Do It with Dominoes

Pre-K–2   Number and Operations   i-Plan   9 Lessons   45 minutes each

Overview: In this i-Plan, students explore the four models of addition (counting, sets, number line, and balanced equations) using dominoes. They also learn about the order property, the relation between addition and subtraction, and the result of adding 0. Students will also write story problems in which the operation of addition is required and begin to memorize the addition facts. Appendix A includes a brief bibliography of relevant children's books.

Mathematical Content: The sequence of lessons in this i-Plan builds an understanding of the processes and properties of addition, including the order property and the additive identity.

Using the Plan: This set of sequenced mathematical activities is designed as an instructional unit focusing on addition for students who have learned to count but have not yet mastered addition of one-digit numbers. These lessons also explore foundational algebraic understandings. The mathematical ideas are represented in both pictures and equations. The mathematical concepts are connected to Language Arts through writing. It is recommended that this set of lessons be used in the suggested sequence. The time spent on each lesson will vary according to the needs of the students, but they have been planned to last approximately 45 minutes. For younger learners, the teacher could divide the lesson into time segments appropriate to the students' current stage of development.

NCTM Standards: **Number and Operations Pre-K–2**
http://standards.nctm.org/document/chapter4/numb.htm

Understand numbers, ways of representing numbers, relationships among numbers, and number systems

Understand meanings of operations and how they relate to one another

Compute fluently and make reasonable estimates

This i-Plan covers the following Number and Operations Standard Expectations:

Count with understanding and recognize "how many" in sets of objects
Connect number words and numerals to the quantities they represent, using various physical models and representations
Develop a sense of whole numbers and represent and use them in flexible ways, including relating, composing, and decomposing numbers
Understand various meanings of addition and subtraction of whole numbers and the relationship between the two operations
Develop fluency with basic number combinations for addition and subtraction
Use a variety of methods and tools to compute, including objects, mental computation, estimation, paper and pencil, and calculators

Algebra Pre-K–2
http://standards.nctm.org/document/chapter4/alg.htm

Represent and analyze mathematical situations and structures using algebraic symbols

Use mathematical models to represent and understand quantitative relationships

This i-Plan covers the following Algebra Standard Expectations:

- Use concrete, pictorial, and verbal representations to develop an understanding of invented and conventional symbolic notations

- Model situations that involve the addition and subtraction of whole numbers, using objects, pictures, and symbols

Websites:

Learning about Number Relationships and Properties of Numbers Using Calculators and Hundred Boards: Displaying Number Patterns
standards.nctm.org/document/eexamples/chap4/4.5/index.htm

Equivalence Part II: Stability in Numbers
illuminations.nctm.org/imath/across/balance/equiv2.html

Dominoes (History)
www.tradgames.org.uk

Dominoes (Rules)
www.dominoes.com/dominoinfo/rules-intro.asp?gamename=40

Inspiring Ideas (Halloween Dominoes/Pumpkin Dominoes)
http://www.crayola.com/idea/index.cfm

Big-Block Dominoes
www.crayola.com/ece/ece_display.cfm?id=83

Materials:
Computer
Internet connection
8.5" x 11" sheets of paper
Chart paper
Markers or crayons
Balance Beam and hanging weights or
    pan balance and weights
Counters
Hundred Boards
Sets of Double 6 dominoes, at least four sets in two or more
    colors
Calculators
Addition charts
File cards
Teacher Recording Sheets

Optional: Domino Transparencies—punch holes with a paper punch into 3" x 5" file cards that have been cut in half. Or, photocopy an actual set of dominoes on a copier set on transparency mode or make a transparency of pages 2 and 3 from *Domino Addition,* a book listed at the end of this i-Plan. After you make the transparency, you can cut the individual dominoes apart.

Overview: The unit consists of nine lessons and a pre-lesson activity that builds on and extends early understandings about counting and addition. Because familiarity with the many models of addition is important to students' success in problem solving, all four models are presented. Together they provide a structure for developing a rich conceptual schema for addition. In this unit, students also investigate properties of addition, represent addition in pictures, and write problems involving addition. Dominoes will be

used in most lessons, so having several sets in two or more colors will be necessary. Double 6 domino sets are inexpensive and are widely available in discount outlets, toy stores, and dollar stores.

Pre-Lesson Activity
In this activity, students listen to a counting book, play a game of dominoes, and create a set of picture dominoes.

Lesson 1: "Counting to Find Sums"
Students listen to a counting book as they show with counters the number being described. Next they count the spots on dominoes and write sums in vertical and horizontal format.

Lesson 2: "Hopping on the Number Line"
Students generate sums using the number line model, a model that highlights the measurement aspect of addition. The order property is introduced.

Lesson 3: "Exploring Adding with Sets"
A children's book sets the stage for students to write addition problems, find sums using sets, and present results in the form of a table. The additive identity is introduced.

Lesson 4: "Balancing Discoveries"
Students use actual and online balances to explore the fourth model of addition.

Lesson 5: "Seeing Doubles"
Children compute double sums using a method of their choice and begin making a set of triangle-shaped flash cards. A problem involving dominoes is posed as an extension activity.

