Operations and Algebraic Thinking

The term *operations* seems rather straightforward, as it has traditionally been the focus of elementary mathematics education. **Operations** consist of the use of numbers to add, subtract, multiply, and divide.

Algebraic Thinking has two components–the development of *mathematical thinking tools* and the study of fundamental *algebraic ideas*. Mathematical thinking tools include the analytical habits of mind, such as problem solving, representation, and reasoning skills. The study of fundamental algebraic ideas consists of the content domain in which mathematical thinking tools develop.

The two components work together. Whereas mathematical thinking tools imply the application of thinking and reasoning processes, algebraic ideas comprise the "meat" for study, such as algebraic variables, expressions, and properties. In order to think logically (e.g., to use a mathematical thinking tool such as deductive reasoning), a child needs something to think about (e.g., showing why addition is commutative). When applying the most current view, which embraces the development of mathematical thinking tools, it becomes exciting to envision first grade children developing their Algebraic Thinking.

The Grade 1 Common Core State Standards for Operations and Algebraic Thinking specify that children should–

- Represent and solve problems involving addition and subtraction.
- Understand and apply properties of operations and the relationship between addition and subtraction.
- Add and subtract within 20.
- Work with addition and subtraction equations.

The following hands-on activities enable teachers to help children learn the concepts of operations and algebraic thinking in a rich and meaningful way. As children work through the activities, teachers will want to help them learn to make sense of problems and persevere at solving them when they become difficult.

To help children become proficient problem solvers, it will be important that teachers lead children to develop self-regulatory strategies, such as focusing on the critical information in a given problem, taking reasonable risks, remaining flexible, and figuring out what they know and do not know. These strategies enable children to become more sophisticated problem solvers by helping them "push through" problems when necessary.

Operations and Algebraic Thinking

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LESSON 1

Objective

Write and solve addition sentences.

Common Core State Standards

- **1.OA.1** Use addition and subtraction within 20 to solve word problems involving situations of adding to, taking from, putting together, taking apart, and comparing, with unknowns in all positions, e.g., by using objects, drawings, and equations with a symbol for the unknown number to represent the problem.

Operations and Algebraic Thinking

Addition Sentences

Adding numbers is essentially joining a part to a part to make a whole. In order to write a number sentence with addition, children will have to be fluent with the plus sign (+) and the equal sign (=). Children should understand that they are writing sentences in which the left side of the equal sign is equal to the right side of the equal sign.

Try It! *Perform the Try It! activity on the next page.*

Talk About It

Discuss the Try It! activity.

- **Ask:** *How many children had apples for dessert? How many had oranges? Which Cuisenaire® Rods did you use to show the apples and oranges?*
- **Ask:** *How many children had fruit? How do you know?*
- **Ask:** *What rods could we use to add together 3 and 4? What number sentence would we write?*
- Discuss with children other situations in which they might want to add two numbers together. Ask them how they would write number sentences in these situations using a plus sign and an equal sign.

Solve It

With children, reread the problem. Ask children to draw a picture to show that two oranges plus three apples equals five pieces of fruit. Then have them write the number sentence 2 + 3 = 5 below their drawing.

More Ideas

For other ways to teach about writing and solving addition sentences—

- Give children Two-Color Counters and have them follow verbal instructions for solving addition sentences. For example, **say:** *Use red counters to show glasses of grape juice, and use yellow counters to show apple juice. Add 4 glasses of grape juice and 5 glasses of apple juice to find how many glasses of juice children drank in all.* Then have children write a number sentence to match the model.
- Have children use Snap Cubes® to show joining problems. For example, **say:** *Five birds were sitting on a tree branch. Two more birds landed on the branch.* **Ask:** *How many were there in all?* Then have children write the addition sentence for the problem.

Formative Assessment

Have children try the following problem.

A fish tank has four fish. A child brings in two more fish for the tank. Circle the addition sentence that shows how many fish in all are in the tank.

A. 4 + 4 = 8 **B.** 4 + 2 = 6 **C.** 2 + 2 = 4

Try It! 30 minutes | Pairs

Here is a problem about writing and solving addition sentences.

At lunch today, two children had oranges for dessert and three children had apples. How many children in all had fruit?

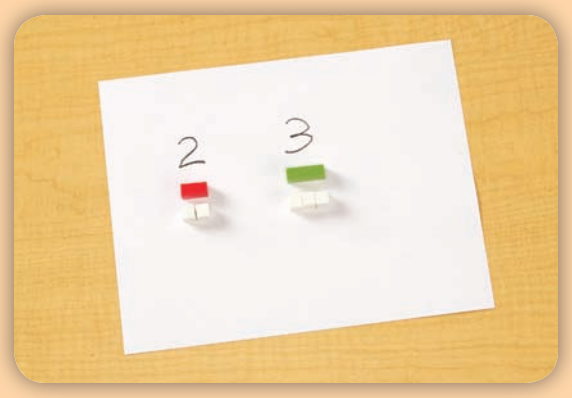
Introduce the problem. Then have children do the activity to solve the problem.

Give each pair Cuisenaire® Rods, crayons, and paper. **Say:** *The white rod is one unit. It stands for one piece of fruit.*

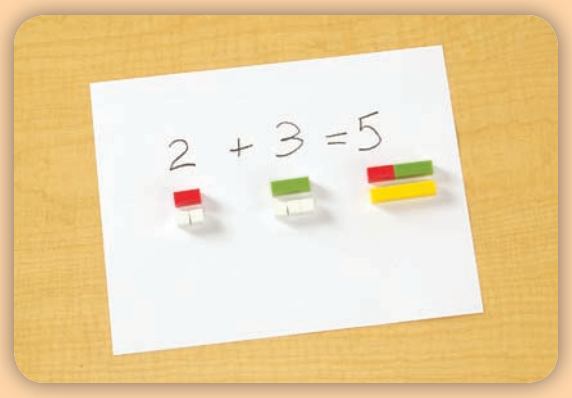
Materials

- Cuisenaire® Rods (5 white, 1 red, 1 light green, and 1 yellow per pair)
- crayons (an assortment per pair)
- paper (1 sheet per pair)

1. Say: *Compare the white rods with the other rods. Find the rod that is equal to 2 units. Put it on your paper above the two white rods. Write "2" above the rods.*



2. Ask children to find the rod that is equal to 3 units. **Say:** *Put the rod on your paper next to the red rod. Write "3" above the 3-unit rod.*



3. Say: *Make a train with a red rod and a green rod to show the sum. Then use the numbers you wrote to make an addition sentence. Write a plus sign and an equal sign to write an addition sentence for* 2 plus 3. *Then match the train with another rod. Use the rods to show the addition sentence.*

⚠ Look Out!

Check that children have placed the addition sign and equal sign in the correct place. Emphasize that the addition sign goes between the numbers being joined and that the equal sign is placed after the numbers have joined. The sum comes after the numbers have joined, so it follows the equal sign.

Answer Key

Use Cuisenaire Rods. Build the addition sentence. Write the number sentence.

(Check students' work.)

1. yellow + purple

5 + 4 = 9

2. dark green + red

6 + 2 = 8

Use Cuisenaire Rods. Build the addition sentence. Draw the model. Write the number sentence.

3. 3 + 4

3 + 4 = 7

Find each sum.

4. 3 + 8 = 11

5. 4 + 4 = 8

6. 1 + 5 = 6

7. 7 + 2 = 9

Answer Key

Challenge! What does the symbol + mean?
What does the symbol = mean?

Challenge: (Sample) add; equals

LESSON 2

Objective

Write and solve subtraction sentences.

Common Core State Standards

- **1.OA.1** Use addition and subtraction within 20 to solve word problems involving situations of adding to, taking from, putting together, taking apart, and comparing, with unknowns in all positions, e.g., by using objects, drawings, and equations with a symbol for the unknown number to represent the problem.

Operations and Algebraic Thinking

Subtraction Sentences

Subtracting numbers requires that children be able to find the difference between two values. Real-life situations will show them that this is a skill they use on a daily basis. In order to write a number sentence, children must use a subtraction sign (–) and an equal sign (=).

Try It! *Perform the Try It! activity on the next page.*

Talk About It

Discuss the Try It! activity.

- **Ask:** *How many Two-Color Counters did you have when you began? How many were taken away? How can you find how many were left?*
- **Ask:** *What part of a subtraction sentence shows how many are left after some are taken away?*
- Encourage children to describe everyday situations in which they might use subtraction sentences. For example, **ask:** *How many of 20 grapes were left for you after your brother ate 10?* Take some of the examples children give and write subtraction problems for them on the board.

Solve It

With children, reread the problem. Have children draw a picture showing the number of balloons that Ben put in his picture.

More Ideas

For other ways to teach about writing and solving subtraction sentences—

- Use Cuisenaire® Rods to show the difference in a "take away" model. Have children use two rods of different lengths. Have them explain the difference in length, and then find a third rod to combine with the shorter rod to equal the longer one. Make sure children understand that the third rod shows the difference between the other two.
- Have children use a number line and Two-Color Counters to model subtraction; for example, **say:** *Chris walked 7 steps forward. Then he took 2 steps back.* **Ask:** *How many steps forward is he?* Have children write a number sentence that shows this problem on the number line.

Formative Assessment

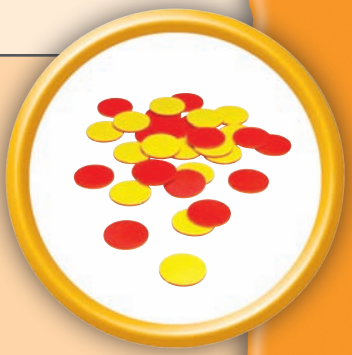
Have children try the following problem.

Billy has 5 apples. He gives 2 apples away. How many does he have left? Circle the number sentence that shows the answer for this problem.

A. 5 – 2 = 7

B. 5 – 2 = 3

C. 3 – 2 = 5



Try It! 30 minutes | Pairs

Here is a problem about writing and solving subtraction sentences.

In Mrs. Hinkley's class, children are pasting paper circles on pictures to show bunches of balloons. Ben wants to show 10 balloons. After creating 10 paper circles, Ben goes to get some water. Ben's friend Leon takes some of Ben's circles. How can Ben figure out how many circles Leon took?

Introduce the problem. Then have children do the activity to solve the problem.

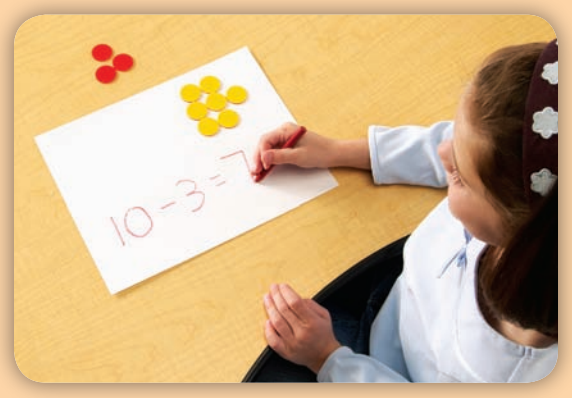
Give each pair Two-Color Counters, paper, and a crayon. **Say:** *Let's pretend that each counter is a paper circle like the ones Ben was using.*

Materials

- Two-Color Counters (10 per pair)
- paper (1 sheet per pair)
- crayons (1 per pair)

1. Ask one partner to assemble the counters in a group. **Say:** *Put the yellow counters in a group on the paper, count them, and write the number of counters below the group.*

2. Ask the other partner to flip 3 counters in the group of 10 over to red. Then place the 3 red counters to the right of the group. **Say:** *Write the number 3 below the group of counters we're taking away. Then write the minus sign before the 3 to show you are taking them away in your number sentence.*



3. Ask: *How many counters are left after 3 are taken away from the 10?* **Say:** *Count to find the number. Then complete the subtraction sentence on your paper to show the answer. Remember to write an equal sign before the number that is left over.*

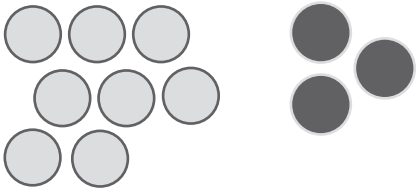
⚠ Look Out!

Some children might want to add instead of subtract. Others might confuse the –, +, and = symbols. Make sure they understand the meanings of these symbols and how they are used. Also watch for children placing the "take away" or smaller number first in the sentence.

Answer Key

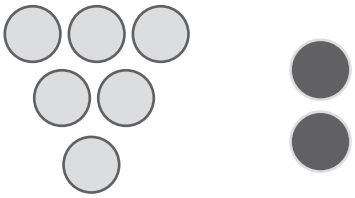
Use Two-Color Counters. Build each subtraction problem. Write the number sentence.

(Check students' work.)

1. 

11 – 3

11 – 3 = 8

2. 

