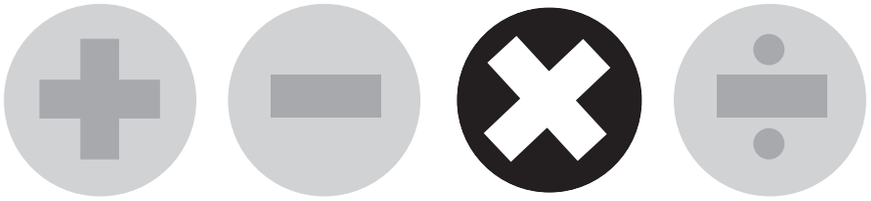
THINKING STRATEGIES: MULTIPLICATION

BUILDING MASTERY OF MULTIPLICATION FACTS



CELIA BARON

MathImagine

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INTRODUCTION

PROGRAM GOAL

Thinking Strategies: Multiplication is a program designed to help students master the basic multiplication facts. The program accomplishes this goal by (1) introducing the facts in logical rather than numerical order and (2) using the commutative or turnaround property (teaching facts like 2 x 3 and 3 x 2 together). The program uses the mathematical processes of communication, connections, reasoning, representation, and problem solving to encourage learning. Teachers can use *Thinking Strategies: Multiplication* with an entire class, small groups, or individual students.

WHAT ARE THE BASIC MULTIPLICATION FACTS?

The basic multiplication facts are combinations, like 5 x 8 or 9 x 3, in which the factors (numbers being multiplied) are less than 10. Because our number system is a base ten number system however, the program also includes multiplication facts in which the numbers being multiplied are 10 as well as the numbers that are less than 10.

WHAT IS MASTERY OF THE BASIC FACTS?

In his book, *Elementary and Middle School Mathematics,* John Van de Walle defines mastery of a basic fact as a quick response time of less than three seconds. This response should be accomplished without resorting to such inefficient means as counting. When a student is able to correctly respond to a fact automatically and without thinking, he or she has mastered that fact.

Building mastery of the basic facts involves the following four stages:

Stage 1: incorrect response/an inappropriate thinking strategy

Stage 2: correct response in more than three seconds using an appropriate thinking strategy

Stage 3: correct response within three seconds using an appropriate thinking strategy

Stage 4: correct response that is automatic and occurs without thinking

Mastery develops with practice (reviewing a variety of facts or procedures). The practice is provided in the program through the student activity sheets, Power Facts, Partner Bingos, and Challenge Facts.

Mastering the Basic Facts: The Latest Research

Van de Walle states that all students are able to master the basic facts if they follow three steps:

1. develop a strong understanding of the operations and number relationships
2. develop efficient thinking strategies for fact retrieval
3. practice the use and selection of those strategies

WHAT IS A "THINKING STRATEGY"?

A thinking strategy is a way of thinking that helps complete a fact *quickly*. For a strategy to be a thinking strategy, it must be done *mentally*, and it must be *efficient.*

The more senses you can involve when introducing the facts, the greater the likelihood students will remember how to complete the facts. Different strategies work for different students. By providing a variety of strategies, students can choose what works best for them. Some strategies are visual—for example, the numbers of a clock, which are used to complete facts with a factor of 5. Some strategies are auditory and involve silly sayings or rhymes. Many of the strategies involve patterns and connecting facts that students have yet to learn with facts they already know how to complete.

PROGRAM LEVELS

The *Thinking Strategies: Multiplication* program is divided into seven levels. Each level begins by having the students model the facts introduced in that level. These models are visual representations of the facts and help students understand why a fact is completed the way it is. Once the students have developed and understand the strategies of that level of the program, they practice them. The facts are then incorporated with the facts introduced in previous levels. At the end of each level, a Level Challenge activity helps students identify and apply thinking strategies to the facts introduced to that point of the program.

Level 1: The first level examines the basic multiplication facts with a factor of 2. It introduces the concept of multiplication, the commutative or turnaround property, and many of the models used in the program. This level introduces the thinking strategies for the facts with a factor of 2.

Level 2: The second level examines the basic multiplication facts with a factor of 5 and multiplication facts with a factor of 10. A number of thinking strategies are developed for completing facts with a factor of 5.

Level 3: The third level examines the basic multiplication facts with a factor of 9. These facts are introduced early in the program because they have many patterns. Two patterns in particular are used to develop the pattern of 9 thinking strategy.

Level 4: The fourth level introduces multiplication facts with a factor of either 1 or 0. Although students may find it easy to complete these facts, they may find the concept of multiplication with the number 0 difficult to understand. The fourth level also introduces the square facts—facts having the same factors (e.g., 3 x 3). Several thinking strategies are presented for these facts, including connections to everyday events and silly sayings.

Level 5: The fifth level examines the basic multiplication facts with a factor of 4. By using the commutative or turnaround property and teaching facts like 2 x 4 and 4 x 2 together, only four basic facts with a factor of 4 and their turnarounds have not yet been introduced in the program. The primary thinking strategy developed to complete facts with a factor of 4 is doubling the corresponding fact with a factor of 2.

Level 6: The sixth level examines the basic multiplication facts with a factor of 3. Only three facts with a factor of 3 and their turnarounds have not been introduced in the program by Level 6. A variety of thinking strategies are developed for these facts.

Level 7: The seventh level examines the remaining basic multiplication facts. The three remaining facts and their turnarounds have factors of 6, 7, and 8. These facts are among the most difficult to learn. A variety of thinking strategies are developed for these facts.

PROGRAM COMPONENTS

Teacher Lessons

The lessons give clear directions for working through the program and provide instructions that teachers can use to help students master the multiplication facts. The lessons involve working with models, such as arrays and ten-frames. Students are encouraged to find as many strategies as possible for completing the facts. With many strategies to choose from, students soon find the strategies that work best for them.

Class Discussion

Class discussions are an integral part of the program. The following are some statements and questions that can be used to encourage student participation in class discussions:

Explain and justify your answer.

Explain your answer in another way.

Can someone else explain the answer in another way?

As a group, describe a different way to find the answer.

If you did not know how to complete this fact, what thinking strategy would you use?

What is another fact that you can complete this way?

How can you model this fact with a picture?

How can you model this fact with another picture?

How does this model explain the fact?

Make up a story problem for this fact.

How does your story problem illustrate the fact?

Practice for Students

The student activity sheets support understanding of number relationships and give students practice with the basic multiplication facts. The activity sheets, which consist mainly of secret messages, line designs, and puzzles, are intended to be fun and engaging. They have the added advantage of being mainly self-correcting.

The program makes it easy to monitor the progress of students. At the end of every level is a level challenge activity. The Level Mystery Number Challenge checks each student's ability to identify and apply the appropriate thinking strategies to the facts introduced to that point in the program. Teachers can keep track of students' progress in other ways. As the students complete each level of the program, have them make a list of the facts they have yet to master from that level. Have the student practice these facts both at school with a classmate and at home with a parent. As the student is able to complete these facts, check them off on the student's progress report (page 127). Teachers can also check which facts their students can complete while they are working on the activity sheet that accompanies each lesson.

Even if some students have not mastered the facts introduced in a level, they can continue to the next level of the program. They will have more opportunities to practice these facts in the levels that follow.

Power Facts

There are fourteen sets of Power Facts—two sets for each level in the program. Each set consists of a list of 20 facts. The facts consist of those the students are introduced to in that level plus some of the more difficult facts from previous levels. The Power Facts are asked only after the thinking strategies for those facts have been fully developed.

The Power Facts are intended to support the learning of the multiplication facts. Ask these facts in class each day. Allow students no more than three seconds to complete each fact on their answer sheet, and then read out the multiplication fact and its product (answer). If the students

have been unable to complete the fact in three seconds, or if they have completed it incorrectly, have them write the completed fact on their answer sheet. Wait 5-7 seconds between facts to give the students time to process the fact. Students can measure their improvement each day as they are able to complete more facts correctly.

Each set of Power Facts is given in rows and columns. It is important to change the order in which the facts are asked—one day ask the first set vertically, the next day the second set horizontally, then from top to bottom, and another day from bottom to top.

Multiplication Grid

At the beginning of the program, hand out a copy of the multiplication grid to each student (see page 123). In each level of the program, students are asked to fill in the grid for the facts they have been introduced to. Teachers may also want to keep a master grid.

Partner Bingo

Partner Bingo is a two-player game. It can be played in class or at home with parents and siblings. Players have a bingo card and 16 facts that they take turns completing. As they complete each fact in order, they shade in one square on their bingo card. The same number might appear in more than one box on the bingo card, and the students must choose which to fill in. The first player to complete a row, column, or diagonal is the winner.

Partner Bingo provides practice with the basic multiplication facts in a fun game setting. The games are a positive way for parents to determine which multiplication facts their children are able to complete and which facts need more practice. There are Partner Bingo games in each level of the program—forty games in all.

Challenge Facts

The Challenge Facts (see page 185) consist of multiplication facts for each level of the program. Recent research does not support using timed tests to help students master the facts. Some students become very anxious when faced with timed tests, and this can affect their sense of their ability to do mathematics.

The Challenge Facts sheets are included in the program as a diagnostic tool. Teachers can use these sheets to find out which facts the students have mastered and which facts they have not mastered. The students can circle the facts that require more practice on the Challenge Facts sheets. There is no time limit indicated on the Challenge Facts.

Teacher Assessment

The intent of the program is not only to have the students master the basic facts, but also to have them do so in a positive manner. The evaluation and assessment should reflect this. Continuous assessment and evaluation allow recognition of student achievement. When students are successful in mastering the facts, they feel good about themselves and about their ability to learn. A powerful assessment tool is to have the students keep track of the facts that they have mastered. Having them track their progress in mastering the facts allows them to see how much they are learning and to feel a sense of accomplishment.