Lesson 6: "Finding Fact Families"
Students use dominoes to search for addition facts and related subtraction facts and explore the concept of the missing addend.

Lesson 7: "Sum Search"
Children practice addition facts, use a calculator to find sums, record them on an addition chart, and look for patterns on the chart.

Lesson 8: "Plenty of Practice"
Students focus on sums of 9, 10, 11, and 12. They make a bar graph based on their sorting of dominos and complete a set of triangle-shaped flash cards.

Lesson 9: "Looking Back and Moving Forward"
Another domino game is introduced to facilitate continuing practice.
Questions for summative evaluation are suggested.

Pre-Lesson Activity

To review rational counting and numeral writing, read a counting book, such as *Fish Eyes* or *Over in the Meadow,* to the students. As you read, ask them to both write the numeral and model the number with counters.

Children who have never played dominoes should be introduced to the game. Begin in a whole-group setting by showing the students a set of Double 6 dominoes. Encourage the students to describe what they notice as they look at the tiles. Then ask for two volunteers to play a game while the other children watch. So that all students can follow the action, ask both volunteers to display all their tiles for this demonstration. The type of game you will want to teach the children is called a Draw Game, and the rules for this game will be found at http://www.dominoes.com/dominoinfo/rules-intro.asp?gamename=40 (where you can also find rules for other dominoes games). Explain that the Draw Game begins with a tile that is randomly chosen from the set of upside down tiles being placed right side up on the playing field. To determine the first player, the children each choose a tile from the set and compare the number of spots on their dominoes. The child whose domino has the most spots goes first. Then help the children play the game.

Younger children might enjoy making a set of picture dominos—see www.crayola.com/ideas/ for directions. When you get to this home page, enter "dominoes" in the search box. If the topics shown are not appropriate, other themes such as mittens or flowers might be suggested for the children to use in their illustrations.

Lesson 1: Counting to Find Sums

This lesson focuses on the "counting" model for addition and begins with reading a counting book. Students model the numbers with counters as the book is read. Then they count the spots on each side of a domino and write in vertical and horizontal format the sums suggested by dominoes. Finally, the students illustrate a domino and record a sum it represents for their portfolio. Rules for the game of dominoes can be found at http://www.dominoes.com/dominoinfo/rules-intro.asp?gamename=40

Learning Objectives:

> Students will count to 12.
> Students will model numbers to 12.
> Students will count sums to 12.
> Students will write and recognize numerals to 12.
> Students will record sums in vertical and in horizontal format.

Lesson Description:

To set the stage for learning, choose a counting book to read. Of the many available, a few are listed at the end of the unit. Any book in which the pictures for the numbers are unambiguous will work, but a book that also presents the written or numerical form of the numbers is preferable. *Ten Little Rabbits* or *Ten Black Dots* are two books that use the number words; *The M & M's Counting Book* uses both numerals and words for the numbers. As students listen to the story, have them model each number as it is mentioned with counters (or coated chocolate candies), then write the numeral and number word for each. This recording process will assist you in assessing the students' current level of functioning.

Next put students in small groups and give each group a set of Double 6 dominoes. Hold up a domino (or display one on the overhead) and have the children count the total number of dots. Then ask them to look in their set to find a domino that has the same number of dots as yours does, one that has one more dot, and one that has one less dot.

Now ask the students to hold a domino vertically so that one side is over the other. Ask them to count the spots on the top part of the domino and write the number. Then have them count the spots on the bottom part and write it under the first number they wrote. Introduce the addition sign, if necessary, and have them draw a line under the bottom number. Then have them count the number of spots in all, record the sum, and read the addition statement to a friend. Encourage the students to continue this procedure with several dominos. Next, repeat this activity asking the children to rotate the domino a quarter turn so it is in a horizontal position. Then ask them to count the spots on the top first, then those on the bottom, and finally to record the sum in horizontal format.

When the students are ready, review some of the sums and the counting process that was used to get those sums. Ask the children to choose one domino to draw for their portfolio and to write the addition statement modeled in the domino in both vertical and horizontal format.

Guiding Questions:

1. How many spots were on this part of the domino? On this part? In all?
2. Are there more or less on this next domino? How can you tell?
3. What is alike between the two ways we recorded the sums? What was different?
4. Can you find a domino with five spots? With ten?
5. I am thinking of a domino with six spots. What could it look like? Could it look any other way?
6. What does the "plus" sign mean?
7. In what two ways did you use a symbol to mean "equals"?
8. What is the largest number you can show on your fingers? What is the largest number modeled on a set of Double 6 dominoes? Which is greater?

Assessment:

At this stage of the unit, it is important to know whether students—
> can model numbers to 12 with concrete objects;
> can count rationally to 12;
> can write and recognize numerals to 12;
> can find sums by counting two addends;
> can record sums in vertical and horizontal notation;
> understand the meaning of the "plus" sign, the "equals" sign, and the bar used in vertical addition format.

