

Addition and Subtraction with Whole Numbers

Strand: Computation and Estimation

Topic: Estimating and finding sums and differences of whole numbers

Primary SOL: 4.4 The student will
b) estimate and determine sums, differences, and products of whole numbers.*

* On the state assessment, items measuring this objective are assessed without the use of a calculator.

Materials

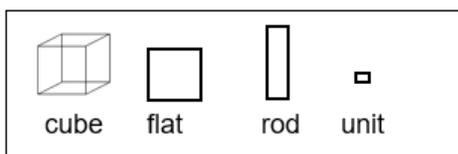
- Base-10 blocks
- Blank base-10 chart
- Calculators

Vocabulary

add, cube, difference, flat, rod, subtract, sum, unit

Student/Teacher Actions: What should students be doing? What should teachers be doing?

1. Have students explore with base-10 blocks how regrouping is used in addition and subtraction and how to record the work with numbers. This will help students bridge from manipulatives to abstract/symbolic representation. Display a base-10 block chart similar to the one below, and review the names of the blocks and their values: cube = 1,000; flat = 100; rod = 10; unit = 1.



2. Facilitate the class in estimating and finding the sum for $846 + 675$. You may allow students to work in pairs or individually. The purpose of this activity is to help students make connections among concrete, pictorial, and symbolic representations of the solution. Write the problem vertically on the board.
 - a. First, ask students to estimate the sum for $846 + 675$ and record it on their paper. Come back to the estimates as a closure for the activity in order to investigate the strategies students used, how close they were to the actual sum, and how they might refine their strategy.
 - b. Then, ask students to use the base-10 materials to find the sum $675 + 846$ with the fewest possible blocks. Remind them to pay attention to what moves or actions they took with the blocks in the process of solving the problem. Ask the students to record what they did pictorially and allow them to use words along with the pictorial model to help describe their actions. Walk around the room to make note of how the students are recording the work. Identify one or two students to call on later to come to the board and show their work.

- c. Next, have them record the actions with numbers and show exactly what happened when they solved with the base-10 material. Walk around the room and make note of how the students are representing their work, and make note of one or two students to invite to show their work on the board so that you can use the students pictorial and symbolic work to make connections among the representations using the following questions.
- What happens to 5 units and 6 units, and how is that shown in the symbolic form? (11 units become 1 rod and 1 unit.)
 - What happens to 7 rods and 4 rods, and how is that shown in the symbolic form? (11 rods become 1 flat and 1 rod.)
 - What happens to 6 flats and 8 flats, and how is that shown in symbolic form? (14 flats become 1 cube and 4 flats.)
 - What is the total shown in each representation? (1 cube [1,000], 5 flats [500], 2 rods [20], and 1 unit, or 1,521)
 - Revisit student estimates and the strategies they used. Which strategies gave estimates closest to the actual sum?
3. After observing the class in the previous activity, you may want to use this activity with the whole class, or you may decide to use it with a small group of students who need additional support. Students will do the same addition problem but will solve it this time using expanding notation and partial sums. First, ask students to state the value of the digit 6 in 675. Write 600 on the board when the answer is given. Ask for the value of the 7 and the 5. Write those as well. Then ask for the values of the digits in 846. Write those on the board. Lining up neatly, write:

$$\begin{array}{r} 600 \qquad 70 \qquad 5 \\ + 800 \qquad + 40 \qquad + 6 \\ \hline \end{array}$$

Ask students to solve these addition problems. They should respond with 1,400; 110; and 11. Ask students, “Where did we get these sums? Where did we get $600 + 800$, $70 + 40$, and $5 + 6$? What are we going to do with 1,400, 110 and 11? [add]” Then add these sums together to get the sum of 846 and 675. Ask, “Is this the same answer as we got when we added with the base-10 blocks? [Yes]”

- a. Present another problem to practice partial sums: $962 + 489$.
- b. First, however, ask, “How would you estimate 962 and 489? What estimate do you have for this problem? How did you arrive at that estimate? Does it make sense?”
- c. Then, have students work together in pairs to solve the problem using base-10 blocks. You may need to do this problem together to make sure that they understand what to do. Discuss what exchanges need to be made. Discuss the value of the digits.
- d. Do this same problem, using the partial-sums method and making explicit connections to the actions with the base-10 material. Write the values of the 9 in 962 and the 4 in the 489 in a column (i.e., $900 + 400$). Write the values of the 6 and 8 (i.e., $60 + 80$). Write the values of the 2 and 9 (i.e., $2 + 9$). Add all values to

get 1,300, 140, and 11. Then add these sums together to get the sum of 962 and 489. Students should write this in their mathematics journals or notebooks.