8 – 2

8 – 2 = 6

Use Two-Color Counters. Build the subtraction shown. Draw the model. Complete the number sentence.

3. 9 – 5 = 4

4. 8 – 7 = 1

5. 5 – 3 = 2

Answer Key

Challenge! Complete the subtraction sentence. Then write an addition sentence to check your answer.

12 – 5 = _____

Challenge: 7; 7 + 5 = 12

LESSON 3

Objective

Compute the sum of three numbers.

Common Core State Standards

- **1.OA.2** Solve word problems that call for addition of three whole numbers whose sum is less than or equal to 20, e.g., by using objects, drawings, and equations with a symbol for the unknown number to represent the problem.

Operations and Algebraic Thinking

Adding Three Numbers

In addition, the numbers being combined are addends, and the total is the sum. When adding more than two numbers, the numbers can be added in any order (5 + 6 + 2 = 13 or 2 + 5 + 6 = 13) or grouped in any way ((5 + 6) + 2 = 13) or 5 + (6 + 2) = 13). Working with this skill also reinforces the concept of making fives and tens. It is this type of strategy that helps children to develop not only their number sense, but also mental math computations.

Try It! *Perform the Try It! activity on the next page.*

Talk About It

Discuss the Try It! activity.

- Have children look at their DecaDots® tiles used in the Try It! activity.
- **Ask:** *Which tiles show the T-shirts? Which show the sweatshirts? Which show the dress shirts?*
- **Ask:** *How many ten tiles can overlap the other tiles? What does the number of ten tiles represent?*
- **Ask:** *How many shirts did Corey pack? How did you know?*

Solve It

With children, reread the problem. Invite children to draw pictures of Corey's shirts or use symbols to represent them. Next, have children label the picture with a numerical answer and write a sentence explaining the number of shirts Corey packed.

More Ideas

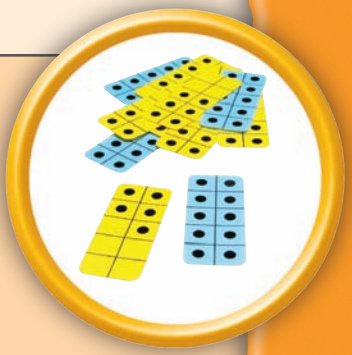
For other ways to teach about adding three numbers—

- Have children use different color Snap Cubes® to represent separate addends, then combine them into one long row, and count to find the sum.
- Have children use counters or Snap Cubes to try adding the same three numbers in different orders to explore the Commutative Property of Addition. Also, Cuisenaire® Rods could be used to explore number properties such as commutative and associative.

Formative Assessment

Have children try the following problem.

Draw pictures to solve this problem, and write a number to show your answer. Mariah is buying bananas. She takes a bunch with 6 bananas, then one with 4 bananas, and then one with 3 bananas. How many bananas did she buy altogether?



Try It! 30 minutes | Pairs

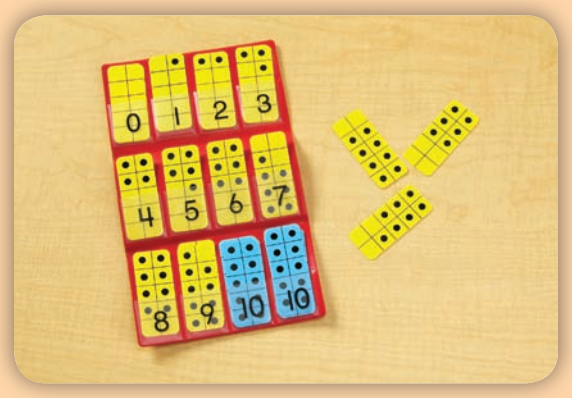
Here is a problem for adding three numbers.

Corey packed 7 T-shirts, 8 sweatshirts, and 6 dress shirts for his trip. How many shirts did he pack in all?

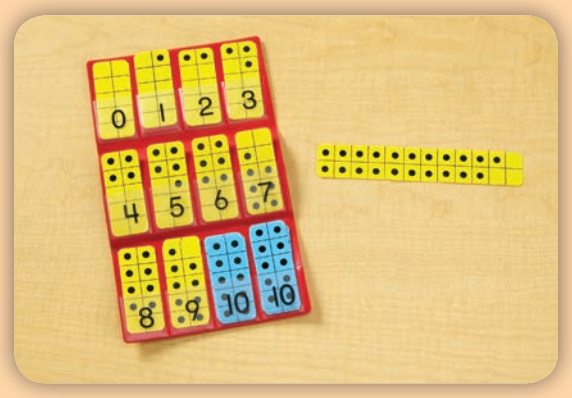
Introduce the story problem. Then have children do the activity to solve the problem.

Say: *Let's determine how many shirts Corey packed.*

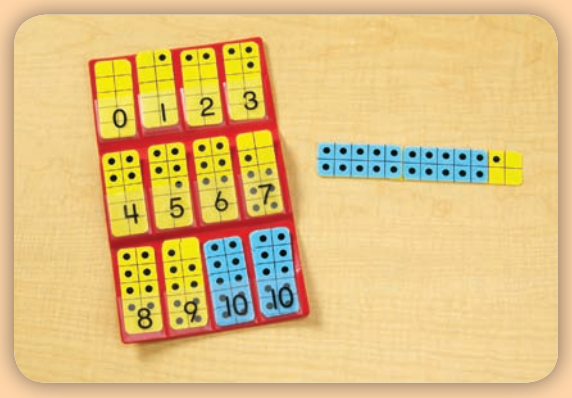
Materials
- DecaDots® wallet (1 per pair)



1. To begin, have children choose tiles to show the numbers of T-shirts, sweatshirts, and dress shirts Corey packed.



2. Have children place the tiles in a row so that as many dots are next to each other as possible. You may overlap part of a tile with another.



3. Finally, have children place a ten tile on top of a group of 10 dots. Repeat if another group of 10 dots exists. **Ask:** *How many shirts did Corey pack in all? What number is represented by the DecaDots?*

⚠ Look Out!

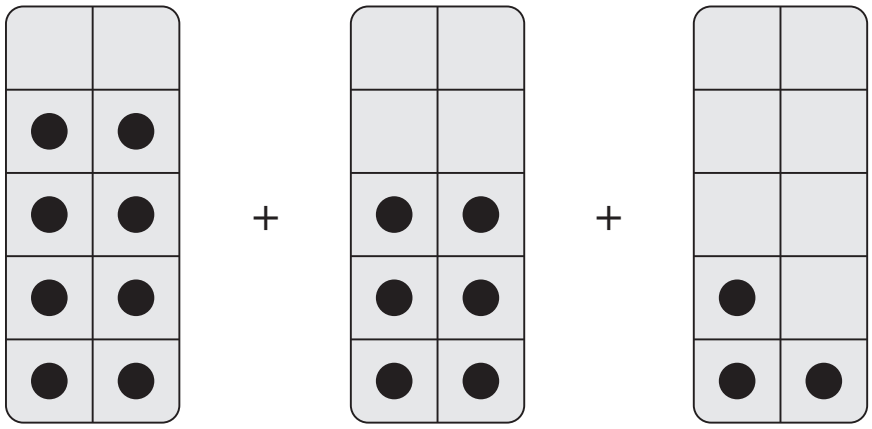
Watch for children who do not know where to begin when adding three numbers. Remind children to add two numbers first and then add the third number.

Answer Key

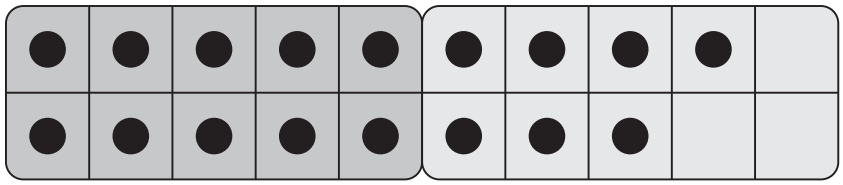
Use DecaDots. Add the numbers modeled. Write the sentence and sum.

(Check students' work.)

1.



8 + 6 + 3 = 17



Use DecaDots. Model the addition. Draw the model. Write the sum.

2. 6 + 8 + 5 = 19

Find the sum.

3. 7 + 7 + 4 = 18

4. 3 + 8 + 9 = 20

Answer Key

Challenge! Find three numbers that add to 16. Write a number sentence for these numbers.

Challenge: (Sample) 10, 4, and 2; 10 + 4 + 2 = 16

LESSON 4

Objective

Explore the Associative Property of Addition.

Common Core State Standards

- **1.OA.2** Solve word problems that call for addition of three whole numbers whose sum is less than or equal to 20, e.g., by using objects, drawings, and equations with a symbol for the unknown number to represent the problem.
- **1.OA.3** Apply properties of operations as strategies to add and subtract. *Examples: If 8 + 3 = 11 is known, then 3 + 8 = 11 is also known. (Commutative property of addition.) To add 2 + 6 + 4, the second two numbers can be added to make a ten, so 2 + 6 + 4 = 2 + 10 = 12. (Associative property of addition.)*

Operations and Algebraic Thinking

Associative Property

As children begin to understand addition, they explore situations in which they repeatedly add the same numbers in different contexts. Teachers can introduce strategies for adding three or more addends that can make solving a problem easier. The Associative Property of Addition allows addends to be regrouped without changing the sum, for example, (1 + 2) + 3 = 1 + (2 + 3).

Try It! *Perform the Try It! activity on the next page.*

Talk About It

Discuss the Try It! activity.

- **Ask:** *How many different number sentences did you find that added these three numbers?*
- **Say:** *Look at the totals for every sentence.* **Ask:** *Did the total change at all?*
- Write *3 + 5 + 2 = 10* on the board. **Ask:** *What do you think will happen if we add 3 + 2 first and then add 5? Will the total still be 10?*

Solve It

With children, reread the problem. Have children explain how changing the order of addends affected each sum. Then have children illustrate the three number sentences by drawing pictures of the three kinds of fish in the fish tank.

More Ideas

For other ways to teach about the Associative Property of Addition—

- Give children eleven Snap Cubes® in three different colors, such as blue, red, and green. Have children make three single-color trains, then combine two of the trains first before adding the third. Have children write a number sentence modeled by the cubes, such as 3 + 3 + 5 = 11. Then have children repeat by combining two different trains first before adding the third. Have them write a new number sentence shown by the cubes, such as 3 + 5 + 3 = 11. Stress to children that the sum of both number sentences is the same, no matter which two numbers are added together first.
- Distribute 12 Two-Color Counters and two copies of the Ten Frame (BLM 2) to children. Write *3 + 4 + 5* on the board. Have children model 3 + 4 on one grid and 5 on the other. Tell children to find the sum. Then have children regroup the counters to show 3 on one grid and 4 + 5 on the other, and find the sum again.

Formative Assessment

Have children try the following problem.

Write the addition sentence another way.

2 + 3 + 4 = 9

_____ + _____ + _____ = 9

Try It! 30 minutes | Groups of 3

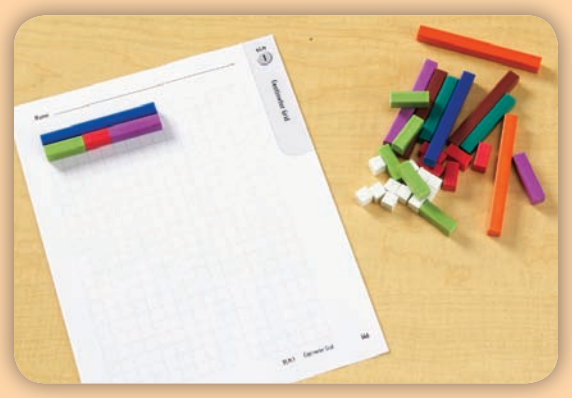
Here is a problem that relates to the Associative Property of Addition.

There are 3 goldfish, 2 catfish, and 4 guppies in a fish tank. Mrs. Kennedy asked her class to write addition problems to show the total number of fish in the tank. They wrote 3 different sentences. Were they all correct?

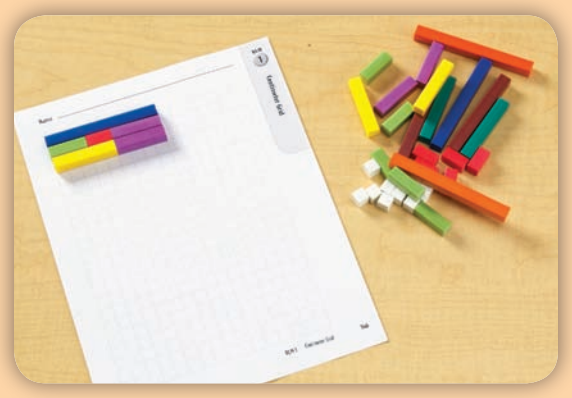
Introduce the problem. Then have children do the activity to solve the problem. Pass out materials to children. Explain that one white Cuisenaire® Rod equals one unit. Have children use the white rods to establish the values of the other rods.