Documenting information about students' understanding and skills throughout the unit can help you focus on individual needs and strengths and foster appropriate additional learning opportunities. A recording format, "Class Notes," is included at the end of this unit. You may find this information useful when discussing children's progress toward learning targets with parents, administrators, colleagues, and the students themselves.

Teacher Reflection Questions:

1. Which material distribution strategies were most effective?
2. Which students met all the objectives of this lesson? What extension activities would be appropriate for those students?
3. Which students did not meet the objectives of this lesson? What instructional experiences do they need next? What mathematical ideas need clarification?
4. Which groups worked together well?
5. Which children were able to model turns easily?
6. What adjustments would you make the next time that you teach this lesson?

Lesson 2: Hopping on the Number Line

In this lesson, students generate sums using the "number line" model. This model highlights the measurement aspect of addition and is a distinctly different representation of the operation from the model presented in Lesson 1. The order property is also introduced. At the end of the lesson, students are encouraged to predict sums and to answer puzzles involving addition.

Learning Objectives:

> Students will use the number line model to find sums.
> Students will investigate the order property of addition.
> Students will solve and create puzzles using the number line.

Lesson Description:

Tell the students that they will find sums using the number line model. Then display a large number line and a 5/4 domino, that is, a domino with 5 spots on the left side and 4

spots on the right. Then demonstrate with a counter how a hop of 5 is taken on the number line. You may wish to encourage students to count aloud as the hop is made. Then make a hop of 4, starting at the place the counter landed. You might choose to have them record what happened using the equation notation $5 + 4 = 9$, or to informally describe the moves this way: "If you take a hop of 5 spaces and then a hop of 4 spaces, you land on 9." You may wish to highlight the fact that in this model, spaces are counted, not points on the number line. After several trials, put the students in pairs and give each pair some dominoes, a counter, and individual number lines or a 12-inch ruler that they can use as a number line. Ask the students to take turns moving the counter on the number line to find the sum shown on the domino and recording the hops in pictures and in equation form. Ask them to draw the first hop and write the first numeral in green and the second hop and numeral in red. Encourage the students to predict the sums and to verify their predictions by moving a counter on the number line.

After allowing time for exploration, ask the students to predict the answers to questions such as "If I take a hop of 3 and then a hop of 5, where will I land?" Now have students make up 2 similar problems on a piece of paper and trade them with a friend. Students should then solve their partners' problems using the number line. When the pairs have finished, call them together to discuss what they did. Encourage them to use the number line in their explanation. Then ask "If I take a hop of 5 and then a hop of 4, where will I land? How about if I take a hop of 4 and then a hop of 5? Will this work every time?" Encourage them to explore the order property by writing each first addend in green and each second one in red.

As a concluding activity, pose puzzles such as "I am the number you land on when you take a hop of 5 and then a hop of 1. Who am I?" You may wish to encourage students to create and share similar problems. One or more of these puzzles could be added to their learning portfolios.

Guiding Questions:

1. What number did you land on when you made a 5-hop, then a 3-hop?
2. Would you land on the same number if you took a 3-hop first, then a 5-hop? How do you know?
3. What sums did you model with hops? How did you record them?
4. Were any of the sums the same? Why?
5. How would you find the sum of 2 and 5?
6. How would you tell a friend to add on the number line?
7. If appropriate for your class—how is using a number line like measuring? How is it different?

Assessment:

At this stage of the unit, it is important to know whether students can:
   use the number line model to find sums;
   use the order property of addition;

solve and create puzzles using the number line.

The guiding questions help students focus on the mathematics and aid you in understanding the students' current level of knowledge and skill with the mathematical concepts of this lesson. You may want to add others that conversations with the students suggest. A teacher's resource, "Class Notes," found after Lesson 9, provides a form on which to document your observations about student understanding and skills. You may find the information useful when planning additional learning experiences for individual students or for documenting progress for students with mandated instructional plans.

Teacher Reflection Questions:

1. Which pairs worked most effectively together?
2. Which pairs were less effective?
3. Which students counted as they took hops and which moved directly to the number?
4. What activities would be appropriate for students who met all the objectives?
5. Which students had trouble using the number line? What instructional experiences do they need next?
6. Did any children notice a connection with measurement?
7. What adjustments would you make the next time that you teach this lesson?

Extension:
If you wish to display a collection of the students' puzzles in a public place, ask the students to copy the puzzle on a file card. Then have them show how they got the answer from the number line on the back of the card. They might want to send a written challenge to students from other classes to solve the puzzles.

Lesson 3: Exploring Adding with Sets

This lesson builds on Lessons 1 and 2 and encourages students to explore another model for addition, the "familiar set" model. This model is similar to the counting model in Lesson 1, because it is based on counting. The model in Lesson 2 is based on measurement. Reading *The Hershey's Kisses Addition Book* will set the stage for this lesson in which students write story problems, find sums using sets, and present results in the form of a table. In the discussion of the table, the students focus on the order property and the effects of adding 0.

Learning Objectives:

Students will explore the results of adding sets.
Students will review the order property and the terms "addend" and "sum."
Students will explore the effects of adding 0.
Students will construct a table showing addends and sums.