The National Council of Teachers of Mathematics recommends the integration of assessment and instruction. The program Thinking Strategies: Multiplication supports this integration. The student activity sheet that accompanies each lesson allows teachers to assess whether or not the students are following the program. As well, many of the activities are self-correcting and allow the students to know if they have understood the lessons.

Teachers can also use the Power Facts to assess the progress of students. Students can hand in their Power Facts answer sheets each day, or they can track their own progress. With either method, the teacher can use the results to complete the students' progress reports.

Discourage students from guessing. Completing a fact incorrectly reinforces the incorrect answer.

Student Self-Assessment

Students know which facts they have mastered and which they have yet to master. As they complete each level of the program, have them write about the facts they are learning in their journals. Have them indicate whether or not the facts in the level that they are working on are easy for them to complete. Have them explain why or why not. They may want to list both the facts they have mastered and the ones they have yet to master. Have them describe thinking strategies for the facts they have yet to master. If they need help in identifying thinking strategies, work with them to find them. A student self-assessment progress report for each level is included in the program (pages 128-134).

Using Individual Response Boards

Student response boards can be either a chalkboard or a dry-erase board made of laminated sheets of cardboard. In classrooms where each student has a response board, the students can write the products of the facts on their boards. Teachers can check off the students' progress reports as the students show the answers on their boards.

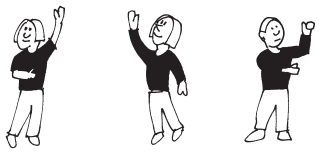
Parental Guidance

Teachers might want to involve parents in the learning process. Power Facts and thinking strategies can be sent home with students so that they can practice the facts with their parents as they are being taught the facts in class. Parents can also help their children by playing Partner Bingo with them.

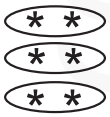
MODELS USED IN THE PROGRAM

The following models are used in the program:

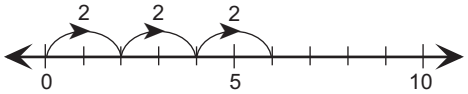
- One or more multiplication buddies appear on each student activity sheet. The buddies will illustrate a fact introduced in that lesson of the program.



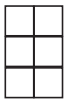
- Groups of stars: The groups of stars model for the multiplication fact 3 x 2 is three groups of two stars.



- Number line: The number line representing the fact 3 x 2 is modelled using three arrows or hops, each with a length of two.

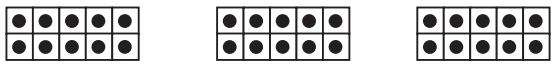


- Array (boxes): A rectangular array is an arrangement of boxes in rows and columns. Below, the array representing 3 x 2 consists of boxes in 3 rows and 2 columns.



3 x 2

- Ten-frame: A ten-frame is an array of 2 rows and 5 columns in which counters or dots are placed to illustrate numbers. The top row is filled in first, beginning on the left. Once the top row is full, the second row is filled in, again beginning on the left. For example, the fact 3 x 10 is represented by three ten-frames:



- Clock (for the multiplication facts with 5): The minute hand of a clock represents the number of minutes after the hour and can be used to represent multiplication facts with a factor of 5. The fact 3 x 5 is represented by the following clock:

LANGUAGES IN MULTIPLICATION

Van de Walle explains that it is useful to think of number sentences, models, and word problems as three separate languages. For example, the fact 3 x 2 could be expressed in the following ways:

- A number sentence would be 3 x 2 = 6.
- A model could be three groups, each containing two stars.
- A word problem could be a story problem involving three children, each with two pennies.

Having students translate from one language to another, when they complete a fact, helps them develop operation meaning.

Understanding the concept of multiplication is the foundation for mastering and applying the multiplication facts.

NUMBER RELATIONSHIPS

According to Van de Walle, students need to develop a strong understanding of the operations and number relationships. The four relationships that students can and should develop with numbers 1 through 10 are:

1. Spatial relationships
2. One and two more, one and two less
3. Anchors or benchmarks of 5 and 10
4. Part-part-whole relationships

Spatial relationships refer to the ability to recognize sets of 1 to 10 objects in patterned arrangements and to tell how many there are without counting.

One-and-two more relationships and *one-and-two-less-than relationships* involve more than just the ability to count on or count back one or two. When students understand these relationships, they understanding, for example, that the number 8 is one more than the number 7 and is two more than the number 6.

Our numeration system is based on the number 10; therefore, the numbers 5 and 10 can serve as *anchors*. The ten-frame is the most powerful model for anchoring the numbers from 1 through 10 to 5 and 10.

Part-part-whole relationships refer to the conceptualizing that a number is made up of two or more parts.

Van de Walle discusses the importance of extending *more and less relationships*, the *double relationship*, and the *near-double relationship* for the numbers 10 and 20. He also considers the *pre-place-value relationship* with 10. Applying this relationship, for example, students have an initial understanding of the role that a set of 10 has for the numbers between 10 and 20. Although students may not

yet have a complete development of place-value concepts, when they see a set of ten and a set of five, they should know without counting that the total is 15.

These relationships are considered in detail in the program *Thinking Strategies: Addition.*

DIFFERENT CLASSES OF MULTIPLICATIVE STRUCTURES

The understanding of the operation of multiplication is supported in the program through models, class discussions, and story problems. Van de Walle explains that most researchers identify four different classes of multiplicative structures: equal groups (repeated addition or rates), which is the most common class; multiplicative comparison; combinations; and product-of-measures.

The following story problems illustrate the different classes of multiplicative structures.

- Equal-Group Problem

  Jessica has 4 pencil cases. In each pencil case, she has 5 pencils. In total, how many pencils does Jessica have in her pencil cases?

- Comparison Problem

  Danny lives 9 blocks from school. Ben lives 3 times as many blocks from school as Danny does. How many blocks from school does Ben live?

- Combination Problem

  Sara has 7 shirts and 5 pairs of pants. How many different outfits does she have in total?

- Product-of-Measures Problem

  A room is 10 metres long and 9 metres wide. What is the area of the room?

The following story problems use humour to illustrate the different classes of multiplicative structures.

- Equal-Group Problem

  An octopus has 8 legs. On each leg, it is wearing 4 watches. How many watches is the octopus wearing?

- Comparison Problem

  Leah eats 3 cookies. Her friend The Giant eats 7 times as many cookies as Leah does. How many cookies does The Giant eat?

- Combination Problem

  Sam will eat sandwiches made only with peanut butter, egg, tuna, or cheese. Each sandwich has to have mustard or pickles or ketchup. How many different combinations of sandwiches will Sam eat?

- Product-of-Measures Problem

  A father bear is in his kitchen, which measures 5 metres by 7 metres. How large is the kitchen?

AND FINALLY...

Before you start the program, look through the seven levels. Explain to the students the order in which they will learn the multiplication facts and why this order works (all facts are taught, and they are taught in logical order). Also, discuss the goals of the program and the intended outcomes. Students can then understand where they are headed and what they can expect to achieve. You may also want to make a class poster of the thinking strategies.

LEVEL 1: FACTS WITH 2

LEVEL 1 OVERVIEW

In Level 1, two main thinking strategies are introduced for facts with a factor of 2: (1) the *addition double strategy* and (2) the *helping fact strategy.*

Students are also introduced to all facts with a factor of 2 regardless of whether 2 is the first or second factor.

Addition Double Strategy

Consider the fact 2 x 3. The fact 2 x 3 represents 2 groups of 3. The addition fact 3 + 3 is called a *double*, and doubles can be related to special pictures. The special pictures provide visual cues for the doubles. For example:

3 + 3 = 6	a bug with 3 legs on each side
4 + 4 = 8	a spider with 4 legs on each side
5 + 5 = 10	a person with 5 fingers on each hand
6 + 6 = 12	an egg carton with 2 rows of 6 eggs
7 + 7 = 14	a calendar with 2 weeks of 7 days
8 + 8 = 16	a box of crayons with 2 rows of 8 crayons
9 + 9 = 18	an 18-wheeler double with 2 sides, each with 9 wheels

Helping Fact Strategy

Any fact that a student has mastered can be used to help complete a fact that a student has not yet mastered. A helping fact is a fact that has one factor in common with the fact being completed. Because our number system is a base ten number system, facts with a factor of 5 or 10 are often used as helping facts.

Consider the fact 2 x 9:

- Addition Double:

  The special picture for the addition fact 9 + 9 is an 18-wheeler double with 2 sides, each with 9 wheels.

  9 + 9 = 18
  SO, 2 x 9 = 18

- Helping Fact:

  2 x 10 = 20
  20 – 2 = 18
  SO, 9 x 2 = 18

The Commutative Property of Multiplication

The commutative or turnaround property of multiplication means that the product of a multiplication fact is the same regardless of the order of its factors. It is a powerful tool in mastering multiplication facts, and it is used throughout the program.

Level 1 consists of the following lessons:

Lesson 1A: Zany Table with 2

This lesson introduces the multiplicative structure of repeated addition and the groups of stars model. The terms *factor* and *product* are also introduced.

Lesson 1B: Triangle Tracks with 2

This lesson introduces the number line model.

Lesson 1C: Zany Table with 2

This lesson discusses the commutative property of multiplication and introduces the rectangular array model. The rectangular array model relates to the multiplicative structure product of measures. The rectangular array model is an excellent model for demonstrating that the operation of multiplication is commutative.

Lesson 1D: Secret Message with 2

This lesson introduces the *addition double strategy*, the primary thinking strategy for multiplication facts with a factor of 2.

Lesson 1E: Match-Ups with 2

This lesson introduces the *helping fact strategy.* This thinking strategy is used to complete many multiplication facts and is used throughout the program.