Materials

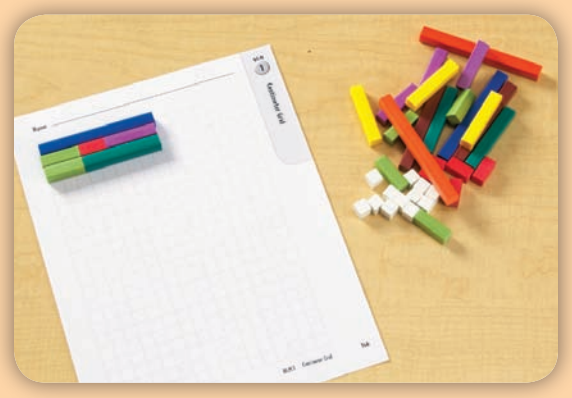
- Cuisenaire® Rods ($\frac{1}{2}$ set per group, or 11 white, 6 red, 5 light green, 3 purple, and 2 each of yellow, dark green, black, brown, blue, and orange)
- Centimeter Grid (BLM 1; 1 per child)
- crayons



1. Have children model the addition problem 3 + 2 + 4 using rods. Ask children to find one rod the same length as the train they built and place it above. Have children draw these trains on their Centimeter Grid.



2. Have children find a rod that is the same length as the light green and red rods. Place this rod underneath to show the sum. **Ask:** *What is the value of this rod?* Have children complete the train with the purple rod. **Ask:** *What number sentence is shown by this new train?* Have children remove the yellow and purple train. Have children draw these trains on their grid.



3. Have children find a rod that is the same length as the purple and red rods. Place this rod underneath to show the sum. Complete the train with the light green rod. **Ask:** *What is the value of this rod? What number sentence is shown by this new train?* Have children draw these trains on their grid. Compare all the sums to confirm they are the same.

⚠ Look Out!

Some children might not see the relationship among the sizes of the rods as easily as others, and may count each rod as one unit. Have children arrange a staircase with the rods to help them see the relationship among them. Then have them stack white rods next to the taller rods to help them see how many units each rod represents.

Answer Key

Use Cuisenaire Rods to build the trains. Write a number sentence for each row.

(Check students' work.)

1.

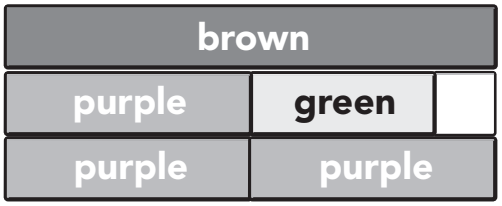
1 + 3 + 2 = 6

1 + 5 = 6

1 + 3 + 2 = 6

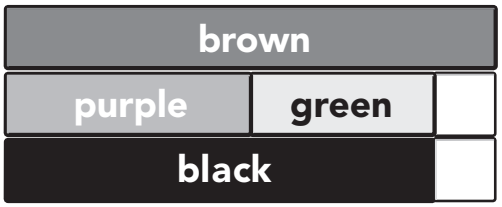
4 + 2 = 6

2.



4 + 3 + 1 = 8

4 + 4 = 8



4 + 3 + 1 = 8

7 + 1 = 8

Group 2 numbers. Add them. Then write an addition sentence with the sum and the third number.

3. 6, 1, and 3

7 + 3 = 10

6 + 4 = 10

4. 4, 1, and 2

5 + 2 = 7

4 + 3 = 7

Answer Key

Challenge! What did writing two number sentences for each set of three numbers tell you about adding three numbers?

Challenge: (Sample) The way you group three numbers does not change the sum.

LESSON 5

Objective

Explore the Commutative Property of Addition.

Common Core State Standards

- **1.OA.3** Apply properties of operations as strategies to add and subtract. *Examples: If 8 + 3 = 11 is known, then 3 + 8 = 11 is also known. (Commutative property of addition.) To add 2 + 6 + 4, the second two numbers can be added to make a ten, so 2 + 6 + 4 = 2 + 10 = 12. (Associative property of addition.)*

Operations and Algebraic Thinking

Commutative Property I

Children's number sense develops as they understand the size of numbers, develop different ways of representing numbers, and use numbers with operations. Exploring the Commutative Property of Addition—whereby children learn that 1 + 2 = 3 means the same thing as 2 + 1 = 3—helps develop children's understanding of the operation of addition.

Try It! *Perform the Try It! activity on the next page.*

Talk About It

Discuss the Try It! activity.

- **Ask:** *What do you notice about the numbers you added in each number sentence? How are they different? How are they the same?*
- **Ask:** *What do you notice about the sum in each number sentence?*
- **Ask:** *How can you show that when you add, you can switch the order of the numbers you are adding and still get the same sum?* Have students break apart their Snap Cube® trains and model switching the order of the numbers they added.

Solve It

With children, reread the problem. Invite children to draw pictures of red and blue stars to model Janie and Tyrone's addition sentences. Have children write two or three sentences to explain why Janie and Tyrone were both right.

More Ideas

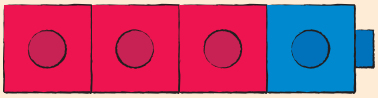
For other ways to teach about the Commutative Property of Addition—

- Write several addition sentences on the board. Tell children that in your addition sentences, the first number is always red and the second is always yellow. Have children use Two-Color Counters to model each one, then flip all the counters over and write the new addition sentence represented by them.
- Have children make a row of 4 red and 6 blue Color Tiles. Then ask children to make another row beneath it of 6 red tiles and 4 blue tiles. Tell children to count the tiles in each row and compare their lengths to show that 4 + 6 = 10 and 6 + 4 = 10. Invite children to use the tiles to model more examples.

Formative Assessment

Have children try the following problem.

The picture below shows 3 + 1 = 4. What is another number sentence that matches the picture below? Circle the answer.



A. 2 + 2 = 4 **B.** 4 + 1 = 5 **C.** 1 + 3 = 4

Try It! 20 minutes | Pairs

Here is a problem that involves the Commutative Property of Addition.

Mr. Andrew will give 2 blue star stickers and 3 red star stickers to students who get A's on their math quizzes. Janie and Tyrone both got A's. They want to know how many stars they will each get. Tyrone wrote 2 + 3 = 5, and Janie wrote 3 + 2 = 5. Who wrote the correct number sentence?

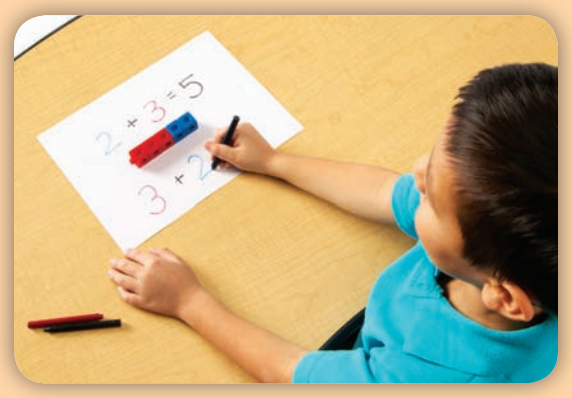
Introduce the problem. Then have children do the activity to solve the problem.

Distribute Snap Cubes®, paper, and crayons to children. Explain to children that they will use the cubes to model two addition sentences.

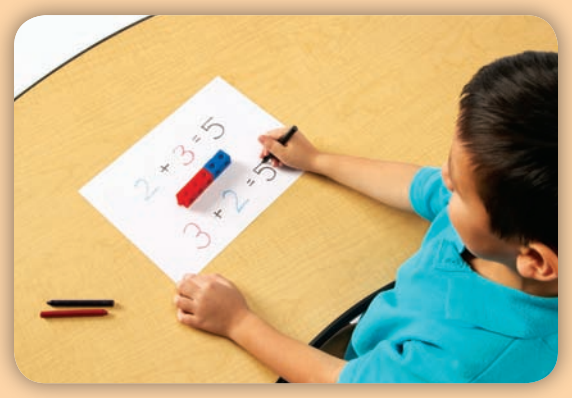
Materials

- Snap Cubes® (3 blue and 3 red per pair)
- paper (1 sheet per pair)
- crayons (1 red, 1 blue, and 1 black per pair)

1. Have children build a train of two blue cubes and then three red cubes. Then have children write the number sentence the train models (2 + 3 = 5) below it using crayon colors to match the cubes in the model.



2. Ask pairs to flip their cube trains over. Have them write the new number sentence modeled by the cube train (3 + 2 = 5) below it.



3. Have pairs examine the number sentences they wrote for each model and compare the two sums. Repeat with more examples as time permits.

⚠ Look Out!

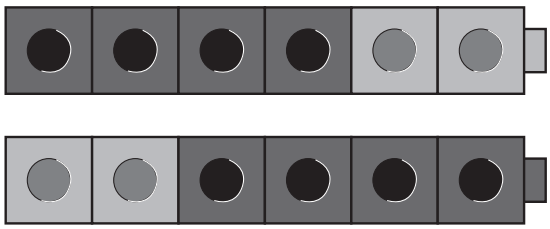
Watch for children who think they can interchange all the numbers in an entire addition number sentence, not just the numbers they are adding. For example, 3 + 5 = 8 would become 8 + 5 = 3. Stress that the sum never changes, just the order of the numbers being added.

Answer Key

Use Snap Cubes. Build the addition sentence. Write a number sentence for each row.

(Check students' work.)

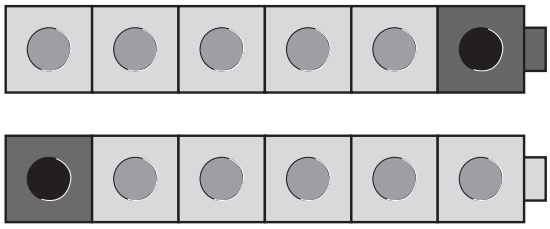
1.



4 + 2 = 6

2 + 4 = 6

2.



5 + 1 = 6

1 + 5 = 6

Use Snap Cubes. Build two addition problems with the numbers. Write both sentences.

3. 5 and 4

5 + 4 = 9

4 + 5 = 9

Write two addition sentences.

4. 2 and 9

2 + 9 = 11

9 + 2 = 11

5. 3 and 7

3 + 7 = 10

7 + 3 = 10

Answer Key

Challenge! What did writing two number sentences for each pair of numbers tell you about adding two numbers?

Challenge: (Sample) The order you add numbers does not change the sum.

LESSON 6

Objective

Explore the Commutative Property of Addition.

Common Core State Standards

- **1.OA.3** Apply properties of operations as strategies to add and subtract. *Examples: If 8 + 3 = 11 is known, then 3 + 8 = 11 is also known. (Commutative property of addition.) To add 2 + 6 + 4, the second two numbers can be added to make a ten, so 2 + 6 + 4 = 2 + 10 = 12. (Associative property of addition.)*

Operations and Algebraic Thinking

Commutative Property II

The Commutative Property of Addition states that addends added in any order will still have the same sum. For any two values, *a* and *b*, $a + b = b + a$. The Commutative Property of Addition is important for numeric values, but it also sets the stage for working with equations in algebra adeptly and flexibly.

Try It! *Perform the Try It! activity on the next page.*

Talk About It

Discuss the Try It! activity.

- **Say:** *Look at your first pair of number sentences.* **Ask:** *How are the numbers being added in each number sentence similar? How are they different?*
- **Ask:** *What did you notice about the sum when you add numbers in a different order?* Elicit from children that the sum is the same regardless of the order of the numbers being added. Discuss as necessary.

Solve It

With children, reread the problem. Ask children to explain in writing the Commutative Property of Addition. Tell children to use this property to explain how Teams A and B got the same answer to the problems.

More Ideas

For other ways to teach about the Commutative Property of Addition—

- Have children create number sentences with three addends. Then have them use one size of Three Bear Family® Counters to model the number sentences and reorder the addends.
- Have pairs of children use a Bucket Balance and Color Tiles to create equalities in which the addends are on the left side of the balance and the sum is on the right side of the balance. For example, have children put 8 tiles on the right side. Have them add 5 tiles to the left side, then 3 tiles to make both sides even. Children should remove tiles from the left side, then add tiles in reverse order, first 3, then 5.

Formative Assessment

Have children try the following problem.

Which of the following means the same as 2 + 3 = 5?