Lesson Description:

To set the stage for this lesson, you may wish to read *The Hershey's Kisses Addition Book,* which is listed in Appendix A. Then ask the children to write an addition story problem that uses sets. Encourage them to share their problems and to put them in their portfolios.

Then provide groups of children with dominoes and a workmat. Tell them that they will consider the number of spots on each side of the domino as a set. Ask them to choose a domino and record the number of spots on each side as well as both sides combined. Next, tape up a large piece of chart paper that displays a recording table featuring columns that you have labeled "Number of Spots on the Left Side," "Number of Spots on the Right Side," and "Number of Spots in All." Display a 5/4 domino and have the students suggest what will go in each column (e.g., 5, 4, 9). Then have them work in pairs to create new entries for the table. When they have identified the sum, help them enter their findings on the class chart. Allow the children time to make several entries, then call them together and review the terms "addend" and "sum." Call on a volunteer to read one row of the chart. Then call on other volunteers to read the other rows. When several have been read, ask the children if they see any similarities among the entries. Repeat with other volunteers. If examples of the order property are not mentioned, prompt them to notice such entries. Also call attention to rows where at least one addend is zero. Encourage students to also notice rows in which the last column shows the same number.

Finally, ask the students to choose one of the rows from the chart and draw a picture illustrating that number fact. They may wish to display these in the classroom or in a more public place.

Guiding Questions:

1. How many spots are on the left side of this domino? On the right? How many in all?
2. Which sum that we listed was the greatest? What addends were used? Do you think we could get a larger sum with this set of dominoes? How?
3. Suppose you had a domino with a "5" and a "0." What would be the sum? How about a "0" and a "5?"
4. Look at this row. Does any other row have the same sum? The same two addends?
5. Would you get the same thing if you had a "4" on the left and a "3" on the right as you would if the "3" were on the left and the "4" on the right? Can you show why?

Assessment:

At this stage of the unit, it is important to know whether students can:

    model addition using the set model;
    identify sums and addends;
    recognize the effect of adding "0;"

recognize and use the order principle.

The suggested guiding questions may assist you in understanding your students' level of knowledge, but others may suggest themselves as you dialogue with your students. You may find it helpful to add to your recordings on the "Class Notes" sheet that you began earlier in this unit. This data may be helpful as you plan strategies for regrouping students and for remediation or extension activities.

Teacher Reflection Questions:

1. Did some students exhibit special strengths? Did some students exhibit reluctance to participate? Why?
2. Which students met all the objectives of this lesson? What extension activities are appropriate for these students?
3. Which students did not meet the objectives of this lesson? What misconceptions did they demonstrate?
4. Can most of the students justify the sum when one addend is "0?"
5. What parts of the lesson went smoothly? Which parts would you change the next time that you teach this lesson?

Lesson 4: Balancing Discoveries

This lesson encourages students to explore another model of addition, the "balance" model. The exploration also involves recording the modeled addition facts in equation form. Students begin to memorize the addition facts by playing the "seven-up game." Note that because the shapes have different values, when using the online balance, only one shape weight should be used throughout the session.

Learning Objectives:

> Students will explore the balance model of addition.
> Students will write the addition modeled on balances in equation form.
> Students will find sums of 7.

Lesson Description:

In this lesson, the balance model for addition will be demonstrated using an actual balance beam or pan balance. If you use a balance beam, you will hang weights from positions in the arms; if you use a pan balance, you will need to enclose sets of weights in plastic bags (and you may want to write on the bags the amount of weights in each). To use a balance beam, display it and review with the students how it operates. Then ask a volunteer to hang a weight on the "3" position of the left arm of the balance beam and then another weight from the "2" position. Next ask "Where would we need to place a weight on the other side so that the beam balances?" If you use a pan balance and weights in plastic bags, put a bag with three weights and a bag with two weights on the left side and ask how many loose weights would be needed to balance them. Accept and model all

student responses. When the response "5" is given, ask students to record this using the equation $3 + 2 = 5$. Continue with other weights until the children are comfortable with the process. You may wish to introduce the children to the online interactive balance found at illuminations.nctm.org/imath/across/balance/equiv2.html   as another way to practice. When they have had time to explore, suggest that they write a portfolio entry about how a balance can help them find sums.

Next put the children into pairs and give them a set of Double 6 dominoes to share equally between themselves. Have them place their dominoes upside down so that the spots are not visible. Display or explain the rules of the "seven-up game:"
1. Each player turns over one domino and finds the total number of spots on it.
2. If it is 7, the domino is placed on end on that player's side of the desk and the player who turned it over writes the appropriate equation.
3. If the domino has any other sum, it is removed to the side.
4. When all the dominoes have been turned over, the player who turned over the most dominoes with a sum of 7 lines up his or her dominoes and pushes them to make them fall over.

Allow the students to play the Seven Up Game until the class period is nearly over. Then call them together to discuss their experiences using the following, or other, guiding questions. For those who are ready, you may wish to suggest a related game where the sum of 10 is the goal.

