Grade 2 Mathematics, Quarter 1, Unit 1.1

Applying Strategies to Addition and Subtraction Problems

Overview

Number of instructional days: 10 (1 day = 45–60 minutes)

Content to be learned

- Solve one-step word problems.
- Solve a variety of problem types (adding to, taking from, putting together, taking apart, and comparing)
- Solve problems with unknowns in all positions.
- Use concrete models, drawings, and strategies based on place value to solve problems.
- Add or subtract 10 to a two-digit number.
- Explain solution strategies (may be supported by drawings or objects).

Mathematical practices to be integrated

Model with mathematics.

- Draw pictures and/or use words to explain.
- Use manipulatives, number lines, tally marks, and blocks.
- Write an equation.

Attend to precision.

- Communicate precisely.
- Ask, "Does this make sense?"
- Make accurate calculations.

Essential questions

- How do you know when to use addition strategies to solve a problem?
- How do you know when to use subtraction strategies to solve a problem?
- How can you use a hundreds chart to solve this problem?
- How did you solve this (addition/subtraction) problem?
- What is your strategy for mental addition/subtraction?
- How can you add 10 to a number?

Written Curriculum

Common Core State Standards for Mathematical Content

Operations and Algebraic Thinking 2.OA

Represent and solve problems involving addition and subtraction.

2.OA.1 Use addition and subtraction ~~within 100~~ to solve one- ~~and two~~ step-word problems involving situations of adding to, taking from, putting together, taking apart, and comparing, with unknowns in all positions, e.g., by using drawings and equations ~~with a symbol for the unknown number to represent the problem.~~[1]

[1] See Glossary, Table 1.

Number and Operations in Base Ten 2.NBT

Use place value understanding and properties of operations to add and subtract.

2.NBT.7 Add and subtract ~~within 1000~~, using concrete models or drawings and strategies based on place value, properties of operations, and/or the relationship between addition and subtraction; relate the strategy to a written method. Understand that in adding or subtracting ~~three-digit numbers~~, one adds or subtracts ~~hundreds and hundreds~~, tens and tens, ones and ones; and sometimes it is necessary to compose or decompose tens ~~or hundreds~~.

2.NBT.8 Mentally add 10 ~~or 100~~ to a given number 100~~–900~~, and mentally subtract 10 ~~or 100~~ from a given number 100~~–900~~.

2.NBT.9 Explain why addition and subtraction strategies work, using place value and the properties of operations.[3]

[3] Explanations may be supported by drawings or objects.

Common Core Standards for Mathematical Practice

4 Model with mathematics.

Mathematically proficient students can apply the mathematics they know to solve problems arising in everyday life, society, and the workplace. In early grades, this might be as simple as writing an addition equation to describe a situation. In middle grades, a student might apply proportional reasoning to plan a school event or analyze a problem in the community. By high school, a student might use geometry to solve a design problem or use a function to describe how one quantity of interest depends on another. Mathematically proficient students who can apply what they know are comfortable making assumptions and approximations to simplify a complicated situation, realizing that these may need revision later. They are able to identify important quantities in a practical situation and map their relationships using such tools as diagrams, two-way tables, graphs, flowcharts and formulas. They can analyze those relationships mathematically to draw conclusions. They routinely interpret their mathematical results in the context of the situation and reflect on whether the results make sense, possibly improving the model if it has not served its purpose.

6 Attend to precision.

Mathematically proficient students try to communicate precisely to others. They try to use clear definitions in discussion with others and in their own reasoning. They state the meaning of the symbols they choose, including using the equal sign consistently and appropriately. They are careful about specifying units of measure, and labeling axes to clarify the correspondence with quantities in a problem. They calculate accurately and efficiently, express numerical answers with a degree of precision appropriate for the problem context. In the elementary grades, students give carefully formulated explanations to each other. By the time they reach high school they have learned to examine claims and make explicit use of definitions.

Clarifying the Standards

Prior Learning

In grades K–1, students developed addition and subtraction strategies within 20 to solve problems. Students mentally added and subtracted mentally to find 10 more or 10 less than a two-digit number. First-graders were exposed to a variety of problem types.

Current Learning

As reinforcement, second-graders continue to solve a variety of addition and subtraction word problems using models or drawings to represent place value. Students developmentally move forward and rely less on concrete models, moving to equations and strategies that represent place value. By the end of second grade, students solve two-step problems.

There are no routines during this unit other than establishing classroom expectations regarding calendar and accessing and using tools and manipulatives.

Future Learning

In third grade, students will fluently add and subtract within 1,000 using strategies and algorithms using place value. They will solve two-step problems using all four operations using whole numbers.