A. 3 + 2 = 5 **B.** 5 – 2 = 3 **C.** 2 + 3 + 2 = 7 **D.** 3 – 2 = 5

Try It! 20 minutes | Groups of 3

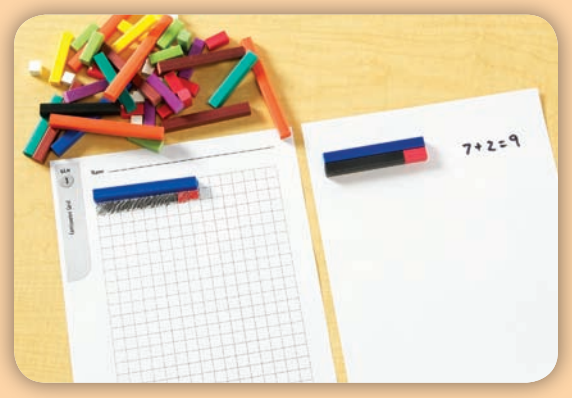
Here is a problem about the Commutative Property of Addition.

Mr. Samuel divided his class into two teams to practice addition problems. He asked Team A to solve 7 + 2. He asked Team B to solve 2 + 7. What answers did the two teams get?

Introduce the problem. Then have children do the activity to solve the problem. Distribute Cuisenaire® Rods, Centimeter Grid (BLM 1), and paper to groups of children.

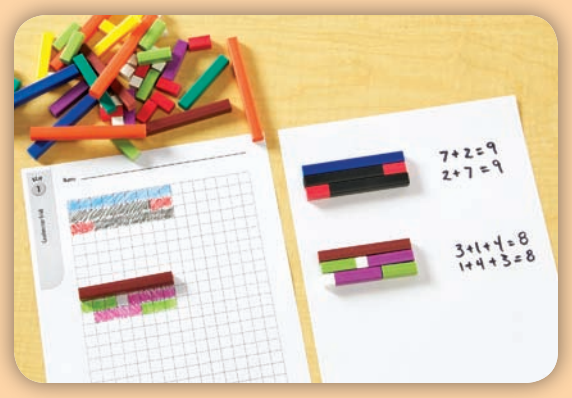
Materials

- Cuisenaire® Rods (half a set per group)
- Centimeter Grid (BLM 1; 1 per group)
- paper (1 sheet per group)
- crayons



1. Ask children to find the rod that is equal to 7. Children should use the white rods to measure, if necessary. Then have children find the rod equal to 2. **Say:** *Now find the rod that is equal to 7 plus 2.* Have children write an addition sentence to show their model.

2. Have children reverse the order of the black and red rods to show 2 + 7. **Say:** *Now build a train to show 2 + 7.* Have children write an addition sentence to show their model. Have children compare the answers of the two addition sentences.



3. Ask: *What if we added three numbers together? Does the order of the three numbers change the answer we get?* Have students model 3 + 1 + 4 with rods, then 1 + 4 + 3. They should reach the conclusion that the numbers can be added in any order.

⚠ Look Out!

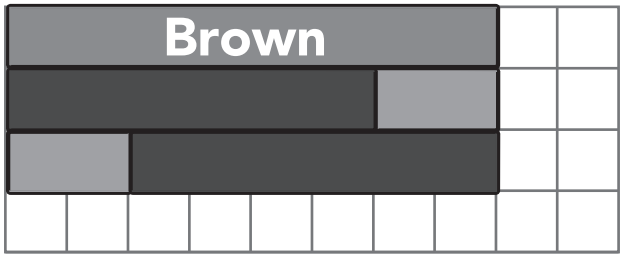
Students may mistakenly think that they can use the Commutative Property of Addition to switch any two numbers in an addition problem. Reaffirm that only the addends can shift places without changing the problem. Demonstrate by showing students that only the numbers to the left of the equal sign may be switched. Also, some students may overgeneralize, thinking that the property can also be applied to subtraction. Demonstrate with rods that changing the number order in a subtraction problem will change the outcome.

Answer Key

Use Cuisenaire Rods to build the model. Write the two addition sentences the model shows.

(Check students' work.)

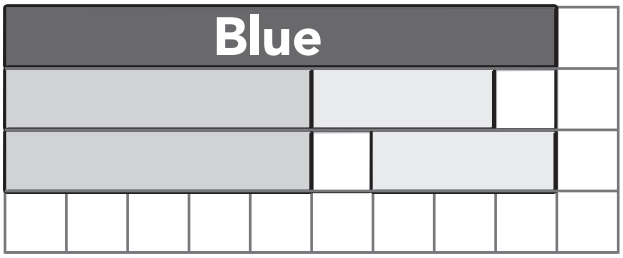
1.



6 + 2 = 8

2 + 6 = 8

2.



5 + 3 + 1 = 9

5 + 1 + 3 = 9

Use Cuisenaire Rods to model the number sentence. Sketch a model that shows the numbers added differently. Write the addition sentence.

3. 3 + 2 = 5

2 + 3 = 5

4. 4 + 5 + 1 = 10

5 + 4 + 1 = 10 or 4 + 1 + 5 = 10

Write an addition sentence that shows the numbers added differently.

5. 8 + 3 = 11

3 + 8 = 11

6. 5 + 4 + 7 = 16

4 + 5 + 7 = 16 or 5 + 7 + 4 = 16

Answer Key

Challenge! Write a different sentence for Question 2 that changes the order of the added numbers. Sketch a model to help.

Challenge: (Sample) 1 + 5 + 3 = 9

LESSON 7

Objective

Identify and create fact families.

Common Core State Standards

- **1.OA.6** Add and subtract within 20, demonstrating fluency for addition and subtraction within 10. Use strategies such as counting on; making ten (e.g., 8 + 6 = 8 + 2 + 4 = 10 + 4 = 14); decomposing a number leading to a ten (e.g., 13 – 4 = 13 – 3 – 1 = 10 – 1 = 9); using the relationship between addition and subtraction (e.g., knowing that 8 + 4 = 12, one knows 12 – 8 = 4); and creating equivalent but easier or known sums (e.g., adding 6 + 7 by creating the known equivalent 6 + 6 + 1 = 12 + 1 = 13).

Fact Families

Fact families provide a method for children to compute fluently with whole numbers. Addition and subtraction fact families help children develop number sense as they see the relationships among numbers and between the operations. Using fact families helps children develop the skill of relating parts to a whole.

Try It! *Perform the Try It! activity on the next page.*

Talk About It

Discuss the Try It! activity.

- **Say:** *Describe the first train you made.* **Ask:** *How many Snap Cubes® of one color did you use? How many cubes of the other color did you use?*
- **Ask:** *What were the addition sentences for your first train? What were the subtraction sentences?*
- **Ask:** *What was the same about the addition sentences and the subtraction sentences?* Help children realize that the same three numbers were used in all four sentences.

Solve It

With children, reread the problem. Then have children choose a number between 4 and 10 and tell how many dolls and trucks might be in a box with that total. Then have children write a fact family of four number sentences for the number they chose.

More Ideas

For other ways to teach about fact families—

- Have children use Two-Color Counters to show fact families in the range 11–20. For example, ask children to show all the fact families for the number 15. Have them line up 15 red counters to represent the total and then use combinations of yellow counters to show the parts that make up the total.
- Use Cuisenaire® Rods to represent fact families. Have children choose one rod and then find as many two-rod combinations that make the same value.

Formative Assessment

Have children try the following problem.

Fill in the missing number in each number sentence.

2 + _____ = 7

5 + 2 = _____

7 – _____ = 5

_____ – 5 = 2

Try It! 30 minutes | Groups of 3

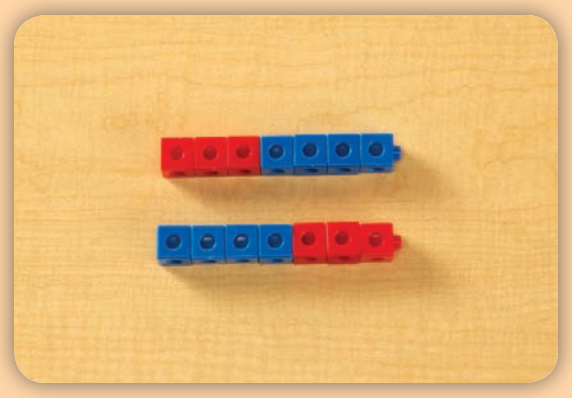
Here is a problem about fact families.

Mrs. Eguchi's class is making boxes of toys to give to another school. Each box can have 4, 5, 6, 7, 8, 9, or 10 toys. Each box will have dolls and trucks. How many dolls and trucks can be in each box?

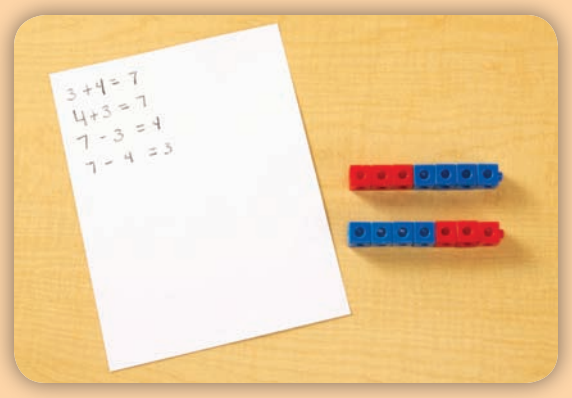
Introduce the problem. Then have children do the activity to solve the problem. Give 40 Snap Cubes® and paper to each group. Assign each group a number from 4 to 10 to represent the number of toys in a box.

Materials

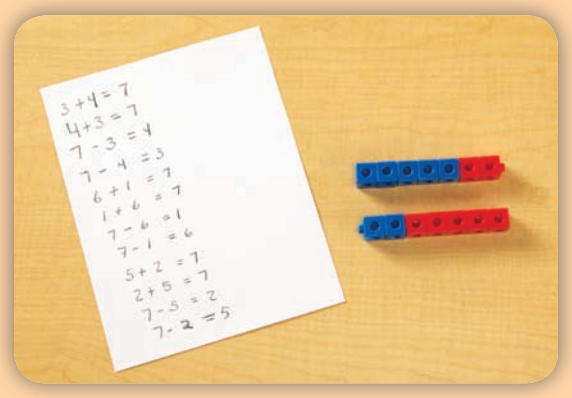
- Snap Cubes® (40 in two colors per group)
- paper (3 sheets per group)
- pencils (1 per child)



1. Ask children to make a train of cubes using two different colors. The total number of cubes in the train should be the same as the number you assigned the group. Children may use any combination of the two colors. Then have children make a second train with the same total, but reverse the numbers of the two colors.



2. Help children to find two addition sentences that describe their trains. Then help them find two subtraction sentences that show what happens if one color is removed from each train that shows the total. Elicit that the same three numbers appear in all the sentences. You may explain that this group of numbers is called a *fact family.* Use your discretion.



3. Encourage children to find all the fact families for their assigned number. Have them make cube trains to show each fact family.

⚠ Look Out!

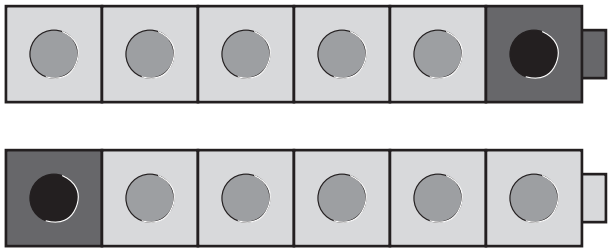
Some children might struggle with the subtraction sentences in the fact family. Reinforce subtraction by using the manipulatives to model how subtraction is part of the family. Also, watch out for children who want to combine three numbers in any which way, such as 3 + 7 = 4. Emphasize that there are two addition facts and two subtraction facts for each set of numbers.

Answer Key

Use Snap Cubes. Build the facts shown. Write two addition sentences. Then write two subtraction sentences.

(Check students' work.)

1.



5 + 1 = 6

1 + 5 = 6

6 − 1 = 5

6 − 5 = 1

Use Snap Cubes. Model two addition sentences. Draw the models. Write a family of sentences.

2. 3, 5, and 8

3 + 5 = 8

5 + 3 = 8

8 − 3 = 5

8 − 5 = 3

3. 6, 4, and 10

6 + 4 = 10

4 + 6 = 10

10 − 4 = 6

10 − 6 = 4

Answer Key

Challenge! Think of two numbers that make a sum of 13. Draw a model to show the sum. Write a family of number sentences.

Challenge: (Sample)
6 + 7 = 13
7 + 6 = 13
13 – 7 = 6
13 – 6 = 7

LESSON 8

Objective

Identify missing addends by calculating the difference between an addend and the sum.