Lesson 1F: Wacky Webs with 2

This lesson introduces even and odd numbers.

Lesson 1G: Secret Message with 2

This lesson provides practice with the thinking strategies for facts with a factor of 2: addition double and helping fact.

Lesson 1H: The Level 1 Mystery Number Challenge

This challenge assesses the students' ability to identify and apply appropriate thinking strategies to the facts introduced in Level 1. Students also review models and vocabulary for the facts introduced in this level.

LESSON 1A: ZANY TABLE WITH 2

TEACHER LESSON

Introducing Terms

Present the multiplication fact 5 x 2 to the students. Explain that the *factors* (numbers) in a multiplicative problem represent different things. One factor represents the sets or groups while the second factor indicates the size of each set or group. The answer to the fact is called the *product.*

Interpreting the Operation of Multiplication

Have the students consider the fact 5 x 2. Ask the students to explain what the multiplication fact 5 x 2 means to them. Remind them that the factors represent different things. In this instance, the first factor, the number 5, represents 5 groups while the second factor, the number 2, represents 2 objects in each of these groups.

Ask students to express the fact in words and in terms of repeated addition. Doing so will help them understand more clearly. For example, for the multiplication fact 5 x 2:

5 x 2 means 5 groups of 2 objects
5 x 2 represents 2 + 2 + 2 + 2 + 2
2 + 2 + 2 + 2 + 2 = 10
SO, 5 x 2 = 10

Ask students to describe situations that model the fact 5 x 2. Examples may include the following:

- 5 children, each having 2 pencils
- 5 shirts, each having 2 buttons
- 5 birthday cakes, each with 2 candles

Modelling Facts

Groups of stars: Introduce students to the model groups of stars. The groups of stars model for the multiplication fact 5 x 2 is the following:

Multiplication buddies: The multiplication buddy in this lesson shows 5 groups of 2.

Encouraging Class Discussion

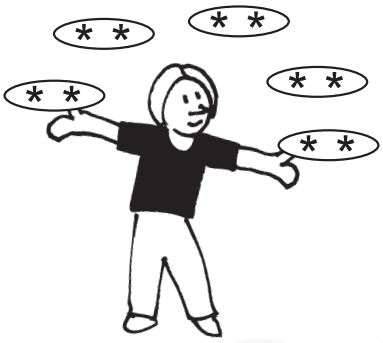
Engaging students in whole-class discussions is an integral part of the program. Prompts for encouraging class discussions can be found on page 2 of the Introduction.

INTRODUCING THE STUDENT ACTIVITY SHEET

Distribute a copy of the sheet, Zany Table, to each student. Read the instructions aloud as a class, and have the students complete the activity.

Note: The multiplicative structure in this lesson is repeated addition. (Other multiplicative structures are possible.) The model that is used is groups of stars. If some students prefer to use a different model, have them do so.

Note: At the beginning of the lesson, some teachers may prefer to divide the class into cooperative working groups, have the students complete the activity sheet in their groups, then discuss the lesson after the activity sheet has been completed.

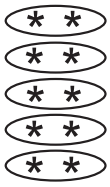
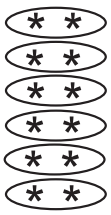


Zany Table

Look at the first row. The multiplication fact 5 x 2 means 5 groups of 2. There are many ways to show 5 x 2. One way is to show it with groups of stars.

The answer to a multiplication fact is called its *product*. The product of 5 x 2 is 10. The numbers being multiplied are called *factors.* In the fact 5 x 2, the numbers *5* and *2* are factors.

Complete the following table row by row, then do what the sentence at the bottom of the page asks.

Multiplication Fact	In Words	Picture	Multiplication Sentence
5 x 2	5 groups of 2		5 x 2 = 10
	3 groups of 2		
			
1 x 2			

Show 5 x 2 with a different picture.

LESSON 1B: TRIANGLE TRACKS WITH 2

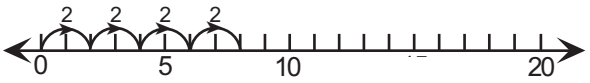
TEACHER LESSON

Present the multiplication fact 4 x 2 to the students. Ask them to explain what this fact means to them and to complete it. Have them express the fact in words and in terms of repeated addition:

4 x 2 means 4 groups of 2 objects
4 x 2 represents 2 + 2 + 2 + 2
2 + 2 + 2 + 2 = 8
SO, 4 x 2 = 8

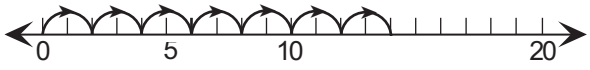
Modelling Facts

Number line: Model the fact 4 x 2 on a number line by using 4 arrows (or hops), each jumping 2 spaces.



Practicing Number Lines

Present the multiplication fact 7 x 2 to the students. Ask the students to complete this fact and explain why 7 x 2 = 14. Have them model this fact on a number line by using 7 arrows or hops, each jumping 2 spaces.



Present the students with other multiplication facts with 2 as the second factor, and ask the students to complete them. Have the students model these facts on number lines.

Creating Story Problems

Having the students create story problems is an excellent way to check that they understand the concept of multiplication. Ask each student to create a story problem that involves the fact 4 x 2. You might suggest the story problem involves mittens, shoes, or socks. Then have the students solve their own story problem and illustrate it. When students interpret multiplication facts as story problems, it reinforces their concept of multiplication.

Note: If students have difficulty creating story problems, discuss and model practical situations that involve the operation of multiplication. Have the students note the models demonstrated by the multiplication buddies on each activity sheet and name the multiplication fact being modeled. Explain to students that they will be asked to create several more story problems as they work through the program.

Encouraging Class Discussion

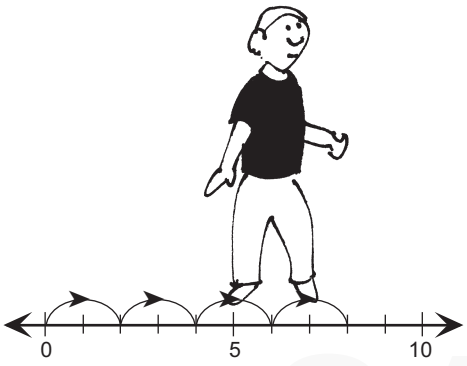
Engaging students in whole-class discussions is an integral part of the program. Prompts for encouraging class discussions can be found on page 2 of the Introduction.

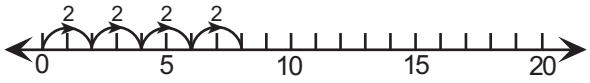
INTRODUCING THE STUDENT ACTIVITY SHEET

Distribute a copy of the sheet, Triangle Tracks, to each student. Read the instructions aloud as a class, and have the students complete the activity.

Note: When the dots are connected correctly, they create a design. This design can be used to check that the facts have been correctly completed. Like many other activities in the program, this one is self-correcting.

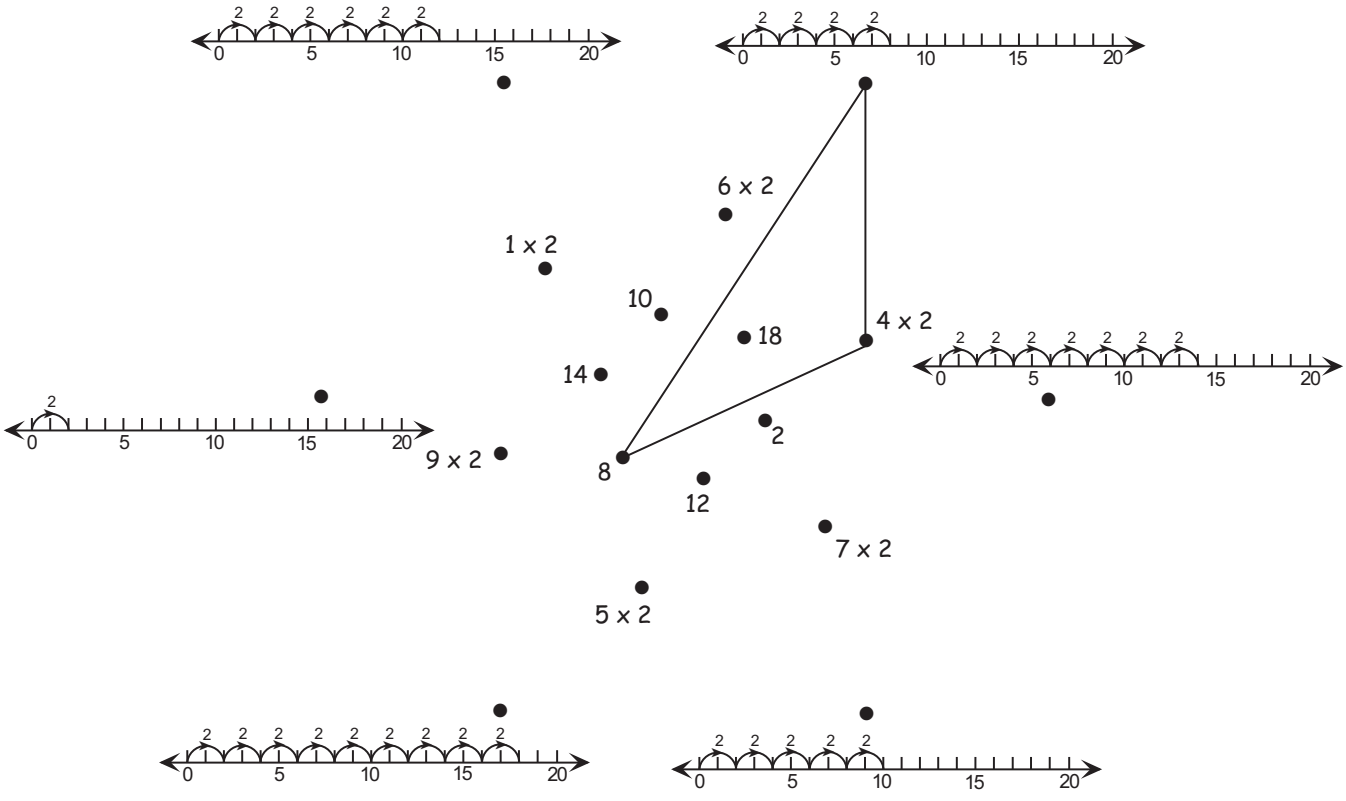
Triangle Tracks



Find 

This number line represents 4 x 2. Find the fact 4 x 2 below. A straight line connects the dots beside the number line and the fact it represents. Find the product of 4 x 2. Notice a line connects the fact and its product. Another line connects the product to its number line. The three lines form a triangle.