Additional Findings

According to *A Research Companion to Principles and Standards for Schools Mathematics*, "idiosyncratic representations are both inevitable and necessary for learning mathematics. Yet representations that are general—that aid the solutions of classes of problems—are essential to mathematics. Children must connect their idiosyncratic representations with mathematical ones if they are to progress very far within the discipline" (p. 263).

With regard to distinguishing between a situational representation of a problem and a solution representation, the book states, "the most powerful problem-solving approach is to understand the situation deeply—that is, to be able to draw it or otherwise represent it to oneself … But textbooks and teachers influenced by textbooks push students to write solution representations that are not consistent with their view of the situation" (p. 69).

Grade 2 Mathematics, Quarter 1, Unit 1.2

Develop an Understanding of Place Value (1s, 10s, 100s)

Overview

Number of instructional days: 15 (1 day = 45–60 minutes)

Content to be learned

- Demonstrate conceptual understanding to whole numbers from 0–900 using place value by applying concepts of equivalency in composing and decomposing.
- Apply expanded notation to demonstrate equivalency using models, explanations, or other representations.
- Demonstrate understanding of relative magnitude of numbers from 0–900 by ordering whole numbers.
- Compare whole numbers to each other or to benchmark numbers.
- Demonstrate understanding of the relation of inequality when comparing whole numbers using 1, 10, or 100 more and 1, 10, or 100 less.
- Connect number words and numerals to the quantities (0–900) they represent using models, number lines, or explanations.

Mathematical practices to be integrated

Model with mathematics.

- Write an equation.
- Use standard and expanded notation.
- Draw pictures.
- Use words and symbols to explain.

Use appropriate tools strategically.

- Model two- and three-digit numbers using manipulatives and drawings.

Look for and make use of structure.

- Make connections or relationships using manipulatives and 100s chart and "this pattern reminds me of" statements.

Essential questions

- How can you make a number that is 10 more? 10 less? 100 more? 100 less?
- How many different ways can you write (a three-digit number) in expanded notation?
- How could you compare any set of numbers?
- How would you order a given set of numbers?
- Why do you use the plus sign (+) to write a number in expanded form?
- How can you decompose/compose (a given number)?

Written Curriculum

Common Core State Standards for Mathematical Content

Number and Operations in Base Ten **2.NBT**

Understand place value.

2.NBT.1 Understand that the three digits of a three-digit number represent amounts of hundreds, tens, and ones; e.g., 706 equals 7 hundreds, 0 tens, and 6 ones. Understand the following as special cases:

b. The numbers 100, 200, 300, 400, 500, 600, 700, 800, 900 refer to one, two, three, four, five, six, seven, eight, or nine hundreds (and 0 tens and 0 ones).

a. 100 can be thought of as a bundle of ten tens — called a "hundred."

2.NBT.2 Count ~~within 1000;~~ skip-count by 5s, 10s, and 100s.

2.NBT.3 Read and write numbers ~~to 1000~~ using base-ten numerals, number names, and expanded form.

2.NBT.4 Compare two three-digit numbers based on meanings of the hundreds, tens, and ones digits, using >, =, and < symbols to record the results of comparisons.

2.NBT.8 Mentally add 10 or 100 to a given number 100~~–900~~, and mentally subtract 10 or 100 from a given number 100~~–900~~.

Common Core Standards for Mathematical Practice

4 Model with mathematics.

Mathematically proficient students can apply the mathematics they know to solve problems arising in everyday life, society, and the workplace. In early grades, this might be as simple as writing an addition equation to describe a situation. In middle grades, a student might apply proportional reasoning to plan a school event or analyze a problem in the community. By high school, a student might use geometry to solve a design problem or use a function to describe how one quantity of interest depends on another. Mathematically proficient students who can apply what they know are comfortable making assumptions and approximations to simplify a complicated situation, realizing that these may need revision later. They are able to identify important quantities in a practical situation and map their relationships using such tools as diagrams, two-way tables, graphs, flowcharts and formulas. They can analyze those relationships mathematically to draw conclusions. They routinely interpret their mathematical results in the context of the situation and reflect on whether the results make sense, possibly improving the model if it has not served its purpose.