Common Core State Standards

- **1.OA.4** Understand subtraction as an unknown-addend problem. *For example, subtract 10 – 8 by finding the number that makes 10 when added to 8.*
- **1.OA.8** Determine the unknown whole number in an addition or subtraction equation relating three whole numbers. *For example, determine the unknown number that makes the equation true in each of the equations 8 + ? = 11, 5 = □ – 3, 6 + 6 = □.*

Operations and Algebraic Thinking

Finding Missing Addends

In addition, the two numbers being combined are addends, and their total is the sum. Addition problems are usually represented by two known addends and an unknown sum; however, problems can have a missing addend, which can be represented by an algebraic unknown, as in the problem 6 + *a* = 12. When an addend is unknown, compute the difference between the known addend and the sum. This process is referred to as using the inverse operation of addition. This process is a building block for algebraic thinking. Some children may be able to solve this type of equation intuitively using fact families.

Try It! *Perform the Try It! activity on the next page.*

Talk About It

Discuss the Try It! activity.

- Have children look at the DecaDots® tiles used in the Try It! activity.
- **Ask:** *Which tiles show the dollars Carson has already saved? Which tiles show the dollars that Carson wants to save?*
- **Say:** *Count on or find a tile to show the difference between the amount Carson has saved and what he wants to save in all.*
- **Ask:** *How much more money does Carson need to save? How do you know?*

Solve It

With children, reread the problem. Ask children to draw pictures of Carson's savings and what he needs to save. Then, have them write a sentence explaining how much more Carson needs to save.

More Ideas

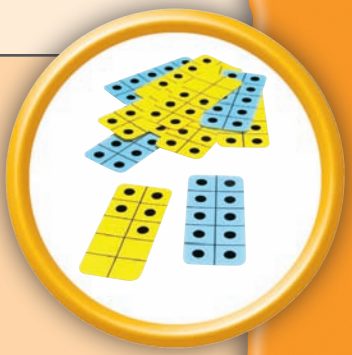
For other ways to teach about missing addends—

- Use Cuisenaire® Rods to find missing addends. Make a train for the sum and then place the given addend along the bottom of the train. Have students fill in the length with the fewest number of rods possible to find the missing addend.
- Have children use Snap Cubes® to find missing addends. Create a train of cubes for the given sum. Then have children create another train all the same color using the given addend. Have children line up the two trains and then build the missing part of the train to find the missing addend.

Formative Assessment

Have children try the following problem.

Draw pictures to solve the problem. Hannah's mother asked her to wash 11 potatoes for dinner. She already washed 5. How many more potatoes should she wash? Write a number sentence to explain your picture.



Try It! 30 minutes | Pairs

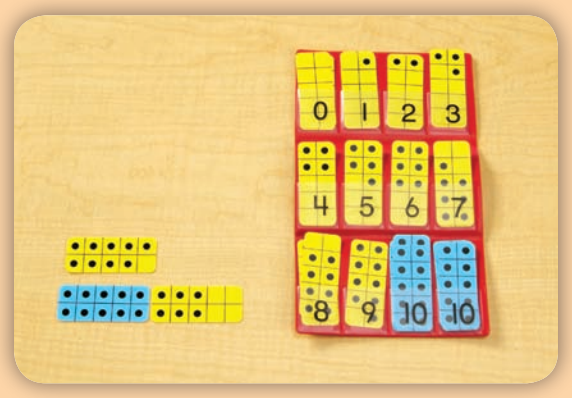
Here is a problem using missing addends.

Carson has $9 in the bank. He wants to save $16 to buy a new game. How much more money does he need to save to buy the game?

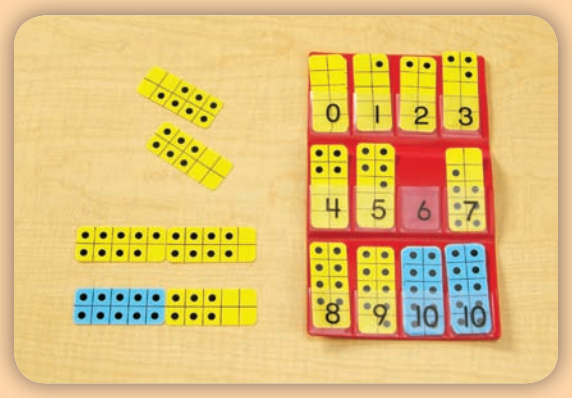
Introduce the story problem. Then have children do the activity to solve the problem.

Say: *Show Carson how much money he needs to save.*

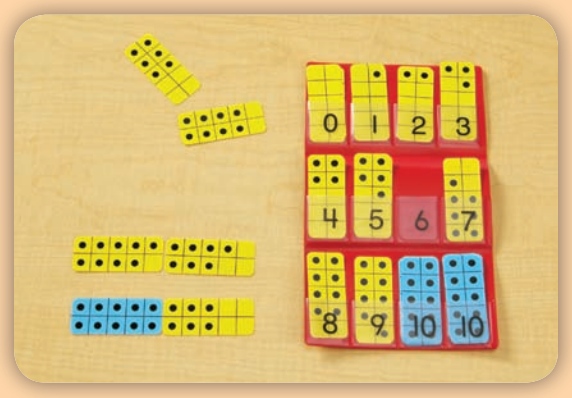
Materials
- DecaDots® wallet (1 per pair)



1. To begin, place tiles in one row to show how much money Carson has in the bank. Place tiles in another row to show how much money he wants to save. Children will have to combine two tiles to show numbers greater than 10. Lay these tiles with their empty boxes facing outward.



2. Have children compare tiles on top of the row of tiles that represents the money Carson has in the bank until the row of tiles has the same number of dots as the row of tiles showing the amount of money he wants to save. Children may have to "guess and check."



3. Ask: *How many more dollars does Carson need to add to his $9 to have $16?*

⚠ Look Out!

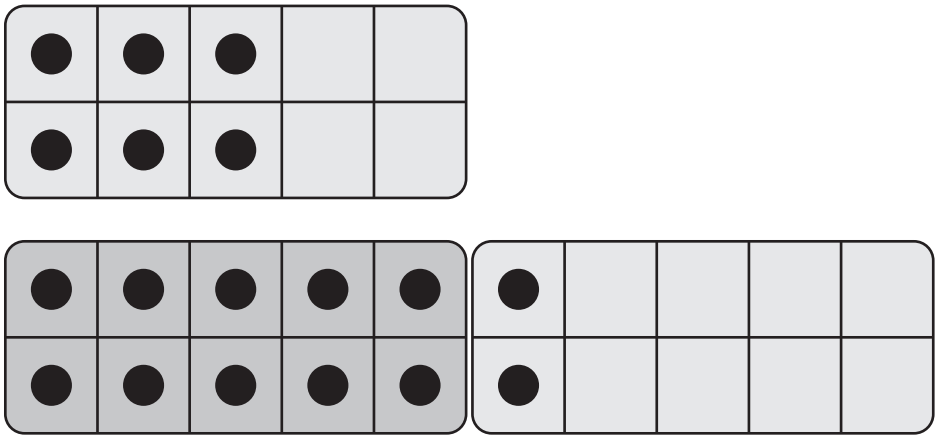
Watch for children who add the addend and sum. Remind children that they already know the sum; the missing addend and 9 must equal 16. Ask children if it would make sense for 9 + 25 to equal 16.

Answer Key

Use DecaDots. Build the sentence. Find the missing number.

(Check students' work.)

1.



$6 + \underline{\ 6\ } = 12$

Use DecaDots. Draw the model. Find the missing number.

2. $7 + \underline{\ 5\ } = 12$

Find each missing number.

3. $9 + \underline{\ 4\ } = 13$

4. $5 + \underline{\ 12\ } = 17$

5. $11 + \underline{\ 4\ } = 15$

6. $9 + \underline{\ 9\ } = 18$

Answer Key

Challenge! Describe how the dots on the DecaDots help you find the missing number. Draw a picture to help.

Challenge: (Sample) They help to show how many have to be added to make the total. It is easy to try different tiles and see which one works.

LESSON 9

Objective

Identify missing subtrahends by calculating the difference between the minuend and the difference.

Common Core State Standards

- **1.OA.4** Understand subtraction as an unknown-addend problem. *For example, subtract 10 – 8 by finding the number that makes 10 when added to 8.*
- **1.OA.8** Determine the unknown whole number in an addition or subtraction equation relating three whole numbers. *For example, determine the unknown number that makes the equation true in each of the equations 8 + ? = 11, 5 = □ – 3, 6 + 6 = □.*

Operations and Algebraic Thinking

Finding Missing Subtrahends

In subtraction, the first number is the *minuend*. The number being subtracted from the minuend is the *subtrahend*. The answer to a subtraction problem is the difference. Subtraction problems have an unknown difference; however, it can have a missing subtrahend instead, as in the problem 12 – *b* = 6. Because the subtrahend and difference are two parts of a whole (minuend), when a subtrahend is unknown, subtract the difference from the whole (minuend) to find the missing subtrahend.

Try It! *Perform the Try It! activity on the next page.*

Talk About It

Discuss the Try It! activity.

- Have children look at their DecaDots® tiles used in the Try It! activity.
- **Ask:** *Which tiles show the number of Tia's stuffed animals? Which tiles show the animals Tia can keep?*
- **Say:** *Count back to find the number of dots that show the difference between how many animals Tia has and how many she can keep.*
- **Ask:** *How many animals will Tia give away? How do you know?*

Solve It

With children, reread the problem. Ask the children to draw pictures of Tia's animals and mark what she needs to give away. Then, have them write a sentence explaining how many animals Tia needs to give away.

More Ideas

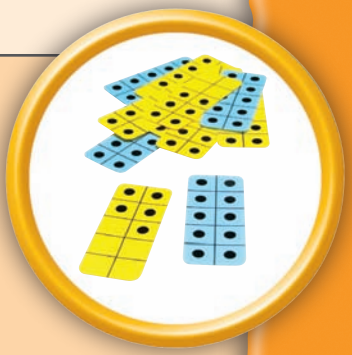
For other ways to teach about missing subtrahends—

- Have children use Snap Cubes® to represent the minuend, then take off the amount needed to result in a given difference and count what was taken off.
- Give children ten frames (BLM 2) and counters. Have them fill in with counters the minuend (whole) on one ten frame. Then have them fill in another ten frame with the known difference. Compare the two to find the missing subtrahend.

Formative Assessment

Have children try the following problem.

Draw pictures to solve this problem. Martin won 12 tickets to a baseball game. He wants to save 4 tickets for his family and give the rest away to friends. How many tickets can Martin give away?



Try It! 30 minutes | Pairs

Here is a problem using missing subtrahends.

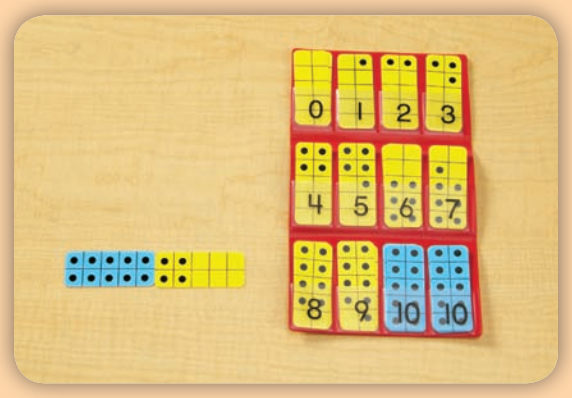
Tia is giving away old toys. She has 14 stuffed animals. Her mother said she could only keep 8. How many stuffed animals will Tia give away?

Introduce the story problem. Then have children do the activity to solve the problem.

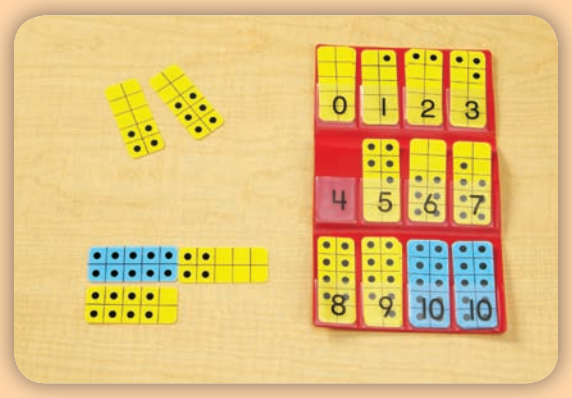
Say: *Let's show Tia how many toys she must give away.*

Materials

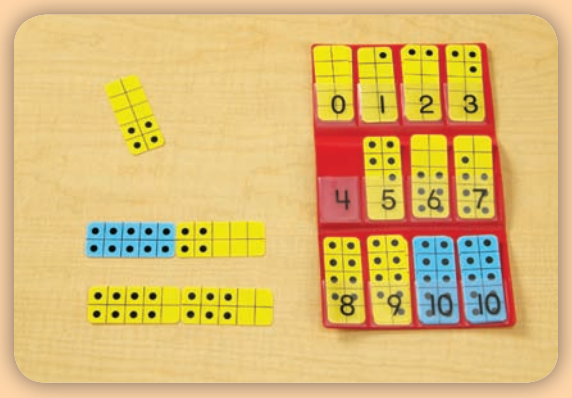
- DecaDots® wallet (1 per pair)



1. To begin, have children choose tiles to show the number of Tia's stuffed animals. Then show how many animals she can keep. **Say:** *You will have to combine two tiles to show numbers greater than 10.*



2. Have children place the tiles next to each other. Compare the number of dots that must be taken away from the tiles representing the number of Tia's stuffed animals to make it look like the tile that represents the number of stuffed animals Tia can keep.