Continue to draw triangles by connecting each number line, the multiplication fact it shows, and its product. Use a ruler to connect the dots.



LESSON 1C: ZANY TABLE WITH 2

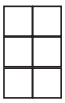
TEACHER LESSON

In this lesson, students are introduced to pairs of facts like 3 x 2 and 2 x 3 at the same time.

Present the multiplication fact 3 x 2 to the students. Beside it, write the multiplication fact 2 x 3. Ask the students if they think the order of the factors in a multiplication fact affects the product.

Modelling Facts

Rectangular array model: The array that represents the multiplication fact 3 x 2 is an arrangement of 6 boxes with 3 rows and 2 columns. The array that represents the fact 2 x 3 is an arrangement of 6 boxes with 2 rows and 3 columns.



3 x 2

2 x 3

Practicing the Rectangular Array Model

Have the students use interlocking cubes to build an array representing the multiplication fact 3 x 2. Have them turn the array on its side. The array of 3 rows and 2 columns now looks like an array of 2 rows and 3 columns and represents the multiplication fact 2 x 3. Have the students note that both facts have a product of 6 and that the order of the factors does not affect the product.

The Commutative Property of Multiplication

Explain that in a multiplication fact, the order of the factors does not affect the product. This property is known as the *turnaround* or *commutative property of multiplication.* The commutative property of multiplication means that the product of a multiplication fact is the same regardless of the order of its factors. It is a powerful tool in mastering the multiplication facts and is used throughout the program.

Encouraging Class Discussion

Engaging students in whole-class discussions is an integral part of the program. Prompts for encouraging class discussions can be found on page 2 of the Introduction.

INTRODUCING THE STUDENT ACTIVITY SHEET

Distribute a copy of the sheet, Zany Table, to each student. Read the instructions aloud as a class, then have the students complete the activity.

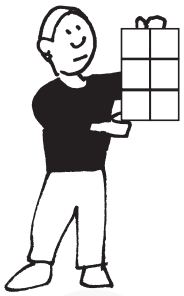
COMPLETING THE MULTIPLICATION GRID

Distribute a copy of the multiplication grid (page 123) to each student. Tell students they will be using this grid throughout the program. Explain to them that the grid will provide them with a visual record of their progress. Have them fill in the multiplication grid for all facts with a factor of 2. Have students note that because the operation of multiplication is commutative, they can fill in both a row and a column of the grid.

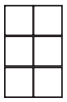
x	0	1	2	3	4	5	6	7	8	9	10
0											
1			2								
2		2	4	6	8	10	12	14	16	18	20
3			6								
4			8								
5			10								
6			12								
7			14								
8			16								
9			18								
10			20								

Note: At the beginning of the lesson, some teachers may prefer to divide the class into cooperative working groups, have the students complete the activity sheet in their groups, then discuss the lesson after the activity sheet has been completed.

Zany Table



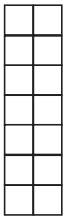
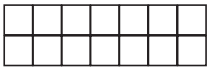
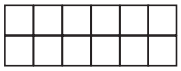
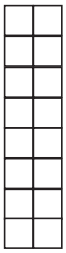
You can model a multiplication fact with an array.



3 groups of 2
3 x 2 = 6

2 groups of 3
2 x 3 = 6

Complete the following table, then answer the question at the bottom of the page.

Multiplication Fact	Picture	Multiplication Fact	Picture	Product
3 x 2		2 x 3		
				
6 x 2				
		2 x 8		

Complete the facts 5 x 2 and 2 x 5. Are the products the same? Explain your answer.

LESSON 1D: SECRET MESSAGE WITH 2

TEACHER LESSON

Present the multiplication fact 2 x 8 to the students. Ask the students to explain what this fact means to them and to complete it. For example:

2 x 8 means 2 groups of 8 objects
2 x 8 represents 8 + 8
8 + 8 = 16
SO, 8 x 2 = 16

Introducing the Addition Double Thinking Strategy

Remind students that an addition fact such as 8 + 8 is called a *double.* An effective thinking strategy for the multiplication facts with a factor of 2 is to connect them to their corresponding double fact.

Doubles can be related to special pictures to provide visual cues. For example:

3 + 3 = 6	a bug with 3 legs on each side
4 + 4 = 8	a spider with 4 legs on each side
5 + 5 = 10	a person with 5 fingers on each hand
6 + 6 = 12	an egg carton with 2 rows of 6 eggs
7 + 7 = 14	a calendar with 2 weeks of 7 days
8 + 8 = 16	a box of crayons with 2 rows of 8 crayons
9 + 9 = 18	an 18-wheeler double with 2 sides, each with 9 wheels

A poster with these pictures can help to reinforce these concepts.

Have students use the addition double strategy to complete the multiplication fact 2 x 8:

The special picture for the addition fact 8 + 8 is a box of crayons with 2 rows of 8 crayons.
8 + 8 = 16
SO, 2 x 8 = 16

Note: If students are counting on as a means for completing the addition doubles, find out if they also use count on to complete other addition facts. For students who need more practice with mastering the addition facts, refer to the program *Thinking Strategies: Addition.*

Using the Commutative Property of Multiplication

The commutative property of multiplication allows the students to use the addition double strategy regardless of whether 2 is the first factor or the second factor of a fact. If students were asked to complete the fact 8 x 2 rather than 2 x 8, they could also use the addition double thinking strategy. Encourage students to use the addition double strategy for any multiplication fact with a factor of 2.

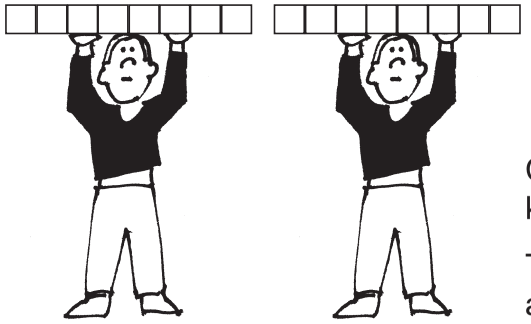
Encouraging Class Discussion

Engaging students in whole-class discussions is an integral part of the program. Prompts for encouraging class discussions can be found on page 2 of the Introduction.

INTRODUCING THE STUDENT ACTIVITY SHEET

Distribute a copy of the sheet, Secret Message, to each student. Read the instructions aloud as a class, then have the students complete the activity.

Note: The letters of the secret message are filled in in order.



Secret Message

Complete the addition facts. The first completed fact is 8 + 8 = 16. In the code key, find the number 16. The letter above **16** is **U**. The letter **U** is written in the first blank.

The second completed fact is 5 + 5 = 10. In the code key, find the number 10. The letter above **10** is **S**. Write the letter **S** in the second blank.

Complete the remaining facts, and fill in the rest of the blanks to find the secret message.

How can you fix a broken pizza?

U														
①	②	③	④	⑤	⑥	⑦	⑧	⑨	⑩	⑪	⑫	⑬	⑭	

Code Key	R	M	P	E	S	A	T	U	O
	2	4	6	8	10	12	14	16	18

① 8 + 8 = 16

② 5 + 5 = 10

③ 4 + 4 = ____

④ 7 + 7 = ____

⑤ 9 + 9 = ____

⑥ 2 + 2 = ____

⑦ 6 + 6 = ____

⑧ 7 + 7 = ____

⑨ 9 + 9 = ____

⑩ 3 + 3 = ____

⑪ 6 + 6 = ____

⑫ 5 + 5 = ____

⑬ 7 + 7 = ____

⑭ 4 + 4 = ____

LESSON 1E: MATCH-UPS WITH 2

TEACHER LESSON

Practicing the Addition Double Strategy

Present the multiplication fact 6 x 2 to the students. Have them complete the fact using the addition double strategy. Remind them that the special picture for the addition fact 6 + 6 is a carton of a dozen eggs.

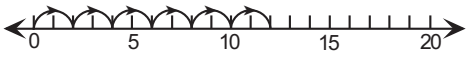
6 + 6 = 12
SO, 6 x 2 = 12

Introducing the Helping Fact Strategy

A helping fact is a fact that has one factor in common with the fact being completed. Any fact that a student has mastered can be used to help complete a fact that has not yet been mastered. Because our number system is a base ten number system, facts with a factor of 5 or 10 are often used as helping facts. Using a helping fact with a factor of 5 is particularly useful for completing facts with a factor of 6.

Modelling the Helping Fact Strategy

Have students model the multiplication fact 6 x 2 on the number line.



The multiplication fact 6 x 2 represents 6 groups of 2 objects and is modelled on the number line by 6 arrows of 2 hops. Have the students compare the multiplication fact 6 x 2 to the fact 5 x 2. Ask the students:

- How can you use the fact 5 x 2 to help you complete the fact 6 x 2?

