

The method is a powerful tool with both routine and non-routine problems.

Saxon Grade 5: Lesson 35 New Concept



LESSON 35

Word Problems About Comparing and Elapsed Time

New Concept

The containers range in weight from 245 pounds to 160 pounds. The heaviest container weighs how many pounds more than the lightest container?

In comparison problems, one number is larger and another number is smaller. Drawing a sketch can help us understand a comparison story. We will draw two rectangles, one taller than the other. Then we will draw an arrow from the top of the shorter rectangle to extend as high as the taller rectangle. The length of the arrow shows the difference in height between the two rectangles. The two rectangles and the arrow each have a circle for a number. For this problem, the rectangles stand for the weights of the two containers.

A comparison problem may be solved by using a subtraction formula. If we subtract the smaller number from the larger number, we find the difference between the two numbers. Here we show two ways to write a comparison equation:

$$\begin{array}{r} \text{Larger} \\ -\ \text{Smaller} \\ \hline \text{Difference} \end{array} \qquad \text{Larger} - \text{Smaller} = \text{Difference}$$

In this problem the number missing is the difference, which we find by subtracting.

$$\begin{array}{r} {\scriptstyle 1} \\ 2\,\overset{1}{\not{4}}5 \text{ pounds} \\ -\ 1\,6\,0 \text{ pounds} \\ \hline 8\,5 \text{ pounds} \end{array}$$

We find that the heaviest container weighs 85 pounds more than the lightest container.

Justify Explain how to decide if the answer is reasonable.

Sample: Use compatible numbers; since 250 − 150 = 100, the answer is reasonable.

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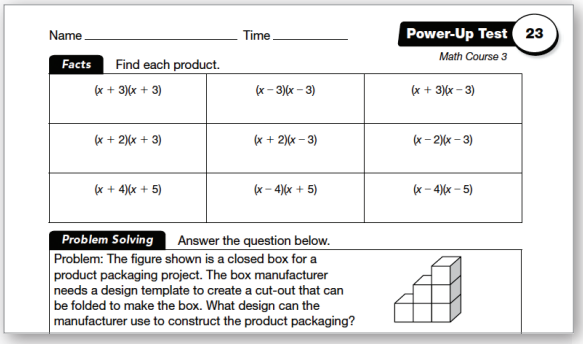
Saxon's instructional approach supports students as they solve the rigorous, noteworthy problems presented in our programs. In addition to stressing math fundamentals and operational fluency, the Saxon curriculum provides even more support for students to become prolific problem solvers. In accordance to NCTM's recommendation that "problem solving should not be an isolated part of the curriculum but should involve all content standards", problem solving is not taught in isolation. Saxon's distributed approach and program structure ensures that students are engaged in meaningful problem solving every day. And every day, the students not only think about math as they solve problems, they also talk about it. Saxon's systematic approach to problem solving is the type of explicit approach promoted by the National Math Advisory Panel's Final Report in that it allows "students many opportunities to ask and answer questions and to think aloud about the decisions they make while solving problems" (page 48).

Conversations in both Saxon's primary program, as well as Saxon's Intermediate and middle school series, steer students toward higher levels of thought as they discuss problem scenarios and solutions.

No other curriculum approaches problem-solving practice and assessment in a cumulative fashion. Therefore, Saxon is uniquely able to hold students accountable for their problem-solving ability and to intervene in a meaningful way whenever a problem-solving weakness develops.

Saxon Course 3 Power Up Test 23



Name _____ Time _____

Power-Up Test 23

Math Course 3

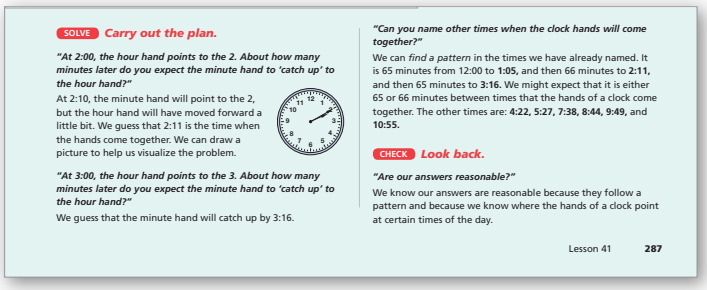
Facts Find each product.

$(x + 3)(x + 3)$	$(x - 3)(x - 3)$	$(x + 3)(x - 3)$
$(x + 2)(x + 3)$	$(x + 2)(x - 3)$	$(x - 2)(x - 3)$
$(x + 4)(x + 5)$	$(x - 4)(x + 5)$	$(x - 4)(x - 5)$

Problem Solving Answer the question below.