3. Ask: *How many animals does Tia have to give away so that she has 8 animals? What tile did you place to make the two sets look the same?*

⚠ Look Out!

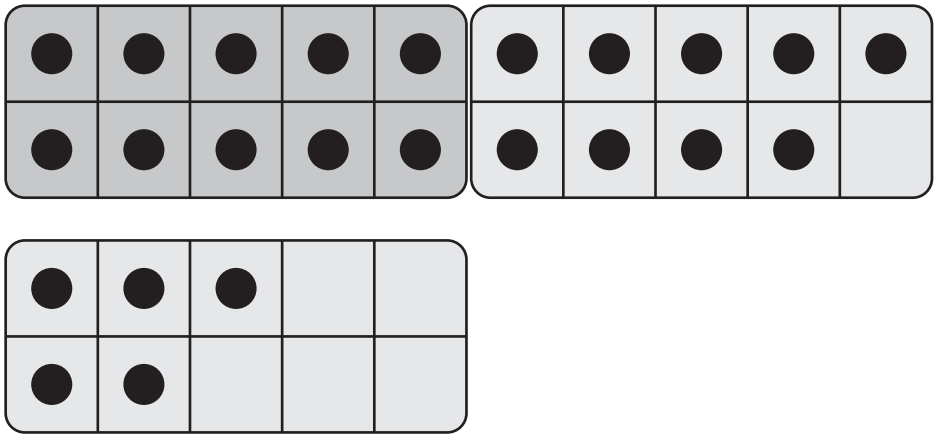
Watch for children who add the minuend and difference. Remind children that the total number of animals Tia has is already known. Ask children if it would make sense for Tia to give away 22 animals.

Answer Key

Use DecaDots. Build the sentence. Find the missing number.

(Check students' work.)

1.



19 – 14 = 5

Use DecaDots. Draw the model. Find the missing number.

2. 20 – 12 = 8

Find each missing number.

3. 12 – 3 = 9

4. 11 – 7 = 4

5. 15 – 4 = 11

6. 19 – 13 = 6

Answer Key

Challenge! How can you use addition to check if you found the correct missing number? Draw a picture to help.

Challenge: (Sample) Add the number found to the number that is by itself on one side of the equal sign. The sum should match the other number in the problem.

LESSON 10

Objective

Explore "counting on" as an addition strategy.

Common Core State Standards

- **1.OA.5** Relate counting to addition and subtraction (e.g., by counting on 2 to add 2).
- **1.OA.6** Add and subtract within 20, demonstrating fluency for addition and subtraction within 10. Use strategies such as counting on; making ten (e.g., 8 + 6 = 8 + 2 + 4 = 10 + 4 = 14); decomposing a number leading to a ten (e.g., 13 – 4 = 13 – 3 – 1 = 10 – 1 = 9); using the relationship between addition and subtraction (e.g., knowing that 8 + 4 = 12, one knows 12 – 8 = 4); and creating equivalent but easier or known sums (e.g., adding 6 + 7 by creating the known equivalent 6 + 6 + 1 = 12 + 1 = 13).

Operations and Algebraic Thinking

Explore Counting On

Stories involving finding the sum by "counting on" help children develop the concept of addition within a real-life context. Using "counting on" as an addition strategy shows the effects of adding whole numbers. While finding the sum, it is important to consider with children, *What does it mean to find the sum?* and *What other groups could be added to find the same sum?*

Try It! *Perform the Try It! activity on the next page.*

Talk About It

Discuss the Try It! activity.

- Have children discuss how they can add numbers by counting on.
- **Ask:** *How can you tell when to add?*
- **Ask:** *On which number do you start when you are counting on?*

Solve It

With children, reread the problem. Ask them to draw a picture that shows how many aluminum cans the class collected on Monday. Have children draw the cans collected on Tuesday, and label them to show counting on. Then have them label how many cans they had in all.

More Ideas

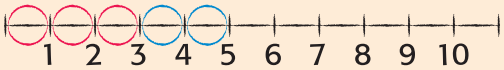
For other ways to teach about counting on—

- Arrange Two-Color Counters for pairs of children. Some should be red side up and the rest should be yellow side up. Have children start by counting the red counters, and then count on the yellow counters to find the number in all.
- Draw a 1–20 number line. Have children make two sets of 1–10 number cards. Allow each child to choose a card. Have one child put an Inchworms™ piece on the first number on the number line, and have the second child count on the number on the card and place the worm in its final position.

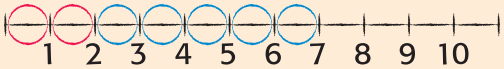
Formative Assessment

Have children try the following problem.

Randy has 4 pencils. His mom gives him 2 more pencils. Choose the number line that shows how to find how many pencils Randy has in all.

A. 

B. 

C. 

Try It! 15 minutes | Pairs

Here is a problem about counting on to add numbers.

First graders are collecting aluminum cans to recycle to earn money for a field trip. If the class collected 5 aluminum cans on Monday and finds 3 more cans on Tuesday, how many cans do they have in all?

Introduce the problem. Then have children do the activity to solve the problem.

Materials
- Base Ten Blocks (10 units per pair)

Before children do the activity, ask them to give examples of situations in which they might want to add two numbers to find a sum. Give Base Ten Blocks to each pair of children. **Say:** *Let's pretend that each block is an aluminum can. Let's find how many cans we will have in all.*

1. Ask each pair of children to show you how many blocks they need to show 5 aluminum cans.

2. Ask each pair of children to figure out how many blocks they need to show 3 aluminum cans.

3. Ask each pair of children to line up their two groups of blocks. Then have children count on to find the total. **Say:** *Count on from 5 to find out how many blocks you have in all.*

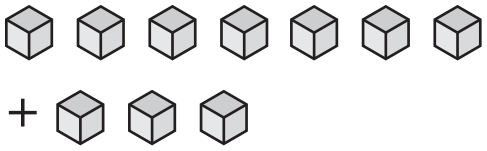
⚠ Look Out!

If children have trouble counting on, make sure that they have lined up the two groups of blocks. If children are having trouble starting to count from 5, have them combine both groups and start counting at 1 to find the total.

Answer Key

Use Base Ten Blocks. Build the numbers shown. Count on to find the total.

(Check students' work.)

1. 

7 + 3 = 10

Use Base Ten Blocks. Build each number. Draw the model. Count on to find the total. Draw the model.

2. 6 + 3

Total 9

3. 5 + 4

Total 9

4. 2 + 3

Total 5

Answer Key

Challenge! Why does the "counting on" strategy work for addition?

Challenge: (Sample) When you add, you are joining two sets. The total number of objects in both sets will equal the answer to the addition sentence.

LESSON 11

Objective

Explore "counting back" as a subtraction strategy.

Common Core State Standards

- **1.OA.5** Relate counting to addition and subtraction (e.g., by counting on 2 to add 2).
- **1.OA.6** Add and subtract within 20, demonstrating fluency for addition and subtraction within 10. Use strategies such as counting on; making ten (e.g., 8 + 6 = 8 + 2 + 4 = 10 + 4 = 14); decomposing a number leading to a ten (e.g., 13 – 4 = 13 – 3 – 1 = 10 – 1 = 9); using the relationship between addition and subtraction (e.g., knowing that 8 + 4 = 12, one knows 12 – 8 = 4); and creating equivalent but easier or known sums (e.g., adding 6 + 7 by creating the known equivalent 6 + 6 + 1 = 12 + 1 = 13).

Operations and Algebraic Thinking

Explore Counting Back

Just as children need to understand that adding involves joining two quantities to form a whole, they must understand that subtracting involves separating a whole into parts. In any subtraction problem, it is important to establish which is the whole and to count the whole before beginning to count back. It is equally important to find a way of marking or separating the portion that is taken away. Reminding children about the real-world context of a problem should reinforce the idea of taking away or separating the whole into parts.

Try It! *Perform the Try It! activity on the next page.*

Talk About It

Discuss the Try It! activity.

- Ask children to give examples of situations in which they might need to count back in order to take away numbers from a total.
- **Ask:** *How many children were on the bus to start?*
- **Say:** *Three children got off the bus.* **Ask:** *How many are left on the bus?*

Solve It

With children, reread the problem. Ask children to draw a picture of 10 children on the bus and then find a way to show that 3 children have left the bus. Then have them identify how many children are left on the bus.

More Ideas

For other ways to teach about counting back—

- Have children make trains of Inchworms™ to model subtraction problems. For example, **say:** *Shelly bought 10 pieces of fruit on Monday morning and ate 2 pieces of fruit on Monday night. Count back from 10 to show how many pieces of fruit she has left.*
- Have children use Base Ten Blocks to model subtraction problems to build on taking away and to go beyond the subtraction algorithm. For example, **say:** *There are 12 cars in the parking lot. Then 4 cars leave at lunchtime.* **Ask:** *How many cars are still in the parking lot?*

Formative Assessment

Have children try the following problem.

There are 12 children waiting to be picked up from school. After 3 children have been picked up by their parents, how many children are left? Draw a circle around the correct answer.

A. 10

B. 15

C. 9

Try It! 30 minutes | Pairs

Here is a problem about counting back to subtract.

There were 10 children riding the school bus. At the first stop, 3 children got off the bus. How many children were left on the bus?

Introduce the problem. Then have children do the activity to solve the problem.

Give each pair of children 10 Snap Cubes®.

Materials
- Snap Cubes® (10 per pair)

1. Have children connect their cubes to make a train of 10.

2. Ask one child in each pair to count back 3 from 10 and take away 3 cubes from the train.

3. Ask children to count the number of cubes that remain in the train. Children should find that there are 7 cubes left in the train. Have children use cubes and counting back to solve additional subtraction problems.

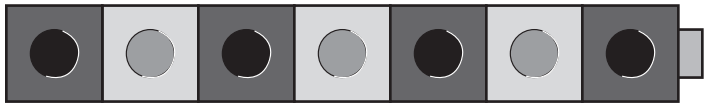
⚠ Look Out!

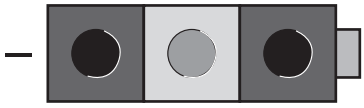
Check that children have subtracted rather than added and that the 3 subtracted cubes are separated from the others. At this age, children are more likely to join numbers than take away. Reinforcing the context of the problem (that children are leaving the group) will help them remember to subtract.

Answer Key

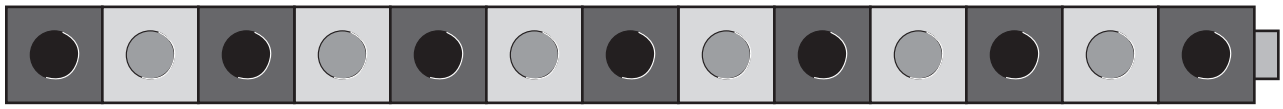
Use Snap Cubes. Make the model shown. Count back to find the answer.

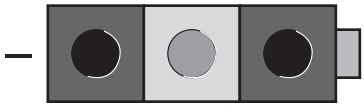
(Check students' work.)

1. 



7 – 3 = 4

2. 



13 – 3 = 10

Use Snap Cubes. Build each number sentence. Count back to find the answer. Draw the model.

3. 9 – 2 = 7

4. 10 – 4 = 6

5. 8 – 5 = 3

Answer Key

Challenge! Why does the "counting back" strategy work for subtraction?

Challenge: (Sample) When you subtract, you are taking objects away from a set. The number left will be the answer to the subtraction sentence.

LESSON 12

Objective

Identify and add doubles to sum 20.

Common Core State Standards

- **1.OA.6** Add and subtract within 20, demonstrating fluency for addition and subtraction within 10. Use strategies such as counting on; making ten (e.g., 8 + 6 = 8 + 2 + 4 = 10 + 4 = 14); decomposing a number leading to a ten (e.g., 13 – 4 = 13 – 3 – 1 = 10 – 1 = 9); using the relationship between addition and subtraction (e.g., knowing that 8 + 4 = 12, one knows 12 – 8 = 4); and creating equivalent but easier or known sums (e.g., adding 6 + 7 by creating the known equivalent 6 + 6 + 1 = 12 + 1 = 13).