Offer students the following explanation:

6 x 2 represents 6 groups of 2
5 x 2 represents 5 groups of 2
6 x 2 represents one more group of 2 than 5 x 2
5 x 2 = 10
10 + 2 = 12
SO, 6 x 2 = 12

Students can use the helping fact strategy to complete the fact 2 x 6, as well as the fact 6 x 2.

2 x 5 = 10
10 + 2 = 12
SO, 2 x 6 = 12

Have students note that it is the common factor 2 that is added to 10 to complete the fact.

Note: Skip-counting has not been included as a thinking strategy. Although skip-counting is important when students are becoming familiar with the products of facts with a factor of 2, encourage them to use other, more efficient strategies for completing these facts.

Encouraging Class Discussion

Engaging students in whole-class discussions is an integral part of the program. Prompts for encouraging class discussions can be found on page 2 of the Introduction.

INTRODUCING THE STUDENT ACTIVITY SHEET

Distribute a copy of the sheet, Match-Ups, to each student. Read the instructions aloud as a class, and have the students complete the activity.

Note: Students will find the connecting lines of each set of multiplication facts form a pattern. They can use the patterns to check their work.

POWER FACTS

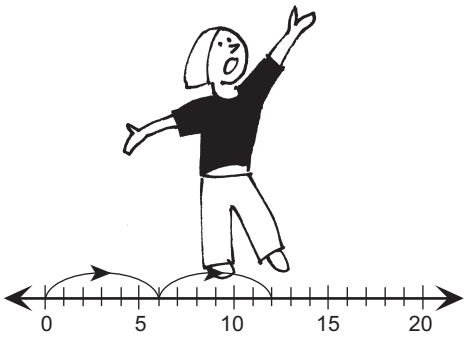
Now that the students have developed the thinking strategies for facts with a factor of 2, hand out the Power Facts for Level 1 (page 136) and the letter for parents or guardians (page 135) for students to take home. Have students practice the first set of Power Facts at least once a day. Students can practice in class and at home.

PARTNER BINGO

Students can practice the multiplication facts with a factor of 2 by playing Partner Bingo, Level 1 (pages 145-149). Have the students complete the facts in order and cross out one square on their card for each fact. Partner Bingo can be played in class or at home.

STUDENT JOURNAL

Have students choose a fact with a factor of 2 and, in their journal, explain their thinking strategy for completing that fact.



Match-Ups

Complete each multiplication fact. Connect the dot beside each fact to the dot beside its product. Use a ruler to keep the lines straight. When you have completed the "match-ups," answer the question at the bottom of the page.

2 x 6 •	• 18	7 x 2 •	• 18
2 x 4 •	• 8	9 x 2 •	• 14
2 x 9 •	• 12	6 x 2 •	• 10
2 x 7 •	• 6	4 x 2 •	• 6
2 x 10 •	• 16	8 x 2 •	• 20
2 x 8 •	• 20	10 x 2 •	• 16
2 x 3 •	• 14	3 x 2 •	• 8
2 x 1 •	• 4	5 x 2 •	• 12
2 x 5 •	• 10	2 x 2 •	• 2
2 x 2 •	• 2	1 x 2 •	• 4

What thinking strategy did you use for completing the fact 2 x 6 ? Explain your answer.

LESSON 1F: WACKY WEBS WITH 2

TEACHER LESSON

Even Numbers

Present the number 2 to the students. Ask:

- Is the number 2 even or odd? (The number 2 is even.)

Ask the students to explain why the number 2 is even:

- An **even** number is a number that can be divided into two equal groups. The number 2 can be divided into two equal groups; therefore, it is even.

Have the students name the even numbers less than or equal to 20:

- The numbers 0, 2, 4, 6, 8, 10, 12, 14, 16, 18, and 20 are even numbers.

Have the students name the ending numerals of the even numbers:

- Even numbers end in 0, 2, 4, 6, and 8.

Have the students note that these numbers are all the products of multiplication facts with a factor of 2.

Odd Numbers

Present the number 5 to the students. Ask:

- Is the number 5 even or odd? (The number 5 is odd.)

Ask the students to explain why the number 5 is odd:

- An **odd** number is a number that cannot be divided into two equal groups. It is not possible to divide the number 5 into two equal groups; therefore, it is odd.

Have the students name the odd numbers less than or equal to 20:

- The numbers 1, 3, 5, 7, 9, 11, 13, 15, 17, and 19 are odd numbers.

Have the students name the ending numerals of the odd numbers:

- Odd numbers end in 1, 3, 5, 7, and 9.

Identifying and Applying Thinking Strategies

Present the following multiplication facts to the students:

2 x 2
2 x 5

Have students complete each fact and explain the thinking strategy they used for each. For example:

(a) 2 x 2

- Addition Double:

  2 + 2 = 4
  SO, 2 x 2 = 4

(b) 2 x 5

- Addition Double:

  The special picture for the addition fact 5 + 5 is a person with 5 fingers on each hand.
  5 + 5 = 10
  SO, 2 x 5 = 10

Even Products

Point out to the students that the product of any multiplication fact with a factor of 2 can be divided into 2 equal groups, and its product is even (regardless of whether or not the other factor is even or odd).

Encouraging Class Discussion

Engaging students in whole-class discussions is an integral part of the program. Prompts for encouraging class discussions can be found on page 2 of the Introduction.

INTRODUCING THE STUDENT ACTIVITY SHEET

Distribute a copy of the sheet, Wacky Webs, to each student. Read the instructions aloud as a class, and have the students complete the activity.

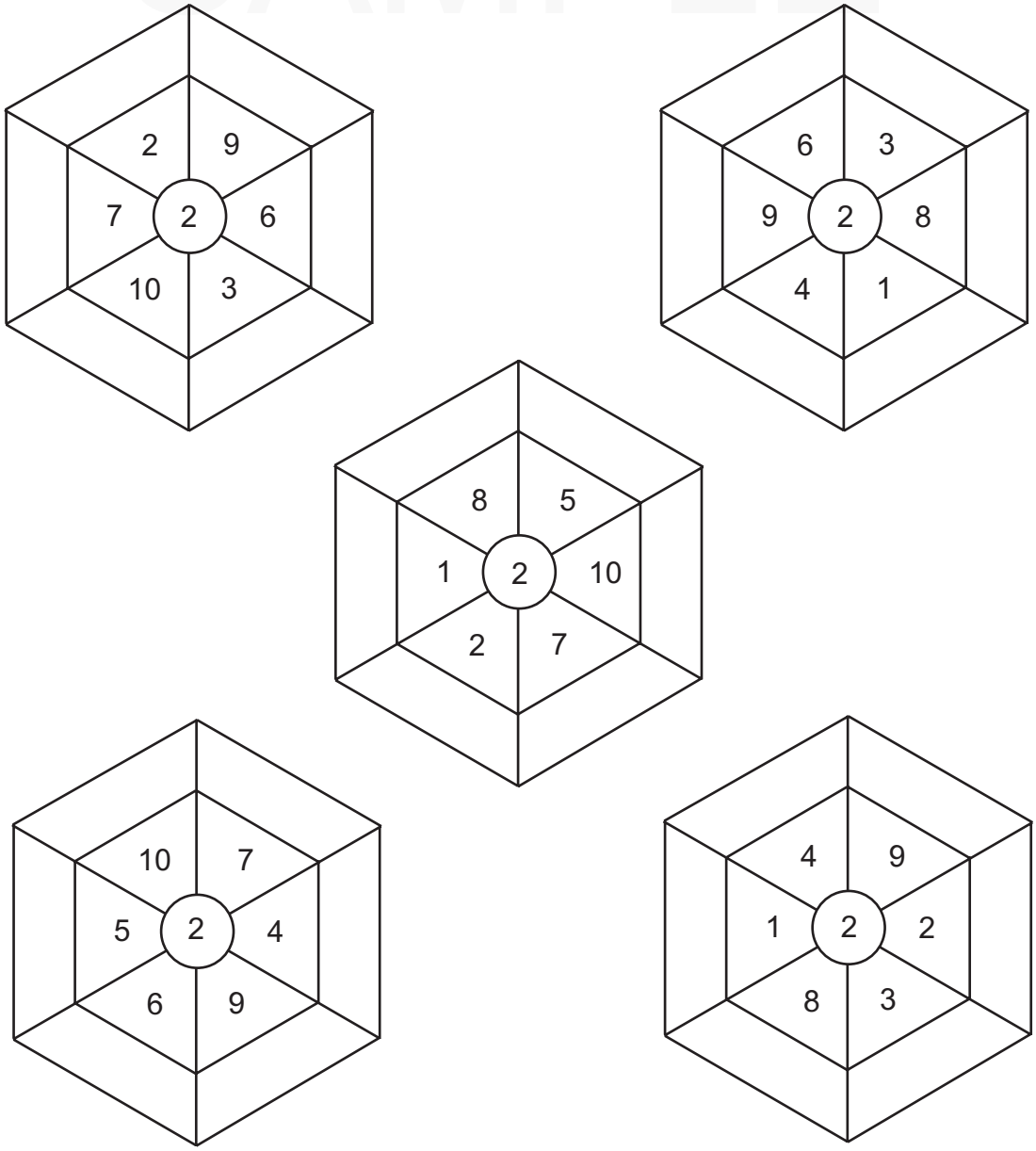
Note: The shaded cells form a pattern that students can use to check their work. Since each fact has a factor of 2, the products are all even, and the outer cells are not shaded in.

Wacky Webs

The numbers ending in 0, 2, 4, 6, and 8 are **EVEN** numbers. The numbers ending in 1, 3, 5, 7, and 9 are **ODD** numbers.

Fill in the outer cells of each web by multiplying the numbers in the inner cells by the number in the middle.