Guiding Questions:
1. When you modeled an equation on the balance beam, what did you do first? Then what? How did you record this?
2. Suppose you put a weight on the "1" and on the "2" on the left hand side of the beam and that you wanted to put a weight on the right hand side to balance the scale. Where would you put it?
3. What equation could you write to show what you did? Can you write another addition equation with the same addends?
4. How could you use the balance beam to complete this number sentence: $3 + \_ = 5$?

Assessment:

At this stage of the unit, it is important to know whether students can:
> find sums using a balance beam;
> write addition sentences in equation form;
> use the terms "addend" and "sum" correctly.

The guiding questions will elicit information that will help you assess the students' current level of knowledge about addition. As a new model for addition has been added today, you may wish to make more entries on the "Class Notes" sheet begun earlier in this unit.

Teacher Reflection Questions:

1. Which students met all the objectives of this lesson? What extension activities are appropriate for these students?
2. Which students did not meet the objectives of this lesson? What instructional experiences do they need next?
3. When the children worked in pairs, did both children contribute equally?
4. Which students have mastered sums of 7? Which are still counting to find these sums?
5. What parts of the lesson went smoothly? Which parts would you change the next time that you teach this lesson?

Lesson 5: Seeing Doubles

In this lesson, the students focus on dominoes with the same number of spots on each side and on the related addition facts. They make triangle-shaped flash cards for the doubles facts. An extension poses a problem that involves dominoes.

Learning Objectives:

Students will write equations using doubles.
Students will review the terms "addend" and "sum."
Students will use equations to record doubles sums.

Lesson Description:

At this point, you may wish to read another of the books listed in Appendix A, for example, *What Comes in 2's, 3's and 4's*. While students remain in their seats, ask them to name things that come in pairs. Record their responses and ask the children to say or write the addition equations the list of pairs suggests. Then ask a volunteer to choose a pair and state the addends and the sum.

You may also wish to discuss some examples from science, such as "If a starfish has 5 arms, how many arms will 2 starfish have?" or "If a flower has 4 petals, how many petals will 2 flowers have?" Now ask the children to write an addition story problem that uses doubles. Encourage them to share their problem with a friend and add it to their portfolios.

When the students complete this activity, give groups of students a set of Double 6 dominoes and ask them to put the tiles upside down. Tell the students to take turns picking a domino and finding the sum in any way they wish. If they pick a double (a domino with the same number of spots on both sides) they should write the equation it suggests. If the tile picked is not a double, it is simply removed from the pile and the next child draws. Play continues until all tiles are drawn. The winner is the child who drew the most doubles. As this game takes only a little time, the students may wish to play it more than once.

Next, provide the children with file cards from which 2 inches of the long side have been cut. Ask them to fold the 3-inch squares to make two right triangles and then to cut the triangles apart. Ask them "How many triangles will we need if we want enough for each doubles fact found on our dominoes?" If the answer "6" is given, remind them that there is a 0/0 domino also, and that they will each need seven cards. Then have children write one doubles fact on each triangle by writing the sum at the right angle and the addends across the hypotenuse, one in each corner. When the students are ready, call them together to display the cards that they created. Encourage them to practice their addition facts with doubles by having a friend cover the sum and show the addends only. You may wish to have the children draw a sample triangle fact card and write its associated addition facts as an entry in their portfolio.

Extension:
Ask the children this seemingly easy question: "How many dominoes will we need for a Double 6 set?" Encourage them to record how they found the answer. Then ask "How many would we need for a Double 9 set?" (The answers are 28 and 55, respectively.)

Guiding Questions:

1. What can you say about the addends in doubles? (They are the same.) What about the sum? (It's always an even number.)
2. What doubles did you find on the dominoes? Did you know any of the doubles facts by heart already?
3. When we listed things that came in pairs, what equations did we write? Did you know any of these facts by heart?
4. Do you know any other facts by heart? Which ones?

Assessment:

At this stage of the unit it is important to know whether students can:
> write equations using doubles;
> use equations to record doubles sums;
> identify sums and addends.

The guiding questions help students to focus on the mathematics studied in this lesson and provide information on the students' current level of knowledge and skill. Because this is the first lesson in which memorization is stressed, you may wish to document on the "Class Notes" sheet found at the end of this unit which facts each student has mastered.

Teacher Reflection Questions:

1. Which pairs worked together most effectively? Have they developed the ability to work together as the year has progressed? Who should work together next?
2. Did some students already know some of the doubles facts at the immediate recall level?

3. Which students met all the objectives of this lesson? Which students are still having difficulty with the objectives of this lesson?
4. What will you differently when you teach this lesson again?
5. What did you learn about the children as you taught this lesson?

Lesson 6: Finding Fact Families

In this lesson, the relationship of subtraction to addition is introduced with a book and with dominoes. Then the children explore the concept of missing addends. They also add cards with sums of 4 to their individual set of triangle-shaped flash cards.

Learning Objectives:

Students will find missing addends.
Students will review the additive identity.
Students will add to their set of triangle-shaped flash cards.

