Grade 4 Clarifying Lessons:
Hooked on Problem Solving

OLD Resources. These resources have NOT yet been updated to align with the revised elementary mathematics TEKS. These revised TEKS were adopted by the Texas State Board of Education in 2005, with full implementation scheduled for 2006–07. These resources align with the original TEKS that were adopted in 1998 and should be used as a starting point only.

What is a Clarifying Lesson?

A model lesson teachers can implement in their classroom. Clarifying Lessons combine multiple TEKS statements and may use several Clarifying Activities in one lesson. Clarifying Lessons help to answer the question "What does a complete lesson look like that addresses a set of related TEKS statements, and how can these TEKS statements be connected to other parts of the TEKS?"

TEKS Addressed in This Lesson

Number, operation, and quantitative reasoning: 4.3A; 4.5A

Underlying processes and mathematical tools: 4.15A; 4.16A, B

Materials

- tiles or squares of paper numbered 1–9
- 5" x 7" index cards and tape, or sticky notes
- markers

Lesson Resources

"Hook Your Students on Problem Solving" by Gloria J. Bledsoe in the NCTM's *Arithmetic Teacher*, December, 1989.

Lesson Overview

Students use each of the digits 1–9 exactly once to form addition problems consisting of two three-digit addends and a three-digit sum and look for patterns in the solutions.

Mathematics Overview

Students use properties of operations and problem-solving strategies to do mental calculations, extending beyond fact recall, and discover patterns.

Set-up (to set the stage and motivate the students to participate)

1. Have students arrange their numbered squares into a 3 x 3 array. Ask, "Does the sum of the two 3-digit numbers represented by the top two rows equal the 3-digit number on the bottom row? (Probably not!) Is it possible to arrange the digits so that the sum of the first two numbers does equal the third 3-digit number?" (4.3A, 4.5A)

2. Have students try to create such an arrangement. Hint: Regrouping is an important consideration. For example: (4.3A, 4.5A)

$$
\begin{array}{r}
291 \\
+384 \\
\hline
675
\end{array}
$$

3. As students begin to find solutions, have them record the solutions on 5" x 7" index cards (or sticky notes) with heavy felt-tip markers. Post the solutions. This gives students a chance to notice duplicates, sort the cards into categories, and begin to search for patterns. (4.16A)

4. Once a fairly large collection of data is posted, ask,"How many solutions do you think might be possible? Can you find a pattern that might make the task easier?" (4.16A)

5. Record the patterns noticed as "Conjectures" and ask students to search for counterexamples to test their conjectures. Conjectures which can be logically explained or for which no counterexample can be found can be listed under "Generalizations." Some possible examples of conjectures are (4.15A; 4.16A, B):

   It is always necessary to regroup to find a solution.

   Neither a 1 nor a 2 can be the hundreds digit of the answer.

   The digits in the answers add up to 18. (This pattern is difficult to notice at first. To speed up the process, ask students to concentrate on the sums.)

Teacher Notes (to personalize the lesson for your classroom)

Guiding Questions (to engage students in mathematical thinking during the lesson)

- Are you able to eliminate any possible arrangements of digits? Why? (4.3A; 4.5A; 4.16A, B)

- What patterns do you see in the addends of your solutions? (4.15A, 4.16A)

- What patterns do you see in the sums of your solutions? (4.15A, 4.16A)

- How can you use one solution to help you find another one? (For example, the commutative property of addition can be used in the tens place to change 291 + 384 = 675 to 281 + 394 = 675.) (4.3A; 4.5A; 4.15A; 4.16A, B)

Teacher Notes (to personalize the lesson for your classroom)

Summary Questions (to direct students' attention to the key mathematics in the lesson)

To have students reflect on the properties of addition that they used in finding their solutions, ask questions such as:

- What strategies did you use to find solutions? (4.3A, 4.5A, 4.15A)

- What is another solution that hasn't been posted yet? (4.3A, 4.5A, 4.15A)

To determine how well students can form, test, and support conjectures from patterns in the solutions, ask questions such as:

- How did you arrive at that conjecture (or generalization)? (4.16A, B)

- Can anyone find a counterexample for any of the conjectures that have been made? (4.3A, 4.5A, 4.16B)

- How can you use your patterns and conjectures to find more solutions?

Teacher Notes (to personalize the lesson for your classroom)

Assessment Task(s) (to identify the mathematics students have learned in the lesson)

- Have students record in their mathematics journals the strategies they used to find solutions.

- Have students record in their journals the patterns they observed in the solutions.

- Have students record in their journals a conjecture that was proven false with a counterexample, along with the counterexample that was used.

Teacher Notes (to personalize the lesson for your classroom)

Extension(s) (to lead students to connect the mathematics learned to other situations, both within and outside the classroom)

- Students can explore how to change the problem to involve subtraction instead of addition. What patterns occur?

- Students can explore how to change the problem to include the digit 0. Do the old patterns still occur? Do new patterns occur?

Teacher Notes (to personalize the lesson for your classroom)