Shade in all the cells that have an **ODD** number.



LESSON 1G: SECRET MESSAGE WITH 2

TEACHER LESSON

Preparing for the Level 1 Mystery Number Challenge

Encourage students to practice the first set of Power Facts. Students can also play Partner Bingo again, either in class or at home, to prepare for the Level 1 Mystery Number Challenge.

Practicing Thinking Strategies

Present the following multiplication facts to the students:

7 x 2
9 x 2

Have students complete each fact and explain the thinking strategies they used for each. For example:

(a) 7 x 2

- Addition Double:

  The special picture for the addition fact 7 + 7 is a calendar with 2 weeks of 7 days.
  7 + 7 = 14
  SO, 7 x 2 = 14

- Helping Fact:

  5 x 2 = 10
  10 + 2 + 2 = 14
  SO, 7 x 2 = 14

(b) 9 x 2

- Addition Double:

  The special picture for the addition fact 9 + 9 is an 18-wheeler double with 2 sides, each with 9 wheels.
  9 + 9 = 18
  SO, 9 x 2 = 18

- Helping Fact:

  10 x 2 = 20
  20 – 2 = 18
  SO, 9 x 2 = 18

Note: Skip-counting has not been included as a thinking strategy. Although skip-counting is important when students are becoming familiar with the products of facts with a factor of 2, encourage them to use other, more efficient strategies for completing these facts.

Have students complete other multiplication facts with 2 as either the first or second factor. (Choose facts they will find more difficult to complete.) Ask them to explain their thinking strategies for these facts.

Encouraging Class Discussion

Engaging students in whole-class discussions is an integral part of the program. Prompts for encouraging class discussions can be found on page 2 of the Introduction.

INTRODUCING THE STUDENT ACTIVITY SHEET

Distribute a copy of the sheet, Secret Message, to each student. Read the instructions aloud as a class, and have the students complete the activity.

Note: This is the first activity sheet in which the multiplication facts are written vertically rather than horizontally. In this program, the first number (the one on top) represents the number of groups while the second number (the one on the bottom) represents the number in each group.

Secret Message

Complete the multiplication facts. In the code key, find the number that matches the product of the first fact. Write the letter that is above it in the first blank, the letter for the second fact in the second blank, and so on. When you have filled in all the blanks, you will find two secret messages.

What word of only 3 syllables contains 26 letters?

___	___	___		___	___	___	___	___	___	___	___
①	②	③		④	⑤	⑥	⑦	⑧	⑨	⑩	⑪

What is the difference between here and there?

___	___	___		___	___	___	___	___	___		___
⑫	⑬	⑭		⑮	⑯	⑰	⑱	⑲	⑳		㉑

Code Key	P 2	M 4	B 6	H 8	R 10	A 12	T 14	E 16	L 18

① 7 x 2	② 2 x 4	③ 8 x 2	④ 6 x 2	⑤ 2 x 9	⑥ 2 x 1	⑦ 4 x 2
⑧ 2 x 6	⑨ 3 x 2	⑩ 2 x 8	⑪ 2 x 7	⑫ 7 x 2	⑬ 4 x 2	⑭ 8 x 2
⑮ 9 x 2	⑯ 2 x 8	⑰ 2 x 7	⑱ 7 x 2	⑲ 8 x 2	⑳ 2 x 5	㉑ 2 x 7

LESSON 1H: THE LEVEL 1 MYSTERY NUMBER CHALLENGE

Before students take the Level 1 Mystery Number Challenge, have them complete all multiplication facts with a factor of 2. Have them discuss the different thinking strategies they can use with these multiplication facts. Emphasize how they can identify and apply the appropriate thinking strategies to multiplication facts with a factor of 2.

INSTRUCTIONS FOR THE LEVEL 1 CHALLENGE

Distribute a copy of the challenge sheet to each student. Explain the challenge: There are nine facts at the top of the page. Below, there are nine boxes with a clue in each box. Complete the facts, then match each completed fact with one of the clues and place it in that box. After each of the facts has been placed into the box with its matching clue, add the products of the three facts in each row and in each column to find the mystery number. Cross out each fact after it has been placed in its box.

SUGGESTIONS FOR MORE PRACTICE

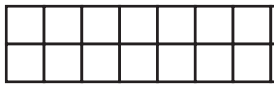
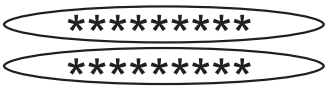
Students will have many more opportunities to practice the multiplication facts of this level in the following levels of the program. However, if students need more practice consider the following suggestions:

- Check that they understand the operation of multiplication.
- Have them model facts using interlocking cubes.
- Check that they have mastered the addition doubles. Encourage them to make use of the special pictures for the doubles.
- Identify the facts they find difficult. Help them develop thinking strategies for these facts. Have them list the facts they find difficult, and encourage them to practice these facts both with a classmate in school and with a parent at home.
- Encourage them to practice the first set of Power Facts.
- Have them play Partner Bingo in class or at home. There are five Partner Bingo games for Level 1 (see pages 145-149).

Level 1 Mystery Number Challenge

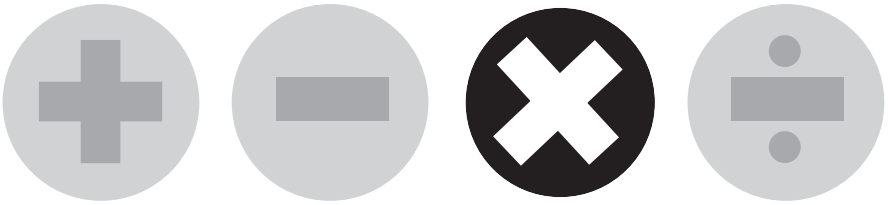
Complete the facts. Then, read the clue in each box, and find the fact that matches it. Place each completed fact into the box with its matching clue. To find the MYSTERY number, add the products of the three facts in each row and the products of the three facts in each column. Remember: rows go across the page, and columns go down the page.

2	5	1	2	3	2	2	6	2
x 8	x 2	x 2	x 7	x 2	x 9	x 2	x 2	x 4

This fact has the same factors.	The product of this fact is 2 more than 10.	This fact can be modelled with the following array: 	= _____
This fact can be modelled as follows: 	This fact has the smallest product.	The product of this fact ends in 0.	= _____
The product of this fact is the number of legs on a spider.	This fact means 2 groups of 8.	This fact can be modelled with the following number line: 	= _____
= _____	= _____	= _____	

APPENDIX A

TEACHER RESOURCES



SELF-ASSESSMENT PROGRESS REPORT FOR STUDENTS • FACTS WITH 2

Complete each fact, and explain your thinking strategy. Place a check mark beside each fact you have mastered.

☐ 2 x 5 =

☐ 8 x 2 =

☐ 2 x 2 =

☐ 7 x 2 =

☐ 2 x 4 =

☐ 10 x 2 =

☐ 2 x 6 =

☐ 2 x 1 =

☐ 3 x 2 =

☐ 2 x 9 =

POWER FACTS

Level 1 A

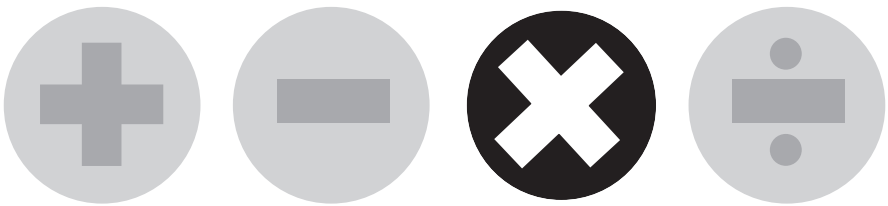
2 x 5 = 10	3 x 2 = 6	2 x 4 = 8	2 x 9 = 18
2 x 6 = 12	8 x 2 = 16	5 x 2 = 10	7 x 2 = 14
4 x 2 = 8	2 x 2 = 4	2 x 10 = 20	2 x 8 = 16
10 x 2 = 20	1 x 2 = 2	8 x 2 = 16	6 x 2 = 12
9 x 2 = 18	2 x 7 = 14	2 x 3 = 6	2 x 1 = 2

Level 1 B

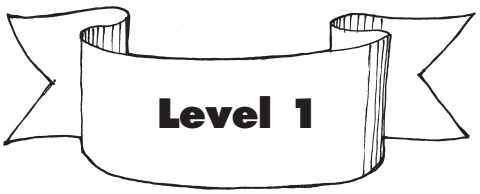
2 x 7 = 14	9 x 2 = 18	8 x 2 = 16	2 x 6 = 12
5 x 2 = 10	2 x 2 = 4	4 x 2 = 8	10 x 2 = 20
2 x 1 = 2	2 x 8 = 16	2 x 10 = 20	7 x 2 = 14
2 x 4 = 8	6 x 2 = 12	1 x 2 = 2	2 x 3 = 6
8 x 2 = 16	3 x 2 = 6	2 x 9 = 18	2 x 5 = 10

APPENDIX B

PARTNER BINGO



Partner Bingo 1



Find a partner.

Partner #1: Complete the first fact beside your card. On your card, find a square that matches the product of the first fact, and shade it in.

Partner #2: Complete the first fact beside your card. On your card, find a square that matches the product of the first fact, and shade it in.

Take turns completing the facts in order and shading in a square on your card. The first one to fill in a row, column, or diagonal wins the game.