Lesson Description:

To review the concept of subtraction, read *Ten Sly Piranhas*. Ask the children to act out with counters what is happening in the story and to write the related subtraction sentence for each page. Then call out a sum and have each child show you a domino with that many spots. Encourage the students to write the addition equation suggested by the domino.

Next, choose two dominoes with the same number of total spots, then display them with one crossed over the other so that both parts of the upper domino but only one part of the bottom domino is visible (see figure 1). Now tell the children that both dominoes have the same number of spots and that they are to guess how many spots are covered on the bottom domino. When a correct response is given, display the domino and ask the students to explain how they knew.
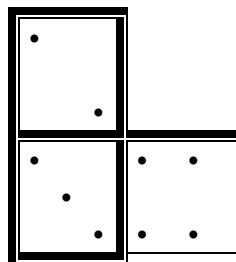

Fig. 1. A 3/2 domino laid over a 1/4 domino

Model the activity a few more times, being sure to include one example of what happens when one domino has 0 spots on one side. Then place the students in pairs and have them

take turns being the teacher. This activity will help them focus on the relationship of subtraction to addition. Finally, ask the pairs to sort the set of Double 6 dominoes by the sums that the dominoes represent. Ask the students to write a sentence about this exercise for their portfolios.

Now call the children together and ask a volunteer to choose a domino that is not a double and write the four number sentences (two addition and two subtraction) that the domino suggests. You may wish to repeat this exercise with other volunteers.

As the lesson concludes, remind the students that they need to practice the addition facts and that making more triangle-shaped flash cards will help them to do so. In this lesson, you might have them make cards with the sums of 0, 1, 3, and 4 that they have not already made.

Guiding Questions:

1. What is missing when I say "2 + 'something' = 5?" Can you write the complete addition sentence?
2. What about when I say "6 + 'something' equals 6?" What addition sentence would show that?
3. If you know the top domino has seven spots, and you can see two on the bottom domino, how many spots on the bottom domino are covered?
4. How many number facts with sums to 3 do you have left to memorize? To 0? To 4? To 1?
5. Can you say the doubles without counting?
6. How many addition and subtraction facts can I write if I pick a 3/4 domino? Suppose I pick a 3/0 domino? A 3/3 domino?
7. How could you help a friend find a subtraction fact related to 5 + 4 = 9?

Assessment:

At this stage of the unit, it is important to know whether students:
▪ can identify the addition facts with sums to 4;
▪ recognize the effects of adding 0;
▪ can use the inverse property of addition to complete addition equations.

The guiding questions help students focus on their current level of understanding and of fact mastery. You may wish to add more documentation to the "Class Notes" chart. These notes will be valuable as you plan appropriate remediation and enrichment opportunities.

Teacher Reflection Questions:

1. Which students have some of the facts memorized?
2. Did most students remember the effects of adding by 0? Did most recall the order property?
3. Which students met all the objectives of this lesson? What extension activities are

appropriate for those students?
4. Which students are still having difficulty with the objectives of this lesson? What additional instructional experiences do they need?
5. What will you do differently the next time that you teach this lesson?

Lesson 7: Sum Search

During this lesson, students practice addition facts in a concentration-game format using dominoes. Then they generate sums to given numbers using a calculator and record them on a hundred board and look for patterns. Later, they record their current level of addition-fact mastery on an addition table.

Learning Objectives:

Students will generate the addition facts with sums of 5, 6, 7, and 8.
Students will recognize the addition facts that they have memorized.
Students will use a game to practice the addition facts.

Lesson Description:

From a set of dominoes, select those that have 5, 6, 7, or 8 total spots. Place them upside down in an array where the children can see them. Now call on one student at a time to turn over two dominoes. When the student turns over dominos with the same total number of spots, the student keeps them. If the dominoes have different sums, both dominoes are returned face down to their place in the array and another child is called on. You may want to play this game twice and then suggest that children can play it in pairs at a later time.

Now display the Internet site "Learning about Number Relationships and Properties of Numbers Using Calculators and Hundred Boards: Displaying Number Patterns," which is found at http://standards.nctm.org/document/eexamples/chap4/4.5/index.htm, or give the children calculators. Give each child a hundred board and explain that they are to use the calculator to find the addend pairs that give a sum of 5, then to ring each sum in yellow on the hundred board. When the students have finished, ask them to ring sums of 6 in green, sums of 7 in black, and sums of 8 in brown. At an appropriate time, call the children together and ask them to describe any patterns that they notice on the hundreds board.

Teacher Note: The colors used are those associated with the lengths of the Cuisenaire rods. Children who are ready for an extra challenge might find addend pairs for other sums and ring them in the appropriate colors—red for 2, light green for 3, purple for 4, blue for 9, and orange for 10.

Now give the students individual addition tables and ask them to completely cover with a black crayon, sticker dot, or marker any facts that they know by heart. This activity will help them focus on the addition facts they know and those they have yet to memorize.