- e. As a follow-up to the estimation question, ask students whether their sum is close to their estimate.
4. Facilitate the class in estimating and finding the difference for $846 - 675$. You may allow students to work in pairs or individually. The purpose of this activity is to help students make connections among concrete, pictorial, and symbolic representations of the solution. Write the problem vertically on the board.
 - a. First, ask students to estimate the difference for $846 - 675$ and record it on their papers. Come back to the estimates as a closure for the activity in order to investigate the strategies students used, how close they were to the actual difference, and how they might refine their strategy.
 - b. Then, ask them to use the base-10 material to find the difference with the fewest possible blocks and remind them to pay attention to what moves or actions they took with the blocks in the process of solving the problem. Ask the students to record what they did pictorially and allow them to use words along with the pictorial model to help describe their actions. Walk around the room to make note of how the students are recording the work. Identify one or two students to call on later to come to the board and show their work.
 - c. Next, have them record the actions symbolically, with numbers, and show exactly what happened when they solved with the base-10 material. Walk around the room and make note of how the students are representing their work, and make note of one or two students to invite to show their work on the board so that you can use the students pictorial and symbolic work to make connections among the representations using the following questions.

$$\begin{array}{r}
 700 \\
 \cancel{800} \\
 - 600 \\
 \hline
 100
 \end{array}
 +
 \begin{array}{r}
 140 \\
 \cancel{40} \\
 + 70 \\
 \hline
 70
 \end{array}
 +
 \begin{array}{r}
 6 \\
 + 5 \\
 \hline
 1
 \end{array}$$

- What happens to 5 units and 6 units, and how is that shown in the symbolic form? (5 units subtracted from 6 units equals 1 unit.)
 - What happens to 7 rods and 4 rods, and how is that shown in the symbolic form? (7 rods subtracted from 4 rods does not work, so we must regroup 10 rods (or 1 flat) from 8 flats, changing the 8 flats to 7 flats. Now, 7 rods can be subtracted from 14 rods, equaling 7 rods.)
 - What happens to 6 flats and 8 flats, and how is that shown in symbolic form? (6 flats subtracted from 7 flats equals 1 flat.)
 - What is the total shown in each representation? (1 flat [100], 7 rods [70], and 1 unit [171])
- d. Revisit student estimates and the strategies they used. Which strategies gave estimates closest to the actual difference?

5. If no one used front-end estimation, you may want to provide another means of estimating by introducing it. Ask students to give the values of the digit 8 in 846 and the digit 6 in 675. Ask, “When we subtract 800 from 600, what is the difference?” [200] “Is this a reasonable estimation? Does it make sense?” Ask students to use front-end estimation to estimate $962 + 489$ ($900 + 400$). Ask, “What is the estimate? Is this close to our answer of 1,451? Is this acceptable?”
6. Provide additional mathematics problems for students to estimate and then solve. Give students opportunities to move from the manipulative (base-10 blocks), to the representational (drawings), to the abstract/symbolic.

Assessment

- **Questions**
 - How could this strategy help you to add or subtract large (more than four-digit) numbers?
 - What base-10 block could be used to represent 10,000?
 - Do you think that front-end estimation or rounding is a better way to estimate? Why?
- **Journal/writing prompts**
 - Explain to the principal how to find $5,634 - 271$, using pictorial representation of base-10 material and numbers. Explain how the two representations are connected using words and symbols.
 - What is the relationship between addition and subtraction, and how can you use the relationship to check your answers when you are adding and subtracting?
 - You are at the grocery store with your mom, and she tells you she cannot spend more than \$50. She wants you to estimate the total for the groceries each time she puts a new item in the basket. Do you think that front-end estimation or rounding is a better way to estimate in this situation? Why?
- **Other Assessments**
 - Pretend that a new student has moved here from another county. They do not know about partial sums. Explain with words, pictures, and numbers how to do partial sums.
 - Your principal wants to know which strategy you prefer: traditional or partial sums. Explain which one and why.
 - Without actually adding, find two addends whose sum is between 450 and 500.
 - Without actually subtracting, find two numbers whose difference is between 450 and 500.

Extensions and Connections

- Have students make up word problems in which addition is required.
- Have students make up word problems in which subtraction is required.

Strategies for Differentiation

- Revisit the relationship between working with base-10 material to working symbolically.
- Have students write several ways to rename 245 without using manipulatives (e.g., 2 hundreds, 4 tens, 5 ones; 2 hundreds, 2 tens, 25 ones).
- Continue to give students practice in partial sums. This computational strategy takes practice in order for students to feel comfortable with it.
- Have students act out and demonstrate the process of regrouping during addition or subtraction. For example, begin with a four-digit number, such as 1,234. Have a student stand in the thousands place and hold one large cube to represent 1,000, another student stand in the hundreds place and hold two flats to represent 200, another stand in the tens place and hold three rods to represent 30, and another stand in the ones place and hold four units to represent 4. Then, have another student pose a subtraction problem for the students holding the blocks, such as $1,234 - 567$. The students holding the base-10 blocks must determine how to demonstrate the solution by regrouping the blocks they are holding.
- Have students continue work with manipulatives and place-value charts until they are able to demonstrate a clear understanding of the process of regrouping.
- Have students use grid paper to keep digits in their proper place-value positions.
- Students can turn notebook paper horizontally to use the columns as columns for place value.
- Access the National Library of Virtual Manipulatives [online addition and subtraction activities](#) with base-10 materials.