Partner #1

① 2 x 9 = _____
② 6 x 2 = _____
③ 8 x 2 = _____
④ 2 x 5 = _____
⑤ 2 x 2 = _____
⑥ 9 x 2 = _____
⑦ 4 x 2 = _____
⑧ 2 x 7 = _____
⑨ 5 x 2 = _____
⑩ 2 x 8 = _____
⑪ 6 x 2 = _____
⑫ 2 x 9 = _____
⑬ 7 x 2 = _____
⑭ 2 x 4 = _____
⑮ 8 x 2 = _____
⑯ 1 x 2 = _____

Partner #1

4	6	14	12	18
18	12	8	6	10
6	8	X	4	16
10	16	2	18	14
16	4	12	8	6

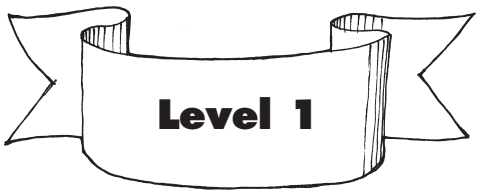
Partner #2

① 8 x 2 = _____
② 2 x 5 = _____
③ 7 x 2 = _____
④ 2 x 9 = _____
⑤ 10 x 2 = _____
⑥ 2 x 6 = _____
⑦ 8 x 2 = _____
⑧ 2 x 3 = _____
⑨ 2 x 9 = _____
⑩ 7 x 2 = _____
⑪ 3 x 2 = _____
⑫ 2 x 8 = _____
⑬ 2 x 5 = _____
⑭ 9 x 2 = _____
⑮ 6 x 2 = _____
⑯ 4 x 2 = _____

Partner #2

18	6	10	6	4
16	2	8	14	12
4	14	X	18	6
18	10	16	4	18
14	12	2	20	16

Partner Bingo 2



Find a partner.

Partner #1: Complete the first fact beside your card. On your card, find a square that matches the product of the first fact, and shade it in.

Partner #2: Complete the first fact beside your card. On your card, find a square that matches the product of the first fact, and shade it in.

Take turns completing the facts in order and shading in a square on your card. The first one to fill in a row, column, or diagonal wins the game.

Partner #1

① 2 x 6 = _____
② 9 x 2 = _____
③ 2 x 7 = _____
④ 8 x 2 = _____
⑤ 10 x 2 = _____
⑥ 2 x 9 = _____
⑦ 2 x 3 = _____
⑧ 5 x 2 = _____
⑨ 2 x 8 = _____
⑩ 6 x 2 = _____
⑪ 2 x 5 = _____
⑫ 9 x 2 = _____
⑬ 2 x 3 = _____
⑭ 8 x 2 = _____
⑮ 7 x 2 = _____
⑯ 2 x 1 = _____

Partner #1

4	2	18	6	10
14	10	14	8	16
18	12	X	14	4
6	8	20	16	6
10	16	4	12	18

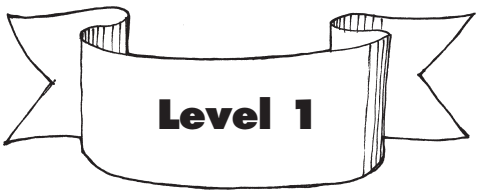
Partner #2

① 2 x 8 = _____
② 2 x 5 = _____
③ 4 x 2 = _____
④ 2 x 6 = _____
⑤ 3 x 2 = _____
⑥ 8 x 2 = _____
⑦ 2 x 7 = _____
⑧ 2 x 9 = _____
⑨ 5 x 2 = _____
⑩ 2 x 7 = _____
⑪ 8 x 2 = _____
⑫ 6 x 2 = _____
⑬ 7 x 2 = _____
⑭ 2 x 2 = _____
⑮ 9 x 2 = _____
⑯ 10 x 2 = _____

Partner #2

18	16	6	2	14
14	2	18	12	10
2	14	X	4	16
16	10	12	18	2
20	16	6	4	8

Partner Bingo 3



Find a partner.

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Partner #2: Complete the first fact beside your card. On your card, find a square that matches the product of the first fact, and shade it in.

Take turns completing the facts in order and shading in a square on your card. The first one to fill in a row, column, or diagonal wins the game.

Partner #1

① 3 x 2 = _____
② 2 x 6 = _____
③ 8 x 2 = _____
④ 2 x 4 = _____
⑤ 2 x 9 = _____
⑥ 7 x 2 = _____
⑦ 2 x 2 = _____
⑧ 2 x 8 = _____
⑨ 2 x 7 = _____
⑩ 4 x 2 = _____
⑪ 2 x 3 = _____
⑫ 9 x 2 = _____
⑬ 6 x 2 = _____
⑭ 2 x 2 = _____
⑮ 2 x 8 = _____
⑯ 10 x 2 = _____

Partner #1

16	6	4	20	10
18	10	12	6	8
8	14	X	2	12
2	12	18	4	16
6	16	10	14	4

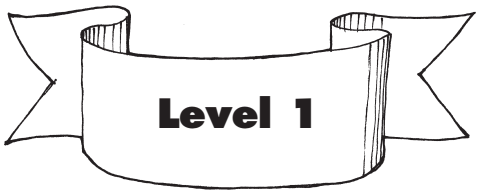
Partner #2

① 2 x 7 = _____
② 9 x 2 = _____
③ 2 x 2 = _____
④ 2 x 6 = _____
⑤ 1 x 2 = _____
⑥ 8 x 2 = _____
⑦ 4 x 2 = _____
⑧ 2 x 9 = _____
⑨ 2 x 8 = _____
⑩ 6 x 2 = _____
⑪ 7 x 2 = _____
⑫ 2 x 4 = _____
⑬ 8 x 2 = _____
⑭ 10 x 2 = _____
⑮ 9 x 2 = _____
⑯ 5 x 2 = _____

Partner #2

18	20	12	8	6
12	14	6	16	12
4	8	X	18	4
18	10	2	6	16
6	16	18	12	14

Partner Bingo 4



Find a partner.

Partner #1: Complete the first fact beside your card. On your card, find a square that matches the product of the first fact, and shade it in.

Partner #2: Complete the first fact beside your card. On your card, find a square that matches the product of the first fact, and shade it in.

Take turns completing the facts in order and shading in a square on your card. The first one to fill in a row, column, or diagonal wins the game.

Partner #1

① 2 x 2 = _____
② 2 x 9 = _____
③ 5 x 2 = _____
④ 2 x 8 = _____
⑤ 7 x 2 = _____
⑥ 1 x 2 = _____
⑦ 2 x 6 = _____
⑧ 2 x 4 = _____
⑨ 2 x 5 = _____
⑩ 8 x 2 = _____
⑪ 2 x 2 = _____
⑫ 9 x 2 = _____
⑬ 10 x 2 = _____
⑭ 2 x 7 = _____
⑮ 4 x 2 = _____
⑯ 6 x 2 = _____

Partner #1

18	8	6	14	20
2	12	10	2	4
10	6	X	16	8
14	16	18	4	6
6	20	16	2	12

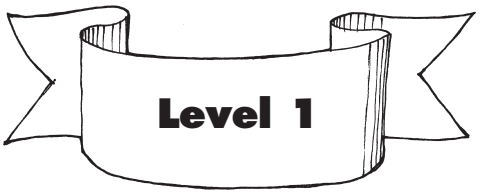
Partner #2

① 2 x 5 = _____
② 2 x 7 = _____
③ 3 x 2 = _____
④ 6 x 2 = _____
⑤ 9 x 2 = _____
⑥ 5 x 2 = _____
⑦ 2 x 8 = _____
⑧ 7 x 2 = _____
⑨ 9 x 2 = _____
⑩ 2 x 6 = _____
⑪ 8 x 2 = _____
⑫ 2 x 7 = _____
⑬ 1 x 2 = _____
⑭ 2 x 8 = _____
⑮ 2 x 9 = _____
⑯ 10 x 2 = _____

Partner #2

16	8	10	18	14
18	2	6	4	12
4	14	X	16	10
10	12	8	6	20
6	16	14	18	4

Partner Bingo 5



Find a partner.

Partner #1: Complete the first fact beside your card. On your card, find a square that matches the product of the first fact, and shade it in.

Partner #2: Complete the first fact beside your card. On your card, find a square that matches the product of the first fact, and shade it in.

Take turns completing the facts in order and shading in a square on your card. The first one to fill in a row, column, or diagonal wins the game.

Partner #1

① 2 x 5 = _____
② 6 x 2 = _____
③ 2 x 8 = _____
④ 4 x 2 = _____
⑤ 2 x 7 = _____
⑥ 2 x 2 = _____
⑦ 9 x 2 = _____
⑧ 2 x 8 = _____
⑨ 2 x 6 = _____
⑩ 2 x 4 = _____
⑪ 7 x 2 = _____
⑫ 2 x 9 = _____
⑬ 2 x 2 = _____
⑭ 5 x 2 = _____
⑮ 8 x 2 = _____
⑯ 2 x 10 = _____

Partner #1

16	4	6	12	8
18	2	10	14	18
12	4	X	2	16
10	14	8	12	6
6	20	16	4	18

Partner #2

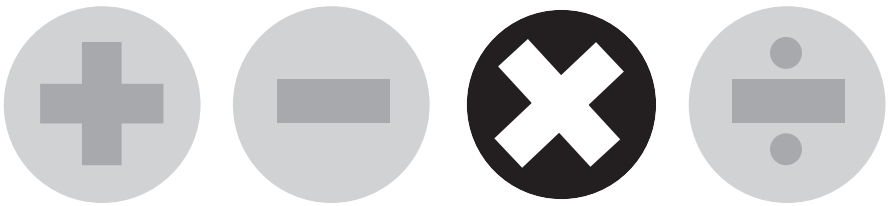
① 8 x 2 = _____
② 2 x 4 = _____
③ 7 x 2 = _____
④ 2 x 9 = _____
⑤ 3 x 2 = _____
⑥ 1 x 2 = _____
⑦ 2 x 6 = _____
⑧ 4 x 2 = _____
⑨ 2 x 7 = _____
⑩ 2 x 3 = _____
⑪ 6 x 2 = _____
⑫ 2 x 8 = _____
⑬ 2 x 1 = _____
⑭ 7 x 2 = _____
⑮ 9 x 2 = _____
⑯ 2 x 5 = _____

Partner #2

4	6	12	18	2
8	14	16	20	8
16	4	X	16	14
2	18	10	12	6
20	14	8	16	4

APPENDIX C

CHALLENGE FACTS



Challenge Facts 1

Complete these facts as fast as you can.