5 Use appropriate tools strategically.

Mathematically proficient students consider the available tools when solving a mathematical problem. These tools might include pencil and paper, concrete models, a ruler, a protractor, a calculator, a spreadsheet, a computer algebra system, a statistical package, or dynamic geometry software. Proficient students are sufficiently familiar with tools appropriate for their grade or course to make sound decisions about when each of these tools might be helpful, recognizing both the insight to be gained and their

limitations. For example, mathematically proficient high school students analyze graphs of functions and solutions generated using a graphing calculator. They detect possible errors by strategically using estimation and other mathematical knowledge. When making mathematical models, they know that technology can enable them to visualize the results of varying assumptions, explore consequences, and compare predictions with data. Mathematically proficient students at various grade levels are able to identify relevant external mathematical resources, such as digital content located on a website, and use them to pose or solve problems. They are able to use technological tools to explore and deepen their understanding of concepts.

7 Look for and make use of structure.

Mathematically proficient students look closely to discern a pattern or structure. Young students, for example, might notice that three and seven more is the same amount as seven and three more, or they may sort a collection of shapes according to how many sides the shapes have. Later, students will see 7×8 equals the well remembered $7 \times 5 + 7 \times 3$, in preparation for learning about the distributive property. In the expression $x^2 + 9x + 14$, older students can see the 14 as 2×7 and the 9 as $2 + 7$. They recognize the significance of an existing line in a geometric figure and can use the strategy of drawing an auxiliary line for solving problems. They also can step back for an overview and shift perspective. They can see complicated things, such as some algebraic expressions, as single objects or as being composed of several objects. For example, they can see $5 – 3(x – y)^2$ as 5 minus a positive number times a square and use that to realize that its value cannot be more than 5 for any real numbers x and y.

Clarifying the Standards

Prior Learning

In kindergarten, students were exposed to the concept of bundling 10 as they counted up to 19 objects. They compared quantities of objects and numerals up to 10. In first grade, students counted bundles of 10, and counted and wrote numerals up to 120. They were introduced to the symbols > and < and used them to compare two-digit numbers.

Current Learning

In second grade, students extend their understanding of the base-ten system. Students use their understanding of addition to develop fluency with addition and subtraction within 100. They solve problems within 1,000 by applying their understanding of models for addition and subtraction. They develop, discuss, and use efficient, accurate, and generalizable methods of computing sums and differences of whole numbers in base-ten notation, Students use their understanding of place value and the properties of operations.

By the end of second grade, students read and write numbers to 1,000. They mentally add to 10, to 100, to a given number 100–900, and they mentally subtract 10 from 100–900.

Routines

- Solve addition and subtraction problems.
- Mentally add/subtract 10 to a two-digit number.

Future Learning

In the third grade, instruction will shift from addition and subtraction to multiplication and division. Addition and subtraction will be used to solve multi-step problems.

Additional Findings

According to *Principles and Standards for Schools Mathematics*, "understanding of numbers develops in prekindergarten through grade 2 as children count and learn to recognize 'how many' in sets of objects. A key idea is that a number can be decomposed and thought about in many ways." The book states "instructional programs … should enable all students to understand numbers, ways of representing numbers, relationships among numbers, and number systems; understanding meanings of operations and how they relate to one another; compute fluently and make reasonable estimates" (pp. 32–33).

The book also states that concrete models can help students represent numbers and develop number sense; they can also help bring students' use of written symbols and can be useful in building place value concepts. Using rote materials does not ensure understanding. Teachers need to uncover students' thinking as they work with concrete materials by using appropriate questions. Teachers need to choose interesting tasks that engage students in a deeper level of thinking and reasoning. "It is absolutely essential that students develop a solid understanding of the base-ten numerations system and place-value concepts by the end of second grade" (p. 81).

Grade 2 Mathematics, Quarter 1, Unit 1.3

Understanding Addition and Subtraction and Relating Those Operations to Linear Models

Overview

Number of instructional days: 15 (1 day = 45–60 minutes)

Content to be learned

- Use drawings and equations to solve word problems using a number line.
- Represent whole numbers as lengths on a number line diagram.
- Use addition and subtraction within 20 to solve one-step problems (adding to, taking from, putting together, taking apart, and comparing).
- Use mental strategies to add and subtract within 20.
- Determine whether a group of objects (up to 20) has an even or odd number of members.
- Write an equation to represent an even number as a sum of two equal addends (i.e., 18 = 9 + 9).

Mathematical practices to be integrated

Make sense of problems and persevere in solving them.

- Explain to themselves the meaning of the problems.
- Check answers to problems using a different method.
- Plan a solution pathway.

Reason abstractly and quantitatively.

- Attend to the meaning of quantities.
- Represent a problem situation symbolically.
- Make meaning of numbers and symbols.

Essential questions

- What combinations can you make when adding a string of numbers to solve a problem?
- How can you tell if an answer is incorrect?
- How do you know if a number is even or odd?
- Why does the order you add the addends not change the sum?
- How can addition help you solve a subtraction problem?
- What does an equal sign tell you about the two sides of an equation?