When the students are ready, remind them of the order property and ask them what else they can cover if they know, for instance, 4 + 3. If they answer 3 + 4, tell them to cover that also. When they have finished, ask if they know something about adding 0. If they can tell you the sum is always the same as the other addend, have them cover all the sums in the first row and column. Encourage them to notice that only a few facts remain visible. Remind them that they need to practice these facts and that making more triangle-shaped flash cards will help them do so.

Finally, ask the children to make fact cards for the sums to 5, 6, and 8 that are not already in their triangle-shaped fact card set.

Guiding Questions:

1. What addends sum to 8? To 7? To 5? To 6?
2. Look at the numbers that add to 7 on the table. Do you see any doubles? How about when you look at those that added to 8? To 6? Why is that?
3. What happens when we add 0 to a number?
4. How many number facts do you have left to memorize?

Assessment:

At this stage of the unit, it is important to know whether students:

- can identify the addition facts with sums of 0 through 8;
- can use the identity property to find sums;
- recognize which addition facts that they have memorized;
- realize how the inverse property of addition reduces the memorization load for the addition facts.

The guiding questions help students focus on their current level of understanding and of fact mastery. The information that you have documented about student understanding and skills throughout the unit on the "Class Notes" sheet can help you to focus on individual needs and strengths and provide appropriate additional learning opportunities. You may also find this information useful when discussing children's progress toward learning targets with students, parents, administrators, and colleagues.

Teacher Reflection Questions:

1. Which students have some of the facts memorized? Which appear to be memorized first?
2. Did most students remember the effects of adding by 0? Did most recall the doubles facts?
3. Which students met all the objectives of this lesson? What extension activities are appropriate for those students?
4. Which students are still having difficulty with the objectives of this lesson? What additional instructional experiences do they need?

5. What will you do differently the next time that you teach this lesson?

Lesson 8: Plenty of Practice

During this lesson, students construct a bulletin board display that focuses on sums of 9, 10, 11, and 12. Then they sort dominoes by the total number of dots and make a bar graph based on their sorting. The children also complete their individual sets of triangle-shaped flash cards and add to their record of memorized facts.

Learning Objectives:

Students will explore the addition facts with sums of 9, 10, 11, and 12.
Students will record the addition facts that they have memorized.
Students will identify the facts that are easy and those that are not so easy for them.
Students will complete a set of triangle-shaped flash cards for the addition facts.

Lesson Description:

Ask children to write one of the focus numbers (9, 10, 11, or 12) on a file card, then to find two dominoes that have that many total spots. Have the students write the addition sentence suggested by the dominoes they found on the card, then repeat until they have written three equations. Then call the class together to share what they have found. Encourage the students to write a portfolio entry that describes what they did.

Now put the children into groups. Have them sort a set of Double 6 dominoes by the total number of dots on each and then use the sorting to arrange the dominoes in the form of a bar graph. When they have finished, ask them to record the bar graph that they made.

As the groups complete the second activity, ask them to complete their set of triangle-shaped flash cards. When they have a complete set, ask them to work with a partner to ask each other the facts shown on the triangle-shaped cards. Encourage the children to focus on the addition facts that they know and to determine why these were easy facts for them to learn.

Guiding Questions:

1. What dominoes have a sum of 8? Of 9? 10? 11? 12?
2. When you found the dominoes that had a sum of 11, did you find any doubles? Why not? How about when you look at those that had a sum of 12? Of 8?
3. What addition sentence would a 5/6 domino suggest?
4. What happens when we add 0 to a number?
5. What do you notice about your "easy" facts?
6. What do you notice about those you do not find easy? Why do you think they are harder for you to remember?

7.   How many number facts do you have left to memorize?

Assessment:

At this stage of the unit, it is important to know whether students:

- can name multiple ways to get sums of 9, 10, 11, and 12;
- have recorded the addition facts that they have memorized;
- have completed a set of triangle flash cards for the addition facts to 12.

The guiding questions help students to focus on their current level of understanding and of fact mastery. Continuing to use the "Class Notes" sheet to document your observations about students' understanding and skills throughout the unit can help you to focus on individual needs and strengths and can help you to give appropriate remediation and enrichment opportunities.

Teacher Reflection Questions:

1.   Which students have most of the facts memorized?
2.   Did most students remember the effects of adding 0?
3.   Which students met all the objectives of this lesson? What extension activities are appropriate for those students?
4.   Which students are still having difficulty with the objectives of this lesson? What additional instructional experiences do they need?
5.   What would you do differently the next time that you teach this lesson?
6.   What did you learn about the children as you taught this lesson?

Lesson 9: Looking Back and Moving Forward

This final lesson is the Performance Assessment guide for this i-Plan and suggests a framework for further exploration. It also reviews the work of the eight previous lessons. During this lesson, students use the mathematical knowledge and skills developed in the previous lessons to demonstrate understanding and ability to apply that knowledge to playing a domino game.

Learning Objectives:

Students will review the models for addition.
Students will use the properties of addition.
Students will memorize the addition facts.

Lesson Description:

While students remain in their seats, ask them to name the models used during this unit. Prompt them if they forget any of them. Then have them illustrate with a domino the addition properties that they explored during the unit. Next call out a sum and have the

children find dominoes that represent that sum.