2 x 3	2 x 5	1 x 2	4 x 2	7 x 2	2 x 9
8 x 2	2 x 2	5 x 2	9 x 2	2 x 10	2 x 6
2 x 7	2 x 4	3 x 2	2 x 6	2 x 2	2 x 8
2 x 9	5 x 2	8 x 2	2 x 3	6 x 2	7 x 2
2 x 1	9 x 2	4 x 2	10 x 2	2 x 8	2 x 2

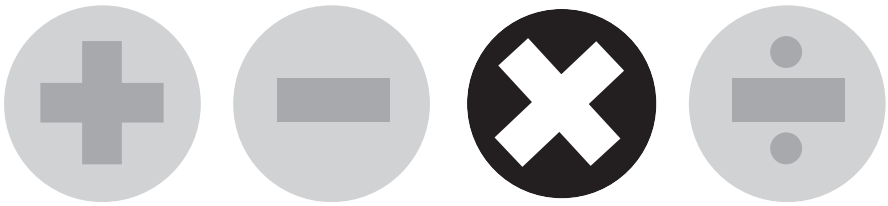
Challenge Facts 2

Complete these facts as fast as you can.

2 x 4	2 x 9	8 x 2	1 x 2	5 x 2	2 x 2
2 x 7	2 x 8	6 x 2	2 x 3	9 x 2	2 x 10
2 x 6	7 x 2	2 x 4	2 x 2	2 x 1	3 x 2
2 x 5	4 x 2	8 x 2	2 x 7	10 x 2	2 x 9
2 x 8	2 x 6	2 x 1	9 x 2	2 x 3	7 x 2

APPENDIX D

ANSWER KEYS

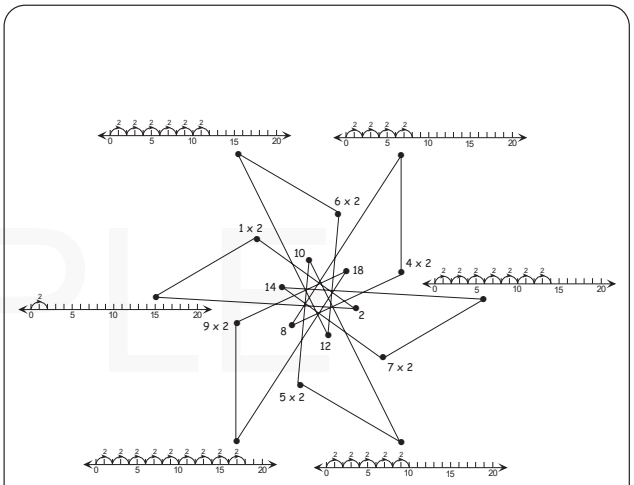


Multiplication Fact	In Words	Picture	Multiplication Sentence
5 x 2	5 groups of 2		5 x 2 = 10
3 x 2	3 groups of 2		3 x 2 = 6
6 x 2	6 groups of 2		6 x 2 = 12
1 x 2	1 group of 2		1 x 2 = 2

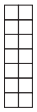
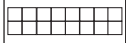
Show 5 x 2 with a different picture.

Pictures will vary.

Lesson 1A, page 9



Lesson 1B, page 11

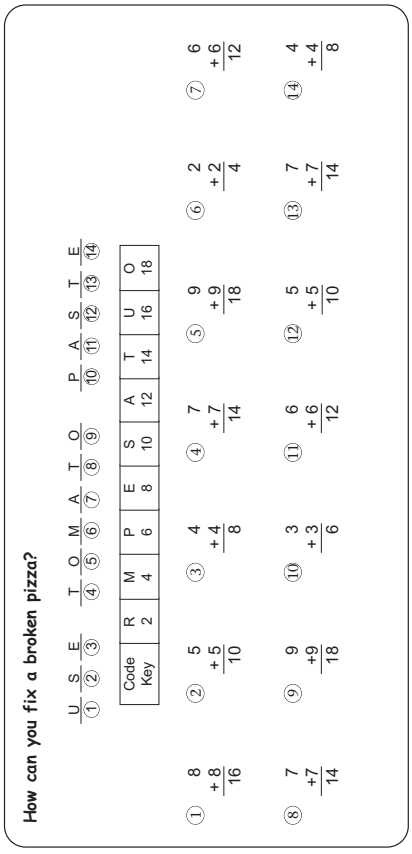
Multiplication Fact	Picture	Multiplication Fact	Picture	Product
3 x 2		2 x 3		6
7 x 2		2 x 7		14
6 x 2		2 x 6		12
8 x 2		2 x 8		16

Complete the facts 5 x 2 and 2 x 5. Are the products the same? Explain your answer.

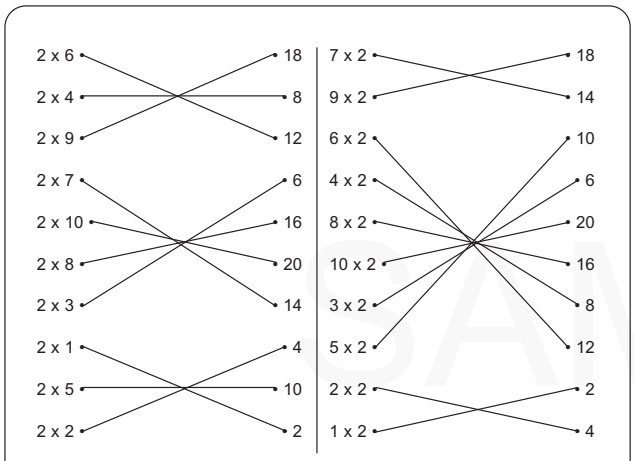
5 x 2 = 10 2 x 5 = 10

The products are the same. Explanations of why the products are the same will vary.

Lesson 1C, page 13



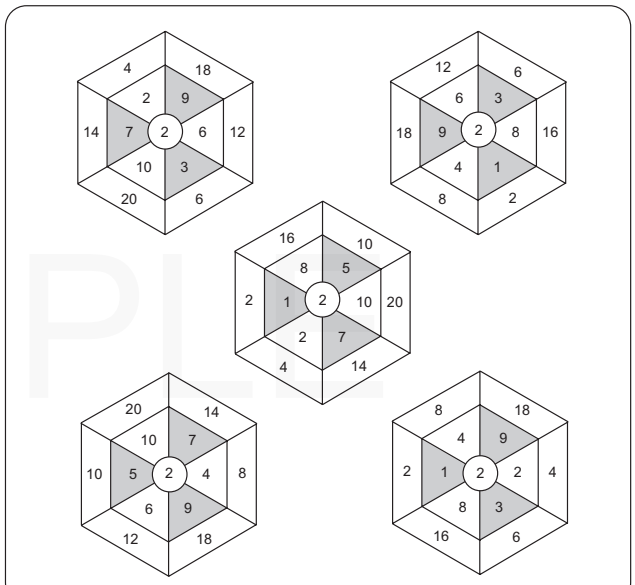
Lesson 1D, page 15



What thinking strategy did you use for completing the fact 2 x 6 ? Explain your answer.

Answers will vary.

Lesson 1E, page 17



Lesson 1F, page 19

What word of only 3 syllables contains 26 letters?

T	H	E		A	L	P	H	A	B	E	T
①	②	③		④	⑤	⑥	⑦	⑧	⑨	⑩	⑪

What is the difference between here and there?

T	H	E		L	E	T	T	E	R		T
⑫	⑬	⑭		⑮	⑯	⑰	⑱	⑲	⑳		㉑

Code	P	M	B	H	R	A	T	E	L
Key	2	4	6	8	10	12	14	16	18

①	7 x 2 = 14	②	2 x 4 = 8	③	8 x 2 = 16	④	6 x 2 = 12	⑤	2 x 9 = 18	⑥	2 x 1 = 2	⑦	4 x 2 = 8							
⑧	2 x 6 = 12	⑨	3 x 2 = 6	⑩	2 x 8 = 16	⑪	2 x 7 = 14	⑫	7 x 2 = 14	⑬	4 x 2 = 8	⑭	8 x 2 = 16							
⑮	9 x 2 = 18	⑯	2 x 8 = 16	⑰	2 x 7 = 14	⑱	7 x 2 = 14	⑲	8 x 2 = 16	⑳	2 x 5 = 10	㉑	2 x 7 = 14							

Lesson 1G, page 21

2 x 8 = 16	5 x 2 = 10	1 x 2 = 2	2 x 7 = 14	3 x 2 = 6	2 x 9 = 18	2 x 2 = 4	6 x 2 = 12	2 x 4 = 8

This fact has the same factors. 2 x 2 = 4	The product of this fact is 2 more than 10. 6 x 2 = 12	This fact can be modelled with the following array: 2 x 7 = 14	= 30
This fact can be modelled as follows: ********* ********* 2 x 9 = 18	This fact has the smallest product. 1 x 2 = 2	The product of this fact ends in 0. 5 x 2 = 10	= 30
The product of this fact is the number of legs on a spider. 2 x 4 = 8	This fact means 2 groups of 8. 2 x 8 = 16	This fact can be modelled with the following number line: 2 x 3 = 6	= 30
= 30	= 30	= 30	

Lesson 1H, page 23