Written Curriculum

Common Core State Standards for Mathematical Content

Measurement and Data 2.MD

Relate addition and subtraction to length.

2.MD.5 Use addition and subtraction within 100 to solve word problems involving lengths that are given in the same units, e.g., by using drawings (such as drawings of rulers) and equations with a symbol for the unknown number to represent the problem.

2.MD.6 Represent whole numbers as lengths from 0 on a number line diagram with equally spaced points corresponding to the numbers 0, 1, 2, ..., and represent whole-number sums and differences within 100 on a number line diagram.

Operations and Algebraic Thinking 2.OA

Add and subtract within 20.

2.OA.1 Use addition and subtraction ~~within 100~~ to solve one- ~~and two-~~step word problems involving situations of adding to, taking from, putting together, taking apart, and comparing, with unknowns in all positions, e.g., by using drawings and equations ~~with a symbol for the unknown number to represent the problem.~~[1]

2.OA.2 Fluently add and subtract within 20 using mental strategies.[2] By end of Grade 2, know from memory all sums of two one-digit numbers.

[2] See standard 1.OA.6 for a list of mental strategies.

Work with equal groups of objects to gain foundations for multiplication.

2.OA.3 Determine whether a group of objects (up to 20) has an odd or even number of members~~, e.g., by pairing objects or counting them by 2s;~~ write an equation to express an even number as a sum of two equal addends.

Common Core Standards for Mathematical Practice

1 Make sense of problems and persevere in solving them.

Mathematically proficient students start by explaining to themselves the meaning of a problem and looking for entry points to its solution. They analyze givens, constraints, relationships, and goals. They make conjectures about the form and meaning of the solution and plan a solution pathway rather than simply jumping into a solution attempt. They consider analogous problems, and try special cases and simpler forms of the original problem in order to gain insight into its solution. They monitor and evaluate their progress and change course if necessary. Older students might, depending on the context of the problem, transform algebraic expressions or change the viewing window on their graphing calculator to get the information they need. Mathematically proficient students can explain correspondences between equations, verbal descriptions, tables, and graphs or draw diagrams of important features and relationships, graph data, and search for regularity or trends. Younger students might rely on using

concrete objects or pictures to help conceptualize and solve a problem. Mathematically proficient students check their answers to problems using a different method, and they continually ask themselves, "Does this make sense?" They can understand the approaches of others to solving complex problems and identify correspondences between different approaches.

2 Reason abstractly and quantitatively.

Mathematically proficient students make sense of quantities and their relationships in problem situations. They bring two complementary abilities to bear on problems involving quantitative relationships: the ability to *decontextualize*—to abstract a given situation and represent it symbolically and manipulate the representing symbols as if they have a life of their own, without necessarily attending to their referents—and the ability to *contextualize*, to pause as needed during the manipulation process in order to probe into the referents for the symbols involved. Quantitative reasoning entails habits of creating a coherent representation of the problem at hand; considering the units involved; attending to the meaning of quantities, not just how to compute them; and knowing and flexibly using different properties of operations and objects.

Clarifying the Standards

Prior Learning

In first grade, students used a variety of models to add within 100. They demonstrated fluency when adding and subtracting facts to 10. They were exposed to a variety of word problems.

Current Learning

As reinforcement, students move forward in adding and subtracting fluently within 20. Developmentally, students use addition and subtraction to solve one-step word problems. These problems include adding to, taking from, putting together, taking apart, and comparing, with unknowns in all positions. Students should be applying their knowledge of place value (tens and ones) to solving addition and subtraction problems by using models of tens and ones, such as base-ten blocks and drawings. By the end of second grade, they move from concrete pictures to algorithms with application of base-ten knowledge. Second grade students know sums of all two one-digit numbers from memory by the end of the year.

Routines

- Find 1 more, 1 less, 10 more, 10 less than a given number.
- Compare/order numbers by benchmark numbers.

Future Learning

In third grade, instruction will shift from addition and subtraction to multiplication and division, and addition and subtraction will be used to solve multi-step problems. Students will continue to use number lines to solve problems moving from length in second grade to more abstract concepts such as time intervals in minutes in third grade.

Additional Findings

According to *Principles and Standards for School Mathematics*, "The decisions that teachers make about problem solving opportunities influence the depth and breadth of students' mathematics learning. Teachers must be clear about the mathematics they want their students to accomplish as they structure situations that are both problematic and attainable for a wide range of students" (pp. 118–119).

The book also states that by the end of second grade, "a key idea is that a number can be decomposed and thought about in many ways" (p. 33).