Now put the students in pairs and have each pair turn a set of dominoes upside down. Then have each partner pick a domino from the set at the same time and compare the total number of spots. The child whose domino has the most spots writes the two addition sentences in horizontal format for both dominoes. If the number of spots is equal, each child writes one of the sentences. Have them continue the game until one child has written 10 addition sentences. Have them repeat the game, this time recording in vertical format.

Next have the children sort five or six facts that they need to learn from their set of triangle-shaped flash cards. Put the children into pairs to practice those facts using the cards that they selected.

As a summative assessment activity, display a domino and have the children describe it in an addition equation, then find at least one more domino with the same number of dots. You may wish to ask them to add a final entry to their portfolios in which they answer the question, "What did I learn in this unit?"

Guiding Questions:

1. What dominoes represent sums of 7?Of 11?
2. What is it like when we add 1? (Counting.)
3. What do you notice about the sum of the 4/5 and that of the 5/4 domino?
4. How many weights would you need to put on the right side to balance a weight hanging from the "3" and one hanging from the "5" on the left side?
5. What pair of hops on the number line will get you to "8"? Any others?
6. If you add 0 to a number, what is the sum?
7. What are the addition facts and the subtraction facts that this triangle card helps you to practice?
8. What activity did you like most? Which was hardest for you? Why?
9. Suppose you could do some of your work over again. What would you choose?
10. How many number facts do you have left to memorize?
11. Which of these number facts will you learn this week?

Assessment:

At this stage of the unit, it is important to know:
> whether students understand several models for addition;
> whether students can use the properties of addition;
> which addition facts students have memorized.

The guiding questions help students to focus on the mathematics they have studied in the lessons of this unit and help you gather summative assessment data on individual students. The documentation that you have collected about students' understanding and skills throughout the unit will help you to plan appropriate remediation and enrichment

opportunities.

Teacher Reflection Questions:

1. Which students met all the objectives of this lesson? What extension activities are appropriate for those students?
2. Which students are still having difficulty with the objectives of this lesson? What additional instructional experiences do they need?
3. Are students able to recognize the facts that they know by heart and those that they still need to learn? How can you provide more practice on these?
4. What would you do differently the next time that you teach this lesson?

You may wish to review the "Class Notes" documents that you completed throughout this unit. These can guide the summative comments you make for individual students.

Looking Back:

1. With which models were most students the most comfortable?
2. Which students met all the objectives of this unit? What extension activities are appropriate for those students?
3. Which students did not meet the objectives of this unit? What additional instructional experiences do they need?
4. Did all students display understanding of the addition properties?
5. Can students explain how to find sums in several ways?
6. Do the students recognize the facts that they know and those they have yet to learn?
7. What were the greatest challenges for the students?
8. Which portions of this i-Plan were the students most motivated to complete? Why?

This set of questions may help you determine the focus of your next instructional activities. Documenting the level of each student's understanding makes accurate information available for planning subsequent instructional activities.

Moving Forward:

1. How can I help students to continue to focus on the important ideas in this set of lessons?
2. What other learning experiences will help students explore addition?
3. How might I connect the essential ideas of this unit with lessons about similar mathematics content?
4. What learning experiences would help students not yet comfortable with these concepts?
5. Which learning experiences would help them continue toward mastery of the addition facts?
6. What did I learn about the students while I taught this unit?

Appendix A

A Sampling of Children's Books Relevant to this Unit

Aker, Suzanne. *What Comes in 2's, 3's, & 4's*. New York: Simon and Schuster, 1990.
Crews, Donald. *Ten Black Dots*. New York: Greenwillow, 1986.
Ehlert, Lois. *Fish Eyes: A Book You Can Count On*. New York: Harcourt Brace, 1990.
Grossman, Virginia. *Ten Little Rabbits*. New York: Scholastic, 1991.
Keats, Ezra Jack. *Over in the Meadow*. New York: Scholastic, 1971.
Long, Lynette. *Domino Addition*. New York: Scholastic, 1996.
McGrath, Barbara B. *The M & M's Counting Book*. Cambridge: Charlesbridge, 1994.
Pallotta, Jerry. *The Hershey's Kisses Addition Book*. New York: Scholastic, 2001.
Wise, William. *Ten Sly Piranhas*. New York: Dial, 1993.

Teacher Assessment Resource

Class Notes

Mathematical Idea:_____   Date:_____

Name of Student	Comments about Understanding and Fact Mastery

HUNDRED CHART

1	2	3	4	5	6	7	8	9	10
11	12	13	14	15	16	17	18	19	20
21	22	23	24	25	26	27	28	29	30
31	32	33	34	35	36	37	38	39	40
41	42	43	44	45	46	47	48	49	50
51	52	53	54	55	56	57	58	59	60
61	62	63	64	65	67	67	68	69	70
71	72	73	74	75	76	77	78	79	80
81	82	83	84	85	86	87	88	89	90
91	92	93	94	95	96	97	98	99	100