Add Doubles

Doubling numbers is a way to show joining and an informal method to introduce multiplication within the context of addition. Children should already understand how to add numbers when they are introduced to doubling. In this particular method, children should learn that two equal numbers will double when they are added together. It is important to explore the notion of equal numbers by showing equal representations of values with manipulatives. This will informally introduce the idea of symmetry, if $a = b$, then $b = a$, and the reflexive property, $a = a$, which are important ideas for algebraic thinking.

Try It! *Perform the Try It! activity on the next page.*

Talk About It

Discuss the Try It! activity.

- Ask for examples of situations in which children might need to double a number. For example, a person might need 10 markers to play a game. How many markers would two players need?
- **Ask:** *If one ant has 6 legs, how can you find out how many legs two ants have?*
- **Say:** *A spider has 8 legs.* **Ask:** *How can you find out how many legs two spiders have?*

Solve It

With children, reread the problem. Then ask children to draw a picture of two ants that shows the number of legs. Then ask children to draw a picture of a cat that shows its 4 legs. Then have children tell how many legs two cats have altogether.

More Ideas

For other ways to teach about doubling—

- For children who need additional practice, have them draw a picture with two dogs. Ask children to use Pattern Blocks to build one dog and then two dogs. Have them count the number of legs on both dogs.
- To extend the concept, have children count the faces on a 2-cm Color Cube (6). Then have children find the double, or the number of faces on two cubes (12). Then have children double the double, or find the number of faces on four cubes (24).

Formative Assessment

Have children try the following problem.

A fish has 4 fins. Circle the group that shows how many fins two fish have in all.

A. 

B. 

C. 

Try It! 25 minutes | Groups of 3

Here is a problem about doubling.

In science, Mark's class is studying models of ants. Mark sees that each ant has 6 legs. How many legs do two ants have altogether?

Introduce the problem. Then have children do the activity to solve the problem.

Give each group a set of Pattern Blocks. **Say:** *All insects have 6 legs. Ants are insects. Let's pretend that each ant's body is made of 3 yellow blocks and that there are legs on 2 sides of each block.*

Materials

- Pattern Blocks (6 yellow hexagons and 12 tan rhombuses per group)

1. Ask each group of children to make one ant. Have children count the number of legs. Make sure children's ants have 6 legs.

2. Ask children to make a second identical ant from blocks. Have children count the number of legs on the second ant.

3. Ask children to find the total number of legs on the two ants.

⚠ Look Out!

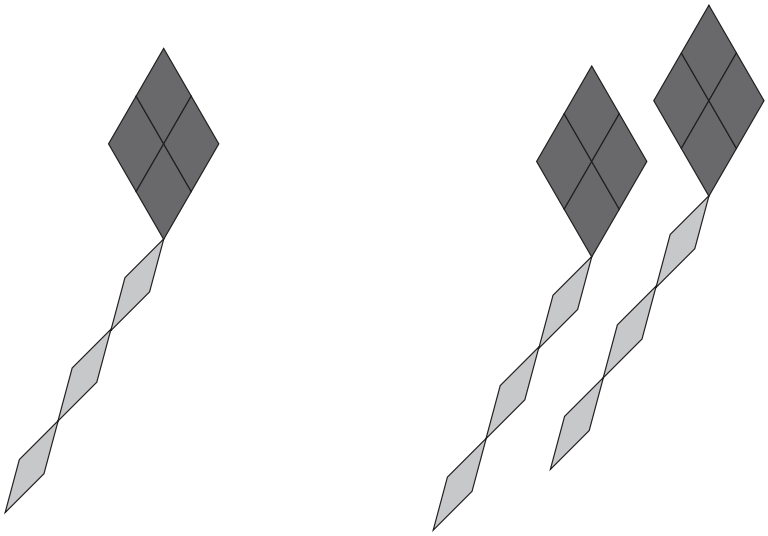
Look out for children who might struggle visually to produce the ant using blocks. Have them build the second ant on top of the first for direct comparison. Make sure children understand that values must be equal in order to double.

Answer Key

Use Pattern Blocks. Build the kites shown. Complete the sentences.

(Check students' work.)

1.



1 kite has ___3___ ◇.

2 kites have ___6___ ◇.

Use Pattern Blocks. Build a design. Draw a group of 1 and 2. Write two sentences like the ones above.

2. Check students' drawings and sentences.

Answer Key

Challenge! If one house has four windows, how can you find how many windows are in 2 houses? How can you find how many windows are in 3 houses?

Challenge: (Sample) Draw a picture with 2 houses and count the number of windows. Draw a picture with 3 houses and count the number of windows.

LESSON 13

Objective

Subtract numbers using comparison subtraction.

Common Core State Standards

- **1.OA.6** Add and subtract within 20, demonstrating fluency for addition and subtraction within 10. Use strategies such as counting on; making ten (e.g., 8 + 6 = 8 + 2 + 4 = 10 + 4 = 14); decomposing a number leading to a ten (e.g., 13 – 4 = 13 – 3 – 1 = 10 – 1 = 9); using the relationship between addition and subtraction (e.g., knowing that 8 + 4 = 12, one knows 12 – 8 = 4); and creating equivalent but easier or known sums (e.g., adding 6 + 7 by creating the known equivalent 6 + 6 + 1 = 12 + 1 = 13).

Comparison Subtraction

Comparison subtraction relies on children being able to compare the relative values of two numbers. Difficulties with comparison subtraction often revolve around confusion about whether to add or subtract. Children should be aware that words such as *difference, less than, minus,* or *decreased by* often indicate that they should subtract to find an answer. Using manipulatives to show the difference between two values can help children to develop fluency with comparison subtraction, which will translate to increased ability to order fractions, decimals, and integers in the higher grades.

Try It! *Perform the Try It! activity on the next page.*

Talk About It

Discuss the Try It! activity.

- Ask children to give examples of situations in which they might need to use comparison subtraction.
- **Ask:** *What are two ways that you can find the difference between 9 and 5?* Elicit from children that they can use counting on, or they could assign a unit of one to a white Cuisenaire® Rod and count how many white rods equal a purple rod.
- **Ask:** *What rod shows the difference between 9 and 5? What number does it represent?*

Solve It

With children, reread the problem. Ask children to draw a picture of the situation and show the number of books that makes up the difference between 9 books and 5 books.

More Ideas

For other ways to teach about comparison subtraction—

- Have children use Two-Color Counters to model and solve subtraction problems. For example, **say:** *Leslie has 8 crayons. She also has 3 markers.* **Ask:** *How many more crayons does Leslie have than markers?* **Say:** *Use counters to find and show the answer.*
- Have children use Snap Cubes® to build single-color trains of different lengths and then compare the lengths to find the difference.

Formative Assessment

Have children try the following problem.

The Jones family has 5 cats. The Martinez family has 2 cats. How many more cats does the Jones family have? Circle the answer.

A. 3 **B.** 7 **C.** 5

Try It! 30 minutes | Pairs

Here is a problem about comparison subtraction.

Franklin Elementary School had a reading contest. Tonya read 9 books. Ron read 5 books. How many more books did Tonya read than Ron?

Introduce the problem. Then have children do the activity to solve the problem. Explain that comparison subtraction is a way to show "how many more" or "how many less." Give each pair a set of Cuisenaire® Rods and a Centimeter Grid (BLM 1). **Say:** *Suppose that a white rod stands for 1 unit. Then each other rod stands for a different number of units.*

Materials

- Cuisenaire® Rods (5 white and 1 of every other color per pair)
- Centimeter Grid (BLM 1; 1 per pair)
- crayons (several per pair)

1. Have children identify the rod for 9 and place it on the grid. Instruct children to represent the rod on the grid by coloring and writing its value.

2. Have children identify the rod for 5 and place it underneath their representation of 9. Ask children to represent its value on the grid and create a vertical number sentence, 9 – 5.

3. Have children work together to build the difference between the numbers of units. Have them use white rods or combinations of other colors. **Ask:** *Which rod will make the yellow rod as long as the blue rod? Which rod shows the difference between the numbers of units? How can you find out how many more 9 is than 5?*

⚠ Look Out!

If children have trouble figuring out how to set up a comparison, remind them that they need to show each value with a rod in order to compare the values. Ask them how many books Tonya read and how many books Ron read. Also, be aware that children might use different strategies to build the difference using several rods.

Answer Key

Use Cuisenaire Rods. Build the subtraction shown. Write the number sentence.

(Check students' work.)

1.

9 – 3 = 6

2.

8 – 5 = 3

Use Cuisenaire Rods. Build the subtraction shown. Draw the model. Complete the number sentence.

3. 10 – 3 = 7

4. 8 – 2 = 6

5. 7 – 5 = 2

Answer Key

Challenge! The answer to a subtraction problem and the number being subtracted should add to what number?

Challenge: (Sample) The first number in the subtraction problem.

LESSON 14

Objective

Relate addition and subtraction facts.

Common Core State Standards

- **1.OA.6** Add and subtract within 20, demonstrating fluency for addition and subtraction within 10. Use strategies such as counting on; making ten (e.g., 8 + 6 = 8 + 2 + 4 = 10 + 4 = 14); decomposing a number leading to a ten (e.g., 13 – 4 = 13 – 3 – 1 = 10 – 1 = 9); using the relationship between addition and subtraction (e.g., knowing that 8 + 4 = 12, one knows 12 – 8 = 4); and creating equivalent but easier or known sums (e.g., adding 6 + 7 by creating the known equivalent 6 + 6 + 1 = 12 + 1 = 13).

Operations and Algebraic Thinking

Connecting Addition and Subtraction

Through modeling and meaningful connections, children develop the understanding that addition and subtraction are concepts directly related to one another. With repeated practice and teacher reinforcement, children will realize the correlation of these inverse operations. This will help them form a better understanding of both operations.

Try It! *Perform the Try It! activity on the next page.*

Talk About It

Discuss the Try It! activity.

- **Ask:** *How many yellow Snap Cubes were there? How many red cubes were there? What number sentence shows how many cubes there were in all?*
- **Ask:** *What subtraction sentence did you write to show what happened when you took 5 cubes away?*
- **Ask:** *What is the same in both number sentences?* Guide children to note that both have the same numbers. Emphasize that subtraction takes apart what addition joins, so the same numbers have to be in both operations.

Solve It

With children, reread the problem. Have children draw a picture to show the addition problem and write the addition sentence (5 + 3 = 8). Then have children draw a picture to show the subtraction problem and write the subtraction sentence (8 – 3 = 5).

More Ideas

For other ways to teach about connecting addition and subtraction—

- Have each child grab a handful of Snap Cubes®. Then have pairs write two addition and two subtraction problems using the numbers represented by the cubes. Then have them write the answers.
- Have children use Cuisenaire® Rods to show problems. For example, **say:** *There were 2 bugs on a leaf. Then 4 more bugs landed on the leaf.* **Ask:** *How many bugs were there in all? What if 2 bugs flew away?* Have children write addition and subtraction sentences for each problem.

Formative Assessment

Have children try the following problem.

Sara had 3 crayons. Then Tim gave her 4 more. How many crayons did Sara have in all? 3 + 4 = _____

Later, Sara gave 3 crayons to Ned. How many crayons did Sara have left? 7 – 3 = _____

Try It! 30 minutes | Pairs

Here is a problem about connecting addition and subtraction.

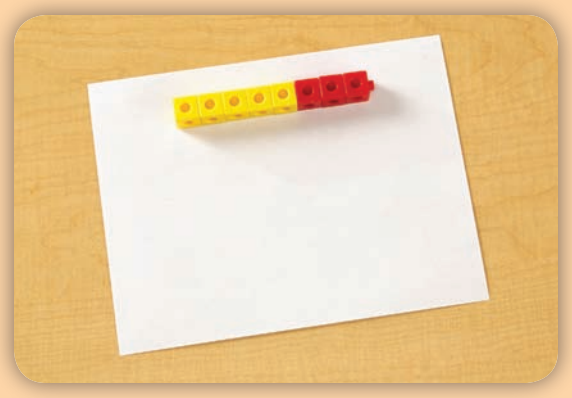
At recess, 5 children are playing tag. Then 3 more children join the game. How many children are playing tag? What will happen if 5 children leave the game?

Introduce the problem. Then have children do the activity to solve the problem.

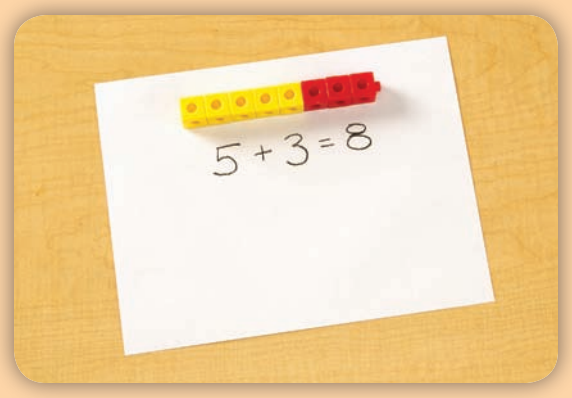
Give Snap Cubes®, pencil, and paper to each pair of children.