Problem: The figure shown is a closed box for a product packaging project. The box manufacturer needs a design template to create a cut-out that can be folded to make the box. What design can the manufacturer use to construct the product packaging?

Saxon Grade 4: Lesson 41 Teacher's Manual Problem Solving Discussion



SOLVE ***Carry out the plan.***

"At 2:00, the hour hand points to the 2. About how many minutes later do you expect the minute hand to 'catch up' to the hour hand?"

At 2:10, the minute hand will point to the 2, but the hour hand will have moved forward a little bit. We guess that 2:11 is the time when the hands come together. We can draw a picture to help us visualize the problem.

"At 3:00, the hour hand points to the 3. About how many minutes later do you expect the minute hand to 'catch up' to the hour hand?"

We guess that the minute hand will catch up by 3:16.

"Can you name other times when the clock hands will come together?"

We can *find a pattern* in the times we have already named. It is 65 minutes from 12:00 to **1:05,** and then 66 minutes to **2:11,** and then 65 minutes to **3:16.** We might expect that it is either 65 or 66 minutes between times that the hands of a clock come together. The other times are: **4:22, 5:27, 7:38, 8:44, 9:49,** and **10:55.**

CHECK ***Look back.***

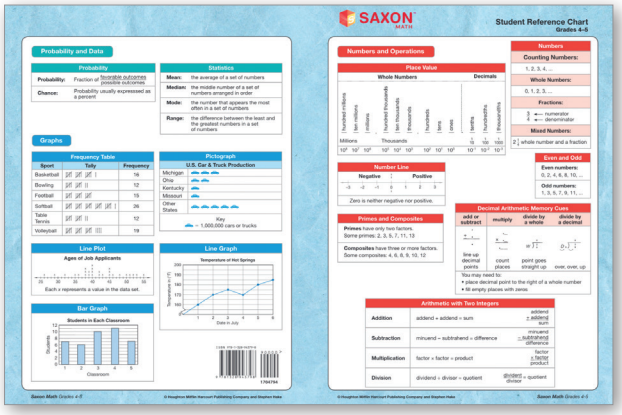
"Are our answers reasonable?"

We know our answers are reasonable because they follow a pattern and because we know where the hands of a clock point at certain times of the day.

Lesson 41 **287**

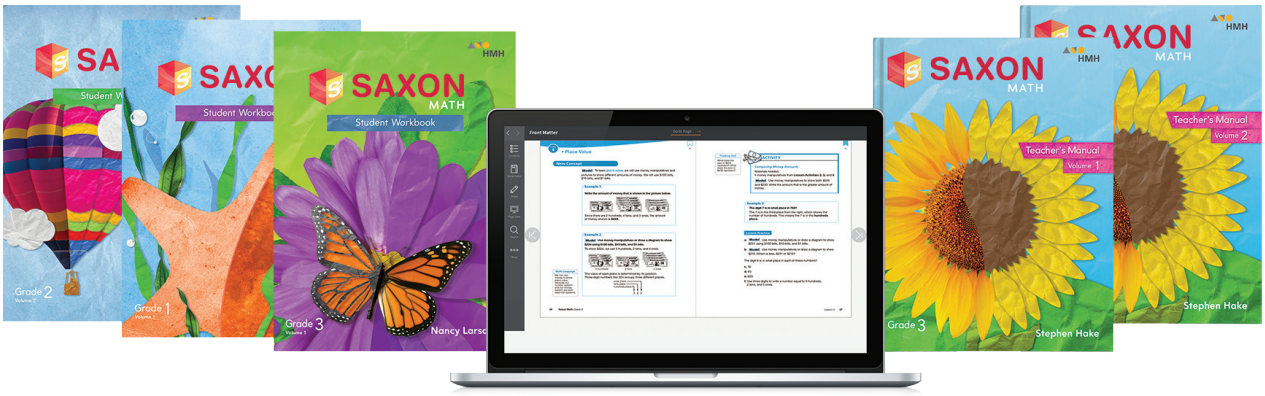
Finally, Saxon students enjoy the provision of math reference materials (math offices, math folders, and student reference guides). These reference materials allow them to proceed with the problem-solving process even when some of the foundational math knowledge needed to solve the problem may not have reached the level of automaticity.

Student Reference Chart



Most schools are fully aware of the effectiveness of Saxon in laying a strong foundation of math content knowledge, but it certainly doesn't stop there. In the Saxon curriculum, quality problems, a solid problem-solving framework, and a unique approach that supports students in their problem-solving endeavors all work together to provide an effective and balanced approach to problem solving. Implementing *Saxon Math* in your school or district will help your students be prepared to solve the math-related problems they will face in life and work in this modern, global, and technological age.

SAXON MATH



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