Materials

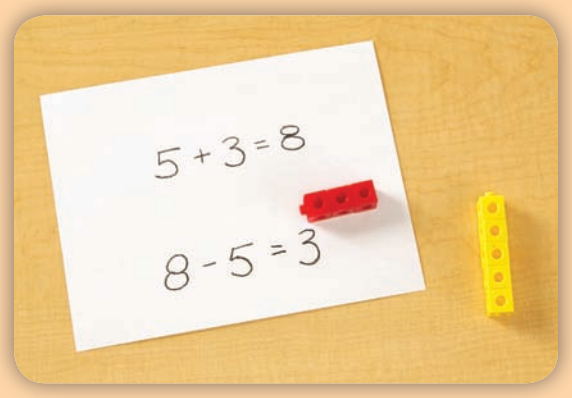
- Snap Cubes® (10 yellow and 6 red per pair)
- paper (1 sheet per pair)
- pencils (1 per pair)



1. Have children make two trains: one of 5 yellow cubes and another of 3 red cubes. Ask children to add the red train to the yellow train. **Say:** *Now you have a train with 5 yellow cubes and 3 red cubes.*



2. Ask: *How many cubes does the train have in all?* **Say:** *Write an addition sentence that shows how you added 5 yellow cubes and 3 red cubes.*



3. Have children build another train of 3 red and 5 yellow cubes (8 cubes total). **Say:** *Now take away 5 yellow cubes from this train.* **Ask:** *What subtraction sentence shows this?* Have children write the subtraction sentence and compare it to the addition sentence. **Say:** *Every time we write an addition sentence, we can find a related subtraction sentence. We can use addition to check our subtraction, and subtraction to check our addition.*

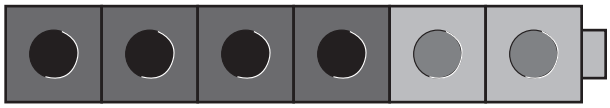
⚠ Look Out!

In the addition part of the activity, children may come up with the number sentence 3 + 5 = 8 instead of 5 + 3 = 8. While this is not wrong, you may wish to remind children that their number sentences should describe what happens to match the order of events in the problem, in which 3 children join 5 children who are already playing on the playground. This applies to the subtraction part of the activity as well; you will want to emphasize to children that their number sentences should show 5 children leaving the game, or 8 – 5 = 3.

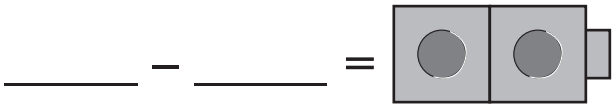
Answer Key

Use Snap Cubes. Make each model. Write an addition sentence. Then write the related subtraction sentence.

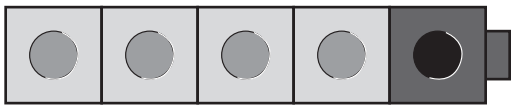
(Check students' work.)

1. 

4 + 2 = 6



6 − 4 = 2

2. 

4 + 1 = 5

5 − 4 = 1

Use Snap Cubes. Build an addition sentence. Build a subtraction sentence. Draw the models. Write the sentences.

3. 3 + 6 = 9

9 9 − 6 3 = 3 6

4. 5 + 2 = 7

7 7 − 2 5 = 5 2

5. 9 + 1 = 10

10 10 − 1 9 = 9 1

Answer Key

Challenge! Write two subtraction sentences that are related to the addition sentence 3 + 8 = 11. Explain.

Challenge: 11 – 3 = 8; 11 – 8 = 3

(Check students' work.)

LESSON 15

Objective

Add or subtract using a make-a-10 strategy.

Common Core State Standards

- **1.OA.6** Add and subtract within 20, demonstrating fluency for addition and subtraction within 10. Use strategies such as counting on; making ten (e.g., 8 + 6 = 8 + 2 + 4 = 10 + 4 = 14); decomposing a number leading to a ten (e.g., 13 – 4 = 13 – 3 – 1 = 10 – 1 = 9); using the relationship between addition and subtraction (e.g., knowing that 8 + 4 = 12, one knows 12 – 8 = 4); and creating equivalent but easier or known sums (e.g., adding 6 + 7 by creating the known equivalent 6 + 6 + 1 = 12 + 1 = 13).

Operations and Algebraic Thinking

Making 10 to Add or Subtract

A foundational skill for adding and subtracting is the use of number recognition strategies. And many such strategies depend on the idea that a number can be composed and decomposed in a variety of ways. Manipulatives are good for helping children get their hands on this idea through concrete experimentation. With the number sense that is derived from these experiences, children will be able to compose and decompose numbers with purpose.

Try It! *Perform the Try It! activity on the next page.*

Talk About It

Discuss the Try It! activity.

- **Ask:** *How did you find the total number of juice bottles?* Discuss the different possible answers.
- **Ask:** *How can you make 7 + 8 easier to do?* Reiterate that 3 can be added to 7 first. Then the problem becomes 10 + 5, which is easy to do mentally.
- Ask children to identify the decomposition they would use if Peyton only brought 6 bottles of juice. Help them realize they would use 8 = 4 + 4. They would add 4 to 6 to make 10 and mentally do the computation 10 + 4 = 14.
- Discuss the fourth Try It! step with children. The subtraction is just the reverse of the addition.

Solve It

With children, reread the problem. Instruct children to draw a picture that shows how the problem is solved using the make-a-10 strategy. Then have children draw the reverse process—that is, 15 – 8 = 7.

More Ideas

For other ways to teach the strategy making 10 to add or subtract—

- Have children use Cuisenaire® Rods to solve the problem. Children use a black rod to represent the 7 bottles of orange juice and a brown rod to represent the 8 bottles of apple juice. Then below that, children use an orange rod plus a yellow rod to represent the converted problem 10 + 5 = 15. A green rod and yellow rod can be used to show the decomposition of 8 into 3 and 5.
- Have children use Base Ten Blocks to solve the problem. Children use 7 units to represent the 7 bottles of orange juice and 8 units to represent the 8 bottles of apple juice. Then the converted problem can be shown using one rod and 5 units.

Formative Assessment

Have children try the following problem.

Which number sentence shows how to find 6 + 8 by making 10? Circle the correct answer.

A. 6 + 3 + 5 = 14 **B.** 6 + 4 + 4 = 14 **C.** 6 + 2 + 6 = 14

Try It! 20 minutes | Pairs

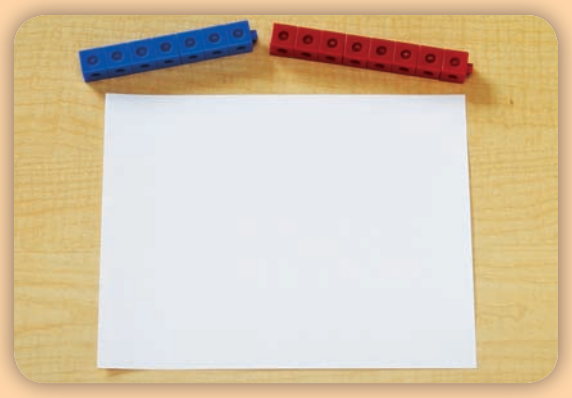
Here is a problem about making 10 to add or subtract.

Peyton and Julie are bringing juice to the class picnic. Peyton is bringing 7 bottles of orange juice. Julie is bringing 8 bottles of apple juice. How many bottles are they bringing in all?

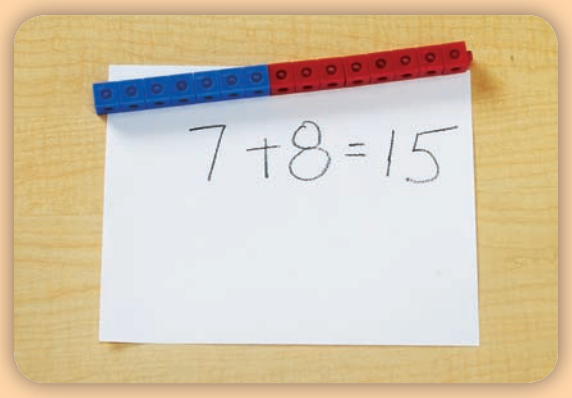
Introduce the problem. Then have children do the activity to solve the problem. Distribute Snap Cubes® and paper to children.

Materials

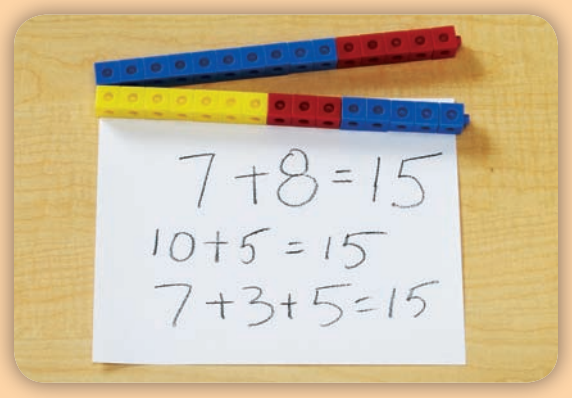
- Snap Cubes® (20 of 2 different colors per pair)
- paper (1 sheet per child)
- pencils (1 per pair)



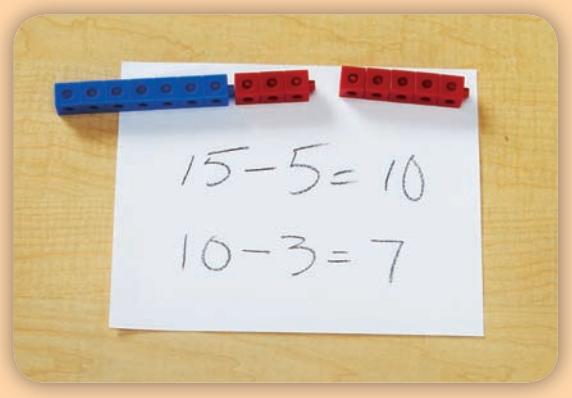
1. Have children build a train of cubes, all the same color, to model the 7 bottles of orange juice. Then have them build a second train, using a second color, to model the 8 bottles of apple juice.



2. Ask: *What did the problem ask us to find?* Elicit that the problem asks for the total number of bottles. Then have children put the two trains together to model the sum. **Say:** *Write a number sentence that shows how you add all the bottles together. You can count all the cubes to find the sum.*



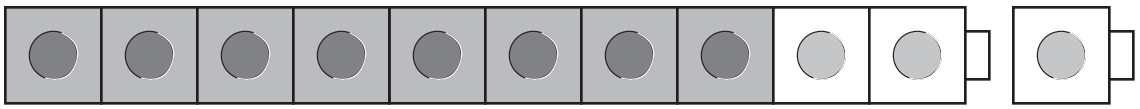
3. Have children break the train after the tenth cube. Elicit that the new lengths are 10 and 5 but the total is still 15. **Ask:** *Which is easier to do mentally, 10 + 5 or 7 + 8?* Point out that the 10-cube train has 3 cubes of the second color. Ask children where those 3 cubes came from. Elicit that they came from breaking 8 into 3 and 5. Help children write number sentences.



4. Have children put the 10-cube and 5-cube trains back together. **Say:** *Let's pretend we want to take away the 8 bottles of apple juice to see how many orange juice bottles there are. But, let's start by taking away 5.* **Ask:** *Why would we take away only 5 first?* Elicit that subtracting 5 leaves 10, and then it is easy to take 3 from 10 to get the answer. Help children write number sentences.

Answer Key

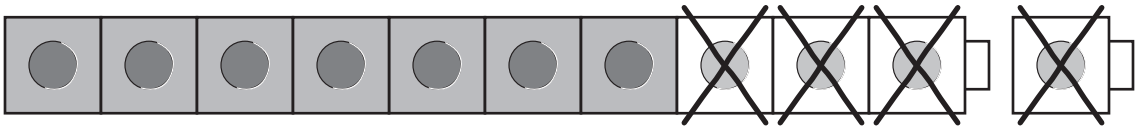
Use Snap Cubes. Build the cube train. Write the addition two ways.

1. 

8 + 3 = 11

8 + 2 + 1 = 11

Use Snap Cubes. Build the cube train. Write the subtraction two ways.

2. 

11 – 4 = 7

11 – 1 – 3 = 7

Add or subtract. Make a 10 first.

3. 8 + 5

8 + 2 + 3 = 13

4. 11 – 2

11 – 1 – 1 = 9

Answer Key

Challenge! Making a 10 can help you add. It can help you subtract, too. Describe other tricks you use to add or subtract.

Challenge: (Sample) If I know 8 + 7 = 15, then I can think of that to know 15 – 7 = 8. When I add 9, I can think of adding 10 and then